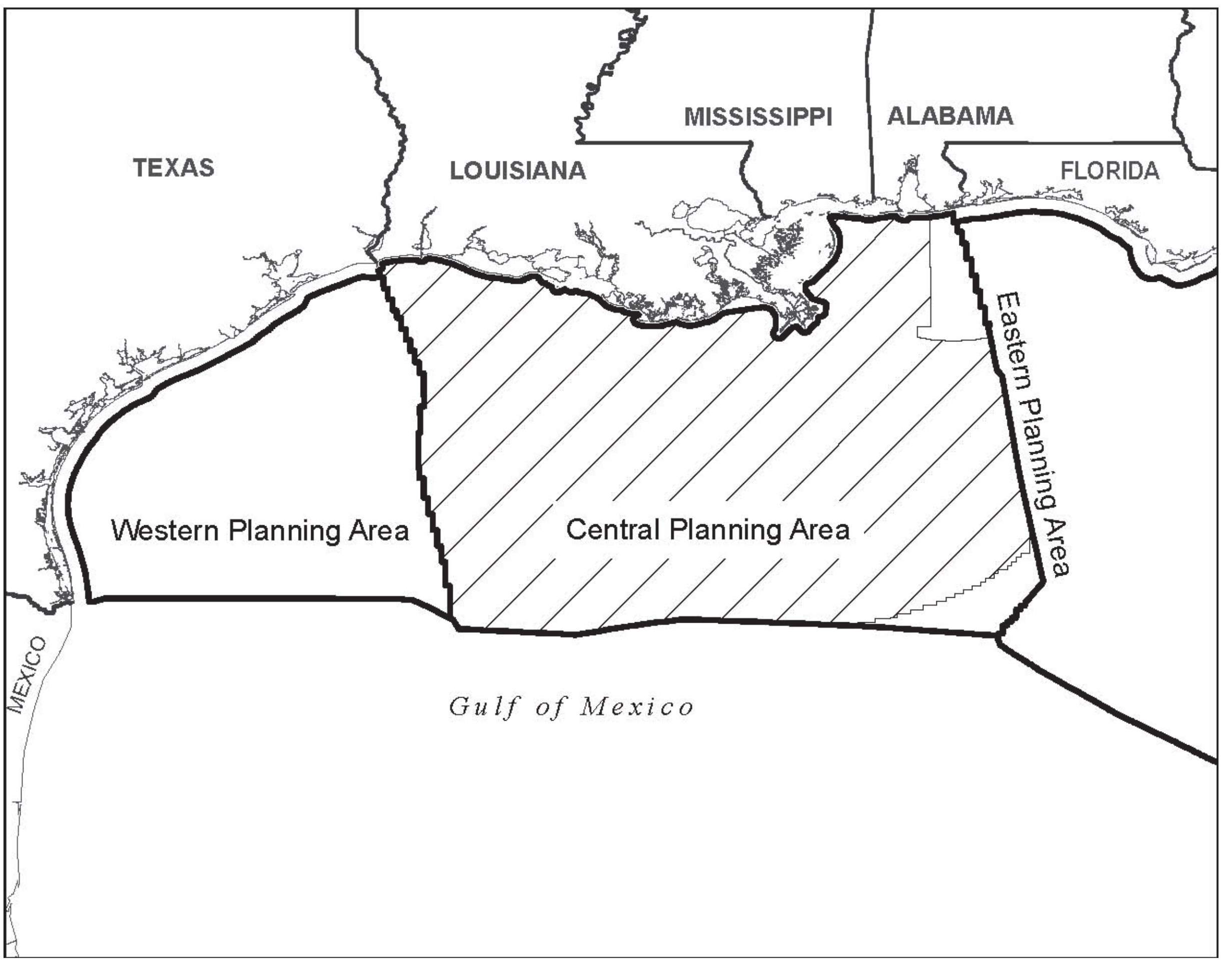
OCS EIS/EA
BOEM 2012-058

Gulf of Mexico OCS
Oil and Gas Lease Sale: 2012

Central Planning Area Lease Sale 216/222

Final Supplemental Environmental Impact Statement

Volume II: Chapters 5-8, Appendices, and Keyword Index



U.S. Department of the Interior
Bureau of Ocean Energy Management
Gulf of Mexico OCS Region

OCS EIS/EA
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Gulf of Mexico OCS Region

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Gulf of Mexico OCS Region

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CHAPTER 5

CONSULTATION AND COORDINATION

5. CONSULTATION AND COORDINATION

5.1. DEVELOPMENT OF THE PROPOSED ACTION

The purpose of this Supplemental EIS is to address the remaining proposed Gulf of Mexico CPA OCS oil and gas lease sale (CPA Lease Sale 216/222) scheduled under the *Outer Continental Shelf Oil and Gas Leasing Program: 2012-2017* (5-Year Program). This Supplemental EIS is being prepared because of the potential changes to the baseline conditions of the environmental, socioeconomic, and cultural resources that may have occurred as a result of (1) the DWH event between April 20 and July 15, 2010 (the period when oil flowed from the Macondo well in Mississippi Canyon Block 252 [**Figure 1-2**]); (2) the acute impacts that have been reported or surveyed since that time; and (3) any new information that may be available since the publication of the Multisale EIS or the 2009-2012 Supplemental EIS. The environmental resources include sensitive coastal environments, offshore benthic resources, marine mammals, sea turtles, coastal and marine birds, endangered and threatened species, and fisheries. This Supplemental EIS analyzes the potential impacts of the proposed action on the marine, coastal, and human environments. It is important to note that this Supplemental EIS was prepared using the scientifically credible information that was publicly available at the time this document was prepared.

5.2. NOTICE OF PREPARATION OF THE SUPPLEMENTAL EIS

On November 10, 2010, a Notice of Intent to Prepare a Supplemental EIS (NOI) was published in the *Federal Register*. A second NOI was published on November 16, 2010, to correct clerical errors. Additional public notices were distributed via local newspapers, the U.S. Postal Service, and the Internet. A 45-day comment period, which closed on January 3, 2011, was announced for the NOI. Federal, State, and local governments, along with other interested parties, were invited to send written comments to the Gulf of Mexico OCS Region on the scope of the Supplemental EIS. The comments in these letters are summarized in **Chapter 5.3.2.**

5.3. DEVELOPMENT OF THE DRAFT SUPPLEMENTAL EIS

Scoping for the Draft Supplemental EIS was conducted in accordance with CEQ regulations implementing NEPA. Scoping provides those with an interest in the OCS Program an opportunity to provide comments on the proposed action. In addition, scoping provides BOEM an opportunity to update the Gulf of Mexico OCS Region's environmental and socioeconomic information base. The scoping process commenced on November 16, 2010, with the publication of the corrected NOI in the *Federal Register*. Scoping meetings were held in Louisiana, Texas, and Alabama. No meeting had more than 15 attendees. The dates, times, locations, and public attendance of the scoping meetings for the Draft Supplemental EIS were as follows:

Tuesday, November 16, 2010
1:00 p.m. CST until adjournment
Hilton New Orleans Airport
New Orleans, Louisiana
9 registered attendees
4 speakers

Wednesday, November 17, 2010
1:00 p.m. CST until adjournment
Houston Airport Marriott
Houston, Texas
16 registered attendees
5 speakers

Thursday, November 18, 2010
1:00 p.m. CST until adjournment
The Battle House Renaissance
Mobile Hotel and Spa
Mobile, Alabama
13 registered attendees
4 speakers

5.3.1. Summary of Scoping Comments

Comments (both verbal and written) were received from the NOI and the three scoping meetings from Federal, State, and local government agencies; interest groups; industry; businesses; the Seminole Tribe of Florida; and the general public on the scope of the Supplemental EIS, significant issues that should be addressed, alternatives that should be considered, and mitigation measures. All scoping comments received, which were appropriate for a lease sale NEPA document, were considered in the preparation of this Supplemental EIS. All speakers at the scoping meetings were generally supportive of the proposed lease sales and recognized the economic benefits of the OCS Program. Comments received from attendees included the following:

- use currently available new information to evaluate impacts;
- supported holding lease sales as soon as possible;
- move expeditiously to complete the Supplemental EIS;
- cancelling lease sales would harm the economy, damage energy production, depress job creation, and reduce revenues to the State and Federal treasuries;
- resume permitting of existing leases;
- Lease Sales 216, 218, and 222 should be held with no reduction in acreage;
- recommended that the Supplemental EIS incorporate all new regulations and requirements put in place post-Macondo; and
- put no restrictions on drilling in deepwater areas.

5.3.2. Summary of Written Comments Received in Response to the Notice of Intent

In response to the NOI, the Bureau of Ocean Energy Management received 11 individual letters by e-mail, 595 identical form e-letters from an advocacy website, and a package of 3 CD’s with over 20,000 identical website-derived form letters from an advocacy group. Information submitted from written comments is summarized in **Table 5-1**, including the form letters submitted by the Consumer Energy Alliance. All scoping comments received that were appropriate for the lease sale NEPA document were considered in the preparation of this Supplemental EIS. Scoping comments appropriate for a lease sale NEPA document include scenario information; physical, biological, and socioeconomic resources to consider; impacting factors and impacts on resources; alternatives to be analyzed; and mitigation measures. Several comments received did not apply to scoping for this document including, but not limited, to scheduling and delays of remaining lease sales, expediting the completion of the Supplemental EIS, impacts from delay of the lease sales that had been scheduled as part of the 5-Year Program, categorical exclusions, and using this Supplemental EIS as a document to tier future lease sales for the 2012-2017 lease sale program. All other comments described in **Table 5-1** were considered in this document.

5.3.3. Cooperating Agency

According to Part 516 of the DOI Departmental Manual, BOEM must invite eligible governmental entities to participate as cooperating agencies when developing an EIS, in accordance with the requirements of NEPA and the CEQ regulations. The BOEM must also consider any requests by eligible government entities to participate as a cooperating agency with respect to a particular EIS, and then to either accept or deny such requests.

The NOI’s published on November 10 and November 16, 2010, included invitations to other Federal agencies and State, tribal, and local governments to consider becoming cooperating agencies in the preparation of this Supplemental EIS. The USEPA (Region 6) and NOAA requested to participate as cooperating agencies. The BOEM has accepted NOAA and USEPA (Region 6) as cooperating agencies.

5.4. Distribution of the Draft Supplemental EIS for Review and Comment

The BOEMRE sent copies of the Draft Supplemental EIS to the public and private agencies and groups listed below. Local libraries along the Gulf Coast were provided copies of this document; a list of these libraries is available on BOEM's Internet website at http://www.boem.gov/Environmental-Stewardship/Environmental-Assessment/NEPA/nepaprocess.aspx. To initiate a public review and comment period on the Draft Supplemental EIS, BOEM published a Notice of Availability in the *Federal Register* on July 1, 2011 (USEPA Notice of Availability publication date, July 1, 2011); all comments received were considered in the preparation of this Final Supplemental EIS.

Federal Agencies

Congress
- Congressional Budget Office
- House Resources Subcommittee on Energy and Mineral Resources
- Senate Committee on Energy and Natural Resources

Department of Commerce
- National Marine Fisheries Service
- National Oceanic and Atmospheric Administration

Department of Defense
- Department of the Air Force
- Department of the Army
  - Corps of Engineers
- Department of the Navy
  - Naval Mine and ASW Command

Department of Energy
- Strategic Petroleum Reserve PMD

Department of the Interior
- Bureau of Ocean Energy Management
- Bureau of Safety and Environmental Enforcement
- Fish and Wildlife Service
- Geological Survey
- National Park Service
- Office of Environmental Policy and Compliance
- Office of the Solicitor

Department of State
- Bureau of Oceans and International Environmental and Scientific Affairs

Department of Transportation
- Coast Guard
- Office of Pipeline Safety

Environmental Protection Agency
- Region 4
- Region 6

Marine Mammal Commission

State and Local Agencies

Alabama
- Governor's Office
- Alabama Highway Department
- Alabama Historical Commission and State Historic Preservation Officer
- Alabama Public Service Commission
- Department of Conservation and Natural Resources
- Department of Environmental Management
- South Alabama Regional Planning Commission
- State Docks Department
- State Legislature Natural Resources Committee
- State Legislature Oil and Gas Committee

Florida
- Governor's Office
- Bureau of Archaeological Research
- City of Gulf Breeze
- City of Panama
- City of Pensacola
- Department of Community Affairs
- Department of Environmental Protection
- Department of State Archives, History and Records Management
- Escambia County
- Florida Coastal Zone Management Office
- Sarasota County Coastal Resources
- State Legislature Natural Resources and Conservation Committee
- State Legislature Natural Resources Committee
- West Florida Regional Planning Council

Louisiana
- Governor's Office
- City of Grand Isle
- City of Morgan City
- City of New Orleans
- Department of Culture, Recreation, and Tourism

Department of Environmental Quality
Department of Natural Resources
Department of Transportation and Development
Department of Wildlife and Fisheries
Houma-Terrebonne Chamber of Commerce
Jefferson Parish Director
Jefferson Parish President
Lafourche Parish CZM
Lafourche Parish Water District #1
Louisiana Geological Survey
South Lafourche Levee District
St. Bernard Planning Commission
State House of Representatives, Natural Resources Committee
State Legislature, Natural Resources Committee

Mississippi

Governor’s Office
City of Gulfport
Department of Archives and History
Department of Natural Resources
Department of Wildlife Conservation
Mississippi Development Authority
State Legislature Oil, Gas, and Other Minerals Committee

Industry

Air Armament Center
Alabama Petroleum Council
American Petroleum Institute
Area Energy LLC
Baker Atlas
Bellwether Group
B-J Services Co
BP Amoco
Chevron U.S.A. Inc.
Coastal Conservation Association
Coastal Environments, Inc.
Continental Shelf Associates, Inc.
Dominion Exploration & Production, Inc.
Ecological Associates, Inc.
Ecology and Environment
Energy Partners, Ltd.
EOG Resources, Inc.
Escambia County Marine Resources
Exxon Mobil Production Company
Florida Petroleum Council
Florida Propane Gas Association
Freeport-McMoRan, Inc.
Fugro Geo Services, Inc.
Gulf Environmental Associates
Gulf of Mexico Newsletter
Horizon Marine, Inc.
Industrial Vehicles International, Inc.
International Association of Geophysical Contractors
J. Connor Consultants
John Chance Land Surveys, Inc.
Marine Safety Office
Midstream Fuel Service
Mote Marine Laboratory
Murphy Exploration & Production
Newfield Exploration Company
NWF Daily News
Petrobras America, Inc.
PPG Industries, Inc.
Propane Market Strategy Newsletter
Science Applications International Corporation
Seneca Resources Corporation
Shell Exploration & Production Company
Stone Energy Corporation
Strategic Management Services-USA
T. Baker Smith, Inc.
Texas Geophysical Company, Inc.
The Houston Exploration Company
Triton Engineering Services Co.
W & T Offshore, Inc.
Washington Post
WEAR-TV

Special Interest Groups

1000 Friends of Florida
Alabama Oil & Gas Board
American Cetacean Society
Audubon Louisiana Nature Center
Bay County Audubon Society
Citizens Assoc. of Bonita Beach
Clean Gulf Associates
Coastal Conservation Association
Earthjustice
Florida Chamber of Commerce
Florida Institute of Oceanography
Florida Marine Research
Florida Natural Area Inventory
Florida Public Interest Research Group
Florida Sea Grant College
Gulf Coast Environmental Defense
Gulf County
Gulf County Atlantic Fisheries
Gulf Island National Seashore
Hernando County Planning Department
Hunt Oil
Izaak Walton League of America, Inc

JOC Venture
Louisiana State University
Marine Mammal Commission
Mission Enhancement Office
Mississippi State University
Mobile Bay National Estuary Program
Natural Resources Defense Council
Nature Conservancy
Nicholas State University
Perdido Key Association
Population Connection
Portersville Revival Group
Sierra Club
South Mobile Communities Association
Southeastern Fisheries Association
The Conservancy
The Conservation Fund
The Daspit Company
The Nature Conservancy
Walton County Growth Management

Ports/Docks

Alabama
Alabama State Port Authority
Port of Mobile

Florida
Panama City Port Authority

Louisiana
Greater Baton Rouge Port Commission
Greater Lafourche Port Commission
Grand Isle Port Commission
Plaquemines Port, Harbor and Terminal District
Port of Baton Rouge
Port of Iberia District
Port of New Orleans
Twin Parish Port Commission
St. Bernard Port, Harbor and Terminal District

Mississippi
Port of Gulfport
State Port Authority

5.5. PUBLIC HEARINGS

In accordance with 30 CFR 256.26, BOEM scheduled public hearings soliciting comments on this Supplemental EIS. The hearings provided the Secretary of the Interior with information from interested parties to help in the evaluation of potential effects of the proposed lease sale. An announcement of the dates, times, and locations of the public hearings was included in the Notice of Availability for this Supplemental EIS. A copy of the public hearing notices was included with this Supplemental EIS that was mailed to the parties indicated above, posted on BOEM's Internet website, and published in local newspapers.

The hearings were held on the following dates and at the times and locations indicated below:

Tuesday, August 2, 2011
1:00 p.m. CDT
Bureau of Ocean Energy Management, Regulation and Enforcement
1201 Elmwood Park Boulevard
New Orleans, Louisiana 70123
4 registered attendees
0 speakers

Tuesday, August 9, 2011
1:00 p.m. CDT
Houston Airport Marriott
George Bush Intercontinental
18700 John F. Kennedy Boulevard
Houston, Texas 77032
12 registered attendees
5 speakers

Thursday, August 11, 2011
1:00 p.m. and 6:00 p.m. CDT
Renaissance Mobile Riverview Plaza Hotel
64 South Water Street
Mobile, Alabama 36602
12 registered attendees
2 speakers

New Orleans, Louisiana, August 2, 2011

There were no speakers at the public hearing held in New Orleans, Louisiana, on August 2, 2011.

Houston, Texas, August 9, 2011

Five speakers representing industry provided testimony at the public hearing held in Houston, Texas, on August 9, 2011. Industry representatives included Marc Lawrence of Global Geophysical, Andy Radford of the American Petroleum Institute, Walt Rosenbusch of the International Association of Geophysical Contractors, Richard Pool of Apache Corporation, and Bryan Anderson of Marine Robotics. All speakers offered support for proceeding with proposed CPA Lease Sale 216/222. Mr. Radford requests that BOEM update the baseline and potential effects of oil and gas leasing, agrees with BOEM's conclusions in the Draft Supplemental EIS, and supports holding the proposed lease sale as soon as possible. Mr. Anderson stated that an orderly procession of the leasing process is essential to the marine industry. Messrs. Radford, Rosenbusch, Pool, and Anderson all support the selection of Alternative A.

Responses to these comments have been incorporated into the responses to the letters of comment in **Chapter 5.11**.

Mobile, Alabama, August 11, 2011

One speaker, Steve Russell, attended both public hearings and provided testimony for both the Mobile Area Chamber of Commerce and Offshore Alabama. Both groups supported offshore oil and gas activities and stated the importance of the continuation of lease sales.

Responses to these comments have been incorporated into the responses to the letters of comment in **Chapter 5.11**.

5.6. COASTAL ZONE MANAGEMENT ACT

If a Federal agency's activities or development projects within or outside of the coastal zone will have reasonably foreseeable coastal effects in the coastal zone, then the activity is subject to a Federal Consistency Determination (CD). To prepare the CD's, the Bureau of Ocean Energy Management reviews each State's Coastal Management Plan (CMP) and analyzes the potential impacts as outlined in this Supplemental EIS, new information, and applicable studies as they pertain to the enforceable policies of each CMP. The Coastal Zone Management Act (CZMA) requires that Federal actions that are reasonably likely to affect any land or water use or natural resource of the coastal zone be "consistent to the maximum extent practicable" with relevant enforceable policies of the State's federally approved coastal management program (15 CFR 930 Subpart C). A consistency review will be performed by the affected States prior to the proposed lease sale, upon receipt of the CD's. Based on the analyses, the BOEM Director makes an assessment of consistency, which is then sent to each State with the Proposed Notice of Sale. If a State concurs, BOEM can hold the lease sale. If the State objects, it must do the following under the CZMA: (1) indicate how BOEM's presale proposal is inconsistent with their CMP and suggest alternative measures to bring BOEM's proposal into consistency with their CMP; or (2) describe the need for additional information that would allow a determination of consistency. Unlike the consistency process for specific OCS plans and permits, there is no procedure for administrative appeal to the Secretary of Commerce for a Federal CD for presale activities. Either BOEM or the State may request mediation. Mediation is voluntary, and the DOC would serve as the mediator. Whether there is mediation or not, the final CD is made by DOI and it is the final administrative action for the presale consistency process. Each Gulf State's CMP is described in Appendix B of the Multisale EIS (USDOI, MMS, 2007b).

5.7. ENDANGERED SPECIES ACT

The Endangered Species Act of 1973 (16 U.S.C. 1631 *et seq.*), as amended (43 U.S.C. 1331 *et seq.*), establishes a national policy designed to protect and conserve threatened and endangered species and the ecosystems upon which they depend. In accordance with Section 7 of the ESA, the Bureau of Ocean Energy Management consulted with NMFS and FWS on possible and potential impacts from the CPA proposed action on endangered/threatened species and designated critical habitat under their jurisdiction. A biological assessment was prepared for each consultation. The action area analyzed in the biological assessments included the lease sale area addressed in this Supplemental EIS.

The formal ESA consultation with NMFS was concluded with receipt of the Biological Opinion on July 3, 2007. The Biological Opinion concludes that the proposed lease sale and associated activities in the Gulf of Mexico under the 5-Year Program are not likely to jeopardize the continued existence of threatened and endangered species under NMFS jurisdiction or to destroy or adversely modify designated critical habitat. The informal ESA consultation with FWS was concluded with a letter dated September 14, 2007. The FWS concurred with BOEM's determination that this proposed action under the 5-Year Program was not likely to adversely affect the threatened/endangered species or designated critical habitat under FWS jurisdiction. Under these existing consultations with FWS and NMFS, the Bureau of Ocean Energy Management requested annual concurrence from both NMFS and FWS to ensure that current activities and any actual take remain consistent with the Terms and Conditions of the Biological Opinion. For 2010, NMFS emailed their concurrence to BOEMRE on December 3, 2009, and FWS emailed their concurrence to BOEMRE on December 8, 2009.

Following the DWH event, BOEMRE requested reinitiation of ESA Section 7 consultation with NMFS and FWS on July 30, 2010. The NMFS responded with a letter to BOEMRE on September 24, 2010; FWS responded with a letter to BOEMRE on September 27, 2010. The reinitiated consultations are not complete at this time, although BOEM is in discussions with both agencies. In the meantime, the current consultations remain in effect, and NMFS and FWS recognize that BOEM-required mitigations and other reasonable and prudent measures should reduce the likelihood of impacts from BOEM-authorized activities. Further, BOEM has determined, under Section 7(d) of the ESA, that the proposed action of this Supplemental EIS is not an irreversible or irretrievable commitment of resources, which has the effect of foreclosing the formulation or implementation of any reasonable and prudent alternative measures. Both BOEM and BSEE are developing an interim coordination program with NMFS and FWS while consultation is ongoing. The BOEM and BSEE will complete joint consultations given the proposed action that is covered in this Supplemental EIS is authorized by both bureaus. As both bureaus move ahead on the next 5-Year Program (2012-2017) and associated consultations, they will clarify language to avoid redundancy and unnecessary delay.

5.8. Magnuson-Stevens Fishery Conservation and Management Act

Pursuant to Section 305(b) of the Magnuson-Stevens Fishery Conservation and Management Act, Federal agencies are required to consult with NMFS on any action that may result in adverse effects to essential fish habitat. The NMFS published the final rule implementing the EFH provisions of the Magnuson-Stevens Fisheries Conservation and Management Act (50 CFR 600) on January 17, 2002. Certain OCS activities authorized by BOEM may result in adverse effects to EFH, and therefore, require EFH consultation.

In March 2000, this Agency's Gulf of Mexico OCS Region consulted with NMFS's Southeast Regional Office in preparing a NMFS regional finding for the Gulf of Mexico region that allows this Agency to incorporate the EFH assessments into NEPA documents. This Agency consulted on a programmatic level, by letters of July 1999 and August 1999, to address EFH issues for certain Agency OCS activities (i.e., plans of exploration and production, pipeline rights-of-way, and platform removals).

An EFH consultation for the CPA lease sales included in the 2002-2007 5-Year Program, using the 2003-2007 Draft Multisale EIS as the NEPA document, was initiated in March 2002 by this Agency with NMFS's Southeast Regional Office. The NMFS responded in April 2002, endorsing the implementation of resource protection measures previously developed cooperatively by this Agency and NMFS in 1999 to minimize and avoid EFH impacts related to exploration and development activities in the CPA. In addition to routine measures, additional conservation recommendations were made. In May 2002, this Agency responded to NMFS, acknowledging receipt and agreement to follow the additional conservation recommendations. The EFH conservation measures recommended by NMFS serve the purpose of protecting EFH. Continuing agreements, including avoidance distances from No Activity Zones around topographic features and those for live-bottom pinnacle features, and circumstances that require project-specific consultation, appear in NTL 2004-G05.

Effective January 23, 2006, NMFS modified the identification and descriptions of EFH. One of the most important changes noted in the amendment is the elimination of the EFH description and identification from waters between 100 fathoms (600 ft; 183 m) and the seaward limit of the EEZ.

Further programmatic consultation was initiated and completed for the lease sales addressed in the 2007-2012 Multisale EIS. The NMFS concurred by letter dated December 12, 2006, that the information presented in the 2007-2012 Draft Multisale EIS satisfies the EFH consultation procedures outlined in 50 CFR 600.920 and as specified in NMFS's March 17, 2000, findings. Provided that BOEM's proposed mitigations, NMFS's previous EFH conservation recommendations, and the standard lease stipulations and regulations are followed as proposed, NMFS agrees that impacts to EFH and associated fishery resources resulting from activities conducted under the 5- Year Program's lease sales would be minimal.

Following the DWH event on July 30, 2010, BOEMRE requested reinitiation of ESA consultation with NMFS and FWS. The NMFS responded with a letter to BOEMRE on September 24, 2010. The EFH consultation was also addressed in NMFS's letter. The reinitiated consultations are not complete at this time, although BOEM, BSEE, and NMFS have had discussions and are working on a new consultation document for the 2012-2017 Multisale EIS.

The existing consultations remain in effect until the reinitiated consultations are completed. Based on the most recent and best available information at the time, BOEM will also continue to closely evaluate and assess risks to listed species and designated critical habitat in upcoming environmental compliance documentation under NEPA and other statutes.

5.9. NATIONAL HISTORIC PRESERVATION ACT

In accordance with the National Historic Preservation Act (NHPA) (16 U.S.C. 470), Federal agencies are required to consider the effect of their undertakings on historic properties. The implementing regulations for Section 106 of the NHPA (16 U.S.C. 470f), issued by the Advisory Council on Historic Preservation (16 CFR 800), specify the required review process. The BOEMRE initiated a request for consultation with the affected Gulf States and Tribal Nations on November 12, 2010, via a formal letter. A timeline of 30 days was provided and two responses were received.

The State of Louisiana, in a letter to BOEMRE dated December 16, 2010, indicated that no known historic properties will be affected by this undertaking and that consultation regarding the proposed action is not necessary. The Seminole Tribe of Florida-Tribal Historic Preservation Officer (STOF-THPO) responded to BOEMRE's request for consultation on December 6, 2010. The STOF-THPO indicated that there was no objection to the proposed undertaking at this time. The STOF-THPO requested to review the impending remote-sensing survey reports that are to be conducted over the high-probability zones within the project area. Additionally, the STOF-THPO requested to be notified if cultural resources that are potentially ancestral or historically relevant to the Seminole Tribe of Florida are inadvertently discovered at any point during this process. No further responses were received beyond the 30-day timeline and no further requests for consultation were received.

This Section 106 consultation is concluded at this time. The BOEM will continue to impose mitigating measures and monitoring and reporting requirements to ensure that historic properties are not affected by the proposed undertaking. The BOEM will reinitiate the consultation process with the affected parties should such circumstances warrant further consultation.

5.10. MAJOR DIFFERENCES BETWEEN THE DRAFT AND FINAL SUPPLEMENTAL EIS'S

Comments on the Draft Supplemental EIS were received during the public hearings and were also received via written and electronic correspondence. As a result of these comments, changes have been made between the Draft and Final Supplemental EIS's. The text has been revised or expanded to provide clarification on specific issues, as well as to provide updated information. In addition, between the Draft and Final Supplement EIS's, the Bureau of Ocean Energy Management continued to update information and data relied on in this document and removed information determined to be irrelevant for this proposed action. None of the alterations between the Draft and Final Supplement EIS's changed the conclusions herein.

5.11. LETTERS OF COMMENT ON THE DRAFT SUPPLEMENTAL EIS AND BOEM'S RESPONSES

The Notice of Availability and announcement of public hearings were published in the *Federal Register* by BOEMRE on July 1, 2011 (USEPA Notice of Availability publication date, July 1, 2011), were posted on BOEMRE's Internet website, and were mailed to interested parties. Distribution of the Draft Supplemental EIS began on July 1, 2011. The comment period ended on August 16, 2011. Fourteen comment letters were received from the public and private agencies and groups listed below:

Federal Agencies

Department of Commerce
- National Oceanic and Atmospheric Administration

Department of the Interior
- Fish and Wildlife Service
- National Park Service

Environmental Protection Agency

State Agencies and Representatives

Alabama Department of Environmental Protection
Louisiana Department of Environmental Quality
Louisiana Department of Natural Resources

Local Agencies

No comments were received.

Organizations and Associations

American Petroleum Institute
Center for Biological Diversity, Defenders of Wildlife, OCEANA, Southern Environmental Law Center
International Association of Geophysical Contractors
SkyTruth
Turtle Island Restoration Network
West Florida Regional Planning Council

Industry

Anadarko
ConocoPhilips

General Public

Viola L. Goldberg

Copies of these letters are presented on the subsequent pages. Each letter's comments have been marked for identification purposes. The BOEM's responses immediately follow each letter.

UNITED STATES DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
NATIONAL MARINE FISHERIES SERVICE
Southeast Regional Office
263 13th Avenue South
St. Petersburg, Florida 33701-5505
(727)824-5317; FAX (727) 824-5300
http://sero.nmfs.noaa.gov/

August 15, 2011 F/SER4:DD

Mr. Gary D. Goeke
Chief, Environmental Assessment Section
U.S. Department of the Interior
Bureau of Ocean Energy Management, Regulation and Enforcement
Gulf of Mexico OCS Region
Leasing and Environment (MS 5410)
1201 Elmwood Park Boulevard
New Orleans, Louisiana 70123-2394

Dear Mr. Goeke:

On December 8, 2010, the National Oceanic and Atmospheric Administration (NOAA) National Marine Fisheries Service (NMFS), Southeast Region requested cooperating agency status for the proposed Outer Continental Shelf (OCS), Western and Central Planning Areas, Gulf of Mexico Oil and Gas Lease Sales for the 2007-2012 Five-Year OCS Program, in accordance with the Council on Environmental Quality's regulations, section 1501.6. Please find enclosed comments from NOAA in response to the July 1, 2011, Notice of Availability of the draft Supplemental Environmental Impact Statement for the OCS Central Planning Area, Gulf of Mexico Oil and Gas Lease Sale 216/222.

If we can be of further assistance, please advise.

Sincerely,

Miles M. Croom

for Roy E. Crabtree, Ph.D.
Regional Administrator

Enclosure

cc: (w/encl.) via electronic mail
PPI.nepa@noaa.gov
F – Lindow, Leathery, Holmes
F/SER – Keys, Silverman
F/SER4 – Fay, Dale
F/SER3 – Bernhart, Baker

NOAA NATIONAL MARINE FISHERIES SERVICE
SOUTHEAST REGIONAL OFFICE COMMENTS ON
U.S. DEPARTMENT OF INTERIOR/BUREAU OF OCEAN ENERGY MANAGEMENT, REGULATION AND ENFORCEMENT
DRAFT SUPPLEMENTAL ENVIRONMENTAL IMPACT STATEMENT FOR THE OUTER CONTINENTAL SHELF CENTRAL PLANNING AREA, GULF OF MEXICO OIL AND GAS LEASE SALE 216/222

August 2011

BACKGROUND

The Department of Interior's Bureau of Ocean Energy Management, Regulation and Enforcement (BOEMRE) prepared a supplemental environmental impact statement (SEIS) for the Outer Continental Shelf (OCS) Central Planning Area, Gulf of Mexico Oil and Gas Lease Sale 216/222. The proposed sale is in the Gulf of Mexico's Central Planning Area (CPA) off the States of Louisiana, Mississippi, and Alabama. The SEIS updates the environmental and socioeconomic analyses in the Gulf of Mexico (GOM) OCS Oil and Gas Lease Sales: 2007–2012; Western Planning Area Sales 204, 207, 210, 215, and 218; CPA Sales 205, 206, 208, 213, 216, and 222, Final Environmental Impact Statement (OCS EIS/EA MMS 2007–018). The SEIS also updates the environmental and socioeconomic analyses in the GOM OCS Oil and Gas Lease Sales: 2009–2012; CPA Sales 208, 213, 216, and 222; WPA Sales 210, 215, and 218; Final SEIS (OCS EIS/EA MMS 2008–041). The SEIS for 2009–2012 was prepared after the Gulf of Mexico Energy and Security Act, which required BOEMRE to offer approximately 5.8 million acres in the CPA (''181 South Area'') for oil and gas leasing.

This SEIS was drafted to consider new circumstances and information arising from the Deepwater Horizon (DWH) event with a focus on updating the baseline conditions and potential environmental effects of oil and natural gas leasing, exploration, development, and production in the Western Planning Area. NOAA National Marine Fisheries Service (NMFS) recognizes that BOEMRE has readdressed many procedures and policies following the DWH event related to drilling safety, oil-spill response, and compliance inspections.

MAGNUSON-STEVENS FISHERY CONSERVATION AND MANAGEMENT ACT (16 U.S.C. §1801 *et seq.*)

The Magnuson-Stevens Fishery Conservation and Management Act (Magnuson-Stevens Act; 16 U.S.C. §1801 *et seq.*) requires Federal agencies to consult with the Secretary of Commerce, through NMFS, with respect to "any action authorized, funded, or undertaken, or proposed to be authorized, funded, or undertaken, by such agency that may adversely affect any essential fish habitat (EFH) identified under this Act." 16 U.S.C. § 1855(b)(2). Under the Outer Continental Shelf Lands Act (OCSLA; 43 U.S.C. § 1331 *et seq*), the BOEMRE is responsible for leasing tracts of the OCS for oil and gas exploration, and for regulating development and production. Certain OCS activities authorized by BOEMRE may result in adverse impacts to EFH, and therefore require EFH consultation. Actions taken by BOEMRE under the OCSLA are evaluated through the National Environmental Policy Act (NEPA). BOEMRE (formerly the Minerals Management Service) and NMFS cooperatively developed modified procedures to incorporate EFH consultation into existing NEPA processes by findings letters dated March 17, 2000, and

March 12, 2002. Our agencies consulted on a programmatic level by letters dated June 4, 1999, July 1, 1999, and August 12, 1999, to address EFH issues related to operational activities, including pipeline rights-of-way, plans for exploration and production, and platform removal in the Gulf of Mexico Central and Western Planning Areas. That programmatic EFH agreement was subsequently amended by a letter dated July 19, 2007, to also include operational activities within a small portion of the Eastern Planning Area.

Following the DWH event BOEMRE requested reinitiation of Endangered Species Act (ESA) consultation with both the U.S. Fish and Wildlife Service and NMFS. NMFS responded by letter dated September 24, 2010, requesting a periodic review of the EFH consultation as well. Regional agency staff are in the process of updating the EFH consultation for the 2012-2017 Multi-sale EIS.

By letter dated December 8, 2010, the NMFS provided comments to BOEMRE in response to a Notice of Intent to prepare the draft SEIS. Specifically we suggested: (1) that BOEMRE broaden the scope of its analysis to consider the impacts of all activities, including potential oil spills and the use of chemical dispersants in any oil spill response efforts, to EFH and other vulnerable deep-water habitats such as deep-sea corals; (2) EFH identifications and descriptions and EFH habitat areas of particular concern designated by the Gulf of Mexico Fishery Management Council and NMFS Highly Migratory Species be updated; and (3) the status and periodic review of the programmatic EFH consultation be included.

In the draft SEIS BOEMRE concludes that adverse effects from routine activities associated with oil and gas leasing, exploration and development are expected to be minimal. This conclusion is based on various mitigating factors including Notice to Lessees (NTL) #2009-G40 for Deepwater Benthic Communities, NTL #2009-G39 Biologically-Sensitive Underwater Features and Areas, and Topographic Features Stipulation in addition to the mitigative measures included in the existing programmatic EFH consultation.

EFH COMMENTS

The draft SEIS proposes four alternatives. Alternative A, the proposed action, would offer for lease all unleased blocks within the WPA for oil and gas operations (excepting whole and partial blocks directly south of Florida and within 100 miles of the Florida coast, and blocks that are beyond the U.S. Exclusive Economic Zone in the area known as the northern gap portion of the Eastern Gap). Alternative B would offer for lease all unleased blocks in the WPA sale area as described for Alternative A, the Proposed Action, with the exception of any unleased blocks subject to the Topographic Features Stipulation. Although the Topographic Features Stipulation presently applies as a conservation recommendation in the EFH consultation currently in force with BOEMRE, NOAA notes the draft SEIS specifies that application of lease stipulations, including the Topographic Features Stipulation, will be considered by the Assistant Secretary of the Interior for Land and Minerals (ASLM). The ASLM may, or may not, require any lease stipulation to be included in a Final Notice of Sale for any lease that may result from this lease sale. To ensure certainty that topographic features receive maximum protection, NOAA recommends Alternative B be selected as the Proposed Action.

NMFS-1

Sections 2.3.1.2 (page 2-20) and 4.1.1.16 of the draft SEIS correctly note that the actual effects of the DWH event on fish populations are unknown at this time, and the total impacts are likely to be unknown for several years. However, this statement contrasts with one made on page xii, NMFS-2

"*Fish Resources and Essential Fish Habitat*" and repeated in section 4.1.1.16 which says "[a] subsurface blowout would have a negligible effect on Gulf of Mexico fish resources." Given the present uncertainty regarding the potential effects of the subsurface blowout resulting from the DWH event on EFH and living marine resources, NMFS recommends the more conservative characterization expressed in sections 2.3.1.2 and 4.1.1.16.3 be used throughout the document.

NMFS-3

The extent of EFH in the Gulf of Mexico described Section 4.1.1.16.1 (page 4-260; last sentence of paragraph two) should note that the EFH Regulations (50 C.F.R. Part 600) require NMFS to describe and identify habitats determined to be EFH for each life stage of each managed species. It is due to the number of managed species, each with several major life stages, in addition to the variety of habitats in the Gulf of Mexico that results in large portions of the Gulf of Mexico being designated as EFH.

NMFS-4

The first sentence of paragraph four in Section 5.8 (page 5-9) should be revised to clarify the identification and description of EFH for species managed by the Gulf of Mexico Fishery Management Council were modified effective January 23, 2006. This was not rulemaking nor did it revise EFH regulations found at 50 C.F.R. Part 600.

NMFS-5

The status of Atlantic bluefin tuna in Section 4.1.1.13.3 (page 4-180) should be updated in accordance with the announcement by NMFS on May 27, 2011, that Atlantic bluefin tuna currently does not warrant species protection under the ESA. NOAA formally designated both the western Atlantic and eastern Atlantic and Mediterranean stocks of bluefin tuna as species of concern. This places the species on a watchlist for concerns about its status and threats to the species under the ESA. NOAA will revisit this decision by early 2013, when more information will be available about the effects of the DWH event, as well as a new stock assessment from the scientific arm of the International Commission for the Conservation of Atlantic Tunas, the international body charged with the fish's management and conservation. (http://www.nmfs.noaa.gov/pr/species/fish/bluefintuna.htm)

ENDANGERED SPECIES ACT (16 U.S.C. §§ 1531 *et seq.)*

Section 7 of the Endangered Species Act (ESA; 16 U.S.C. § 1536(a)(2)) requires federal agencies to consult with the Secretary of Commerce, through NOAA, to ensure that "any action authorized, funded, or carried out by such agency ... is not likely to jeopardize the continued existence of any endangered species or threatened species or adversely modify or destroy [designated] critical habitat ...." *See also* 50 C.F.R. Part 402. Pursuant to NOAA regulations, if the proposed activity may affect a listed species or designated critical habitat, the federal action agency must initiate consultation with NOAA pursuant to Section 7 of the ESA. *See* 50 C.F.R. Part 402.14.

CONSULTATION BACKGROUND

Lease sale 216/222 falls under the June 29, 2007, biological opinion on the 2007-2012 lease sale plan that is currently in reinitiation of ESA consultation. Following the BP/DWH spill, BOEMRE requested reinitiation of ESA consultation on June 30, 2010. NMFS responded on September 24, 2010, with a request for additional information needed to assess the impacts to listed species that were previously not considered prior to the oil spill. Following a teleconference between NMFS and BOEMRE on June 2, 2011, BOEMRE indicated that it cannot provide all the information from the BP/DWH spill that is necessary to complete reinitiation of consultation in time for Sale 216/222. Consequently, BOEMRE does not intend to prepare a biological assessment under the ESA for this lease sale.

Although reinitiation of consultation is ongoing, NMFS and BOEMRE are working on an interim coordination and review process for lease sales until a new consultation is completed. Additional coordination and review may be required for programmatic environmental assessments, individual lease sales, new or usual technologies, and environmental or biological factors that may need to be considered at site-specific levels of review. These and other considerations are currently being discussed between NMFS and BOEMRE. NMFS is providing comments and reviewing proposed lease sale 216/222 for any additional recommendations for listed species that may be needed. BOEMRE has indicated it will continue to follow the mitigation measures established in the biological opinion, require the new safety rule changes that will, among other provisions, provide for increased prevention of future oil spills from blowouts, and may require any additional measures that may be recommended by NMFS to avoid or minimize potentially adverse impacts to listed species.

ESA COMMENTS

Chapter 4-1 states that the effects of proposed CPA Lease Sale 216/222 on these resources [physical, biological, and socioeconomic] are expected to be substantially the same as those presented in the Multi-sale EIS, even when considered in the context of the DWH event. NMFS agrees that while anticipated effects are the same, the natural resource damages remain undetermined at this time to support such a conclusion for listed species. Although such a conclusion may be correct regarding site-specific effects resulting from lease sale 216/222, sea turtles and sperm whales range throughout the Gulf of Mexico in both areas both affected and unaffected by the DWH spill. Considering the unknown effects of exposure of wide-ranging individuals to the effects associated with the DWH spill, and effects associated with the response still being investigated, the impacts to listed species associated with the proposed lease sale must be considered as a stressor in addition to those resulting from the DWH spill. NMFS recommends that impacts to listed species from future oil and gas development consider the cumulative exposure to the DWH spill's effects along with other proposed oil and gas activities. The conservative approach would be to expect impacts from the lease sale to be greater than preceding the DWH spill; however, the magnitude of those effects cannot yet be fully determined.

NMFS-6

Deepwater leases may pose additional risks to the marine environment, and to listed species, when blowouts occur. BOEMRE believes the new safety rules will ensure greater protection against oil spills of the magnitude of DWH from occurring in the future. NMFS believes there are unknown factors surrounding new technologies used in deepwater environments, risks associated with producing oil reserves in the deepwater Gulf of Mexico due to their burial depth, high-temperature, high pressure in-situ conditions, and the technological challenges of containing spills when they occur.

RECOMMENDATIONS

Until an interim coordination and review process is finalized between NMFS and BOEMRE, BOEMRE should request review and consult with NMFS on the following:

NMFS-7

- Any new or unusual technologies used for oil and gas exploration, development, or production to identify and evaluate any potential risks to listed species.
- Development or production permits issued under the lease sale in deepwater areas.
- Spill response plans submitted under the lease sale in deepwater areas.
- If new species are listed or critical habitat is designated in the Gulf of Mexico.
- Once Natural Resource Damage Assessments are available, or any other new information on the effects to listed species in the Gulf of Mexico from the DWH spill is available, BOEMRE should consult with NMFS on the effects on this action.

NMFS-8

REQUIRED CONDITIONS
The following are measures that apply specifically to the protection of listed species that are either measures proposed by BOEMRE that NMFS has evaluated or terms and conditions required by NMFS in the July 29, 2007, biological opinion:

- BOEMRE will require that vessel operators and crews watch for marine mammals and sea turtles, reduce vessel speed to 10 knots or less when assemblages of cetaceans are observed, and maintain a distance of 90 m or greater from whales and a distance of 45 m or greater from small cetaceans and sea turtles (Vessel Strike Avoidance and Injured/Dead Protected Species Reporting, NTL 2007-G04).
- BOEMRE will make information available to vessel operators concerning species information on sea turtles in the GOM and reporting of vessel-struck, or injured and dead animals.
- BOEMRE will ensure that all vessel-struck, or injured or dead turtles with indications of vessel interactions are reported to the Sea Turtle Stranding Network Coordinator in the nearest coastal state. Any takes of listed species shall be reported to the NMFS Southeast Regional Office within no more than 24 hours of the incident to: takereport.nmfsser@noaa.gov. If a BOEMRE action is responsible for the injured or dead animals (e.g., because of a vessel strike), BOEMRE shall require the responsible parties to assist the respective salvage and stranding network as appropriate. Report dead or injured protected species to your local stranding network contacts. A list of sea turtle stranding responders is available at http://www.sefsc.noaa.gov/seaturtleSTSSN.jsp. A list of marine mammal stranding network responders for each state is available at http://www.nmfs.noaa.gov/pr/health/networks.htm.
- BOEMRE will submit an annual report to NMFS Southeast Regional Office regarding the reports of vessel-struck sea turtles, and injured and dead sea turtles reported from oil and gas operators. Hardcopies of all annual reports will be submitted to the following address:

  Assistant Regional Administrator for Protected Resources
  National Marine Fisheries Service
  263 13th Avenue South

St. Petersburg, FL 33701-5505

- BOEMRE will condition all permits issued to lessees and their operators to require them to post signs in prominent places on all vessels and platforms used as a result of activities related to exploration, development, and production of this lease detailing the reasons (legal and ecological) why the release of debris must be eliminated. BOEMRE will require the annual training and certification for marine debris education and elimination for all offshore personnel, including the potential for adverse effects to listed species (Trash and Debris Awareness and Elimination NTL 2007-G03). BOEMRE will also condition all permits issued to lessees and their operators to require them to collect and remove flotsam resulting from activities related to exploration, development, and production of this lease.

- Seismic Survey Mitigation Measures and Protected Species Observer Program (NTL 2007-G02). BOEMRE will require that all seismic surveys employ mandatory mitigation measures including the use of a 500-m "exclusion zone", ramp-up and shut-down procedures, visual monitoring, and reporting. Seismic operations must immediately cease when whales are detected within the 500-m exclusion zone. Ramp-up procedures and seismic surveys may be initiated only during daylight unless alternate monitoring methods approved by BOEMRE are used.

- BOEMRE will require lessees and operators to instruct offshore personnel to immediately report all sightings and locations of injured or dead protected species (marine mammals and sea turtles) to the appropriate stranding network. If oil and gas industry activity is responsible for the injured or dead animals (e.g., because of a vessel strike), the responsible parties should remain available to assist the stranding network. If the injury or death is caused by a vessel collision, the responsible party must notify BOEMRE within 24 hours of the strike.

- BOEMRE will require oil-spill contingency planning to identify important habitats, including designated critical habitat, used by listed species (e.g., sea turtle nesting beaches and piping plover critical habitat) and will require the strategic placement of spill cleanup equipment to be used only by personnel trained in less intrusive cleanup techniques on beach and bay shores.

NMFS-1 Comment noted. If the ASLM's decision is to hold a lease sale under either Alternative A, B, or C, it will be announced in the Final Notice of Sale.

NMFS-2 Clarifying language was added to this Supplemental EIS to include the suggested revisions.

NMFS-3 Information was added to this Supplemental EIS to include the suggested revisions.

NMFS-4 Information was added to this Supplemental EIS to include the suggested revisions.

NMFS-5 Information addressing the May 27, 2011, NOAA announcement that the Atlantic bluefin tuna does not warrant species protection under the ESA at this time was added to **Chapter 4.1.1.16.3**.

NMFS-6 The text has been clarified in this Supplemental EIS.

NMFS-7 Comment noted. The BOEM and BSEE are both in the process of finalizing an interim coordination program with NMFS and FWS, given that the proposed actions in the consultations cover activities both agencies will authorize. The BOEM will serve as the lead agency, with BSEE input.

NMFS-8 Comment noted. As discussed in this Supplemental EIS, BOEM and BSEE will continue to comply with the terms and conditions of the 2007 Biological Opinion.

From: Steven_M_Wright@nps.gov
Sent: Wednesday, August 17, 2011 8:02 AM
To: CPA Supplemental EIS
Cc: Stanley, Joyce A; Spencer, Stephen; waso_eqd_extrev@nps.gov
Subject: Draft Supplemental Environmental Impact Statement, Gulf of Mexico, Outer Continental Shelf, Central Planning Area (CPA) Consolidated Oil and Gas Lease Sale 216/ 222 for the 2007-2012 5-Year OCS Program

The National Park Service has reviewed the Draft Supplemental Environmental Impact Statement (SEIS), Gulf of Mexico, Outer Continental Shelf, Central Planning Area (CPA) Consolidated Oil and Gas Lease Sale 216/ 222 for the 2007-2012 5-Year OCS Program.

NPS-1

Based on the information provided in the Draft SEIS, the National Park Service has no comments at this time.

We appreciate the opportunity to provide input regarding the resources and issues that will be evaluated.

Steven M. Wright
National Park Service
Southeast Regional Office
Planning & Compliance Division
100 Alabama Street SW
Atlanta, GA 30303
(404) 507-5710

NPS-1 Comment noted.

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
Region 6
1445 Ross Avenue, Suite 1200
Dallas, TX 75202-2733

August 17, 2011

Mr. Gary D. Goeke
Chief, Environmental Assessment Section
Leasing and Environment (MS 5410)
Bureau of Ocean Energy Management,
Regulation and Enforcement (BOEMRE)
1201 Elmwood Park Boulevard
New Orleans, LA 70133-2394

Dear Mr. Goeke:

In accordance with our responsibilities under Section 309 of the Clean Air Act (CAA), the National Environmental Policy Act (NEPA), and the Council on Environmental Quality (CEQ) regulations for implementing NEPA, the U.S. Environmental Protection Agency (EPA) Region 6 office in Dallas, Texas and Region 4 office in Atlanta, Georgia, has completed its review of the Draft Supplemental Environmental Impact Statement (DSEIS) prepared by U.S. Department of the Interior, Bureau of Ocean Energy Management, Regulation and Enforcement (BOEMRE), Gulf of Mexico (GOM) Outer Continental Shelf (OCS) Region for the Central Planning Area (CPA) Lease Sale 216/222. EPA Region 6 is participating in the NEPA process as a Cooperating Agency in accordance with the requirements of the CEQ regulations.

Based on our analysis, EPA rates the DSEIS as "**EC-2**" i.e., EPA has "Environmental Concerns and Requests Additional Information" in the Final SEIS (FSEIS)". The EPA's Rating System Criteria can be found here: http://www.epa.gov/oecaerth/nepa/comments/ratings.html. Detailed Comments are enclosed with this letter which more clearly identify our concerns and the informational needs requested for incorporation into the FSEIS. Responses to comments on the DSEIS will be placed in Chapter 5 of the FSEIS, however, the response should include the specific page and paragraph in the document where the revision, if any, was made.

EPA appreciates the opportunity to review the DSEIS. Please send our office two copies of the FSEIS when it is sent to the Office of Federal Activities, EPA (Mail Code 2252A), Ariel Rios Federal Building, 1200 Pennsylvania Ave, N.W., Washington, D.C. 20004. Our classification will be published on the EPA website, www.epa.gov, according to our responsibility under Section 309 of the CAA to inform the public of our views on the proposed Federal action. If you have any questions or concerns, please contact John MacFarlane of my staff at macfarlane.john@epa.gov or 214-665-7491 for assistance.

Sincerely,

Rhonda Smith

Rhonda Smith
Chief, Office of Planning
and Coordination

Enclosure

DETAILED COMMENTS
ON THE
DRAFT SUPPLEMENTAL ENVIRONMENTAL IMPACT STATEMENT (DSEIS)
FOR THE
U.S. DEPARTMENTOF THE INTERIOR, BUREAU OF OCEAN ENERGY MANAGEMENT, REGULATION AND ENFORCEMENT (BOEMRE)
GULF OF MEXICO OUTER CONTINENTAL SHELF REGION
CENTRAL PLANNING AREA LEASE SALE 216/222

BACKGROUND:

The Draft Supplemental Environmental Impact Statement (DSEIS) has been prepared by U.S. Department of the Interior, Bureau of Ocean Energy Management, Regulation and Enforcement (BOEMRE), Gulf of Mexico (GOM) Outer Continental Shelf (OCS) Region for the Western Planning Area (WPA) Lease Sale 216/222. This DSEIS has been prepared to address the potential changes to the baseline conditions of the environmental and socioeconomic resources that took place as a result of the Deepwater Horizon (DWH) event that extended from April 20th to September 19th, 2010. This is not an EIS on the DWH event, although information on this event is analyzed as it applies to the resources in the CPA. Proposed CPA Lease Sale 216/222 is the Federal action addressed in this DSEIS and is the remaining area wide oil and gas lease sale within the CPA.

COMMENTS:

GENERAL COMMENTS

Three purposes are listed as reasons for preparing this DSEIS: to analyze the potential changes to baseline conditions of the environmental, socioeconomic, and cultural resources that may have occurred as a result of (1) the *Deepwater Horizon* event between April 20 and July 15, 2010 (the period when oil flowed from the Macondo well in Mississippi Canyon Block 252); (2) the acute impacts that have been reported or surveyed since that time; and (3) any new information that may be available.

EPA is concerned that conclusions regarding impacts of this proposed action are being based on data that is as stated in the DSEIS as "incomplete." It is stated in the DSEIS that, "Although there has been considerable speculation in media reports regarding the impacts of the Deepwater Horizon (DWH) event, credible scientific data regarding the potential short-term and long-term impacts is incomplete and it could be many years before this information becomes available via the Natural Resource Damage Assessment (NRDA) process, the BOEMRE Environmental Studies Program, and numerous studies by academia. Information will become available on a continuing basis for years via the NRDA process, the BOEMRE Environmental Studies Program, and numerous studies by academia." Although the impact of the DWH event on resources in the CPA are not fully understood at this time, and may take years/decades to fully understand, BOEMRE makes multiple statements throughout the DSEIS about the negligible/minimal nature of this proposed action on CPA resources.

2

USEPA-1

Considering the massive emergency response efforts to protect public health, natural resources, water quality, and infrastructure as a result of the DWH oil spill, impacts that are widespread and are of significant duration should be considered in this environmental assessment. The DSEIS seems inconsistent in that the stated purpose is to consider baseline impacts from the DWH oil spill, but the analysis of those impacts seems to be dismissed here as insignificant with limited data provided to support that conclusion. An analysis of the potential impacts from a catastrophic event, such as a loss of well control events and blowouts, would make this assessment more relevant.

USEPA-2

As stated, the second purpose limits the environmental assessment to only acute impacts resulting from the DWH oil spill. An explanation should be provided as to why the analyses do not also include an assessment of chronic impacts. Although many studies on this topic may be underway, with findings still pending, the findings from previous spills could be analyzed for relevance to this lease sale.

USEPA-3

A recent report released by NOAA titled "Deepwater Horizon: A Preliminary Bibliography of Published Research and Expert Commentary" cites 275+ peer-reviewed publications and technical reports regarding three subject areas (natural, medical, and social sciences) related to the DWH event. These reports are not "speculation in media reports" but are credible peer-reviewed publications (30+ are written by at least one NOAA affiliated author). EPA recommends that BOEMRE consider the extensiveness of this research and findings when determining the significance of impacts from the proposed action on CPA resources. This bibliography would be useful in strengthening the analysis and can be found here: http://www.lib.noaa.gov/researchtools/subjectguides/dwh_bibliography.pdf.

2.0. ALTERNATIVES INCLUDING THE PROPOSED ACTION

USEPA-4

The Council on Environmental Quality's 40 Code of Federal Regulations (CFR) Part 1502.14 of its regulations for implementing NEPA states agencies should present the environmental impacts of the proposal and the alternatives in comparative form, thus sharply defining the issues and providing a clear basis for choice among options by the decisionmaker and the public. Thus, EPA recommends that BOEMRE include a summary table in the FSEIS that outlines the alternatives (with preferred alternative identified). The summary table should summarize major features and include significant environmental impacts of alternatives to facilitate understanding of the alternatives, particularly distinctions between alternatives.

Proposed Central Planning Area Lease Sale 216/222, Page 2-8

USEPA-5

EPA recommends Alternative B - The Proposed Action Excluding the Unleased Blocks Near the Biologically Sensitive Topographic Features, which would assure there would be no disturbance from oil and gas activity to these important geological formations and associated biodiversity. See *Topographic Features Stipulation* discussion on page 4.

USEP A-6

Offshore Waters, Page 2-10

This discussion acknowledges that there is a potential for accidental events. Indeed, that is the basis for preparing this DSEIS. However, the discussion presented here seems to dismiss the significance of the potential for the proposed lease sale to cause direct, indirect, or secondary environmental impacts from a catastrophic drilling accident. While we agree that the federal action of leasing is not the same as drilling, one is a consequence of the other. This inconsistency could significantly diminish the utility of the subsequent analyses presented in the document.

USEP A-7

Coastal Barrier Beaches and Associated Dunes, Page 2-10, paragraph 5

This material includes a discussion of the impacts from a spill other than a catastrophic spill but not from a catastrophic spill such as the DWH oil spill. The reason for this omission is unclear since the purpose of the DSEIS is to examine the impacts of the DWH oil spill on the background conditions.

USEP A-8

Wetlands, Page 2-11

This summary indicates that the proposed action would contribute minimally to the dredging required to maintain navigation channels. Because oil and gas related transportation is one of the greatest uses of federally maintained navigation channels along the central Gulf coast, this issue should be explored further, at least in regards to cumulative impacts.

USEP A-9

Sea Turtles; Pages 2-17 & 4-212, Summary and Conclusion

This section concludes that a catastrophic spill similar to the DWH oil spill would be unlikely to result in any substantive impacts to sea turtles. Please note, however, that during the response to that spill, the dredging for construction of the oil spill barrier berms to the east and west of the Mississippi River resulted in concern for a period of months regarding the potential for exceeding both the lethal and nonlethal sea turtle "takes" for the New Orleans District of the Corps. The sizes and age classes of the turtles killed or entrained at that time of year were also unexpected for the areas where the dredging occurred, leading one to question whether there is currently sufficient information upon which to draw a conclusion that dismisses significant effects.

USEP A-10

The National Marine Fisheries Service states "Since March 15, 2011, a notable increase in sea turtle strandings has occurred in the northern Gulf of Mexico, primarily in Mississippi." Causes of strandings can range from entanglement in fishing lines, algal blooms, vessel strikes, marine debris, contamination, disease, and possible impacts from the DWH spill. Opening an additional 37.1 million acres to oil and gas leasing would increase the amount of vessel, exploration, and drilling activity. These activities combined with other environmental stressors, including another catastrophic oil spill, could lead to significant impacts to an already declining sea turtle population.

4

Topographic Features Stipulation, Pages 2-14 & 2-26

USEPA-11

Page 2-14, Topographic Features, states, "The proposed Topographic Features Stipulation would prevent most of the potential impacts on topographic features from bottom-disturbing activities (structure removal and emplacement) and operational discharges associated with the CPA proposed action." Page 2-26, Section 2.3.1.3.1 states "Monitoring studies have demonstrated that the shunting requirements of the stipulation are effective in preventing the drilling mud and cuttings from impacting the biota of the banks". However, no evidence or reference to those studies is found in the DSEIS, thus, no decision can be made as to whether or not these features are actually impacted by exploration activity, seismic testing, platform construction, drilling, blowouts, or any other oil and gas drilling activity. Because there is no evidence that proves that oil and gas activities do not impact topographic features, EPA is recommending Alternative B - The Proposed Action Excluding the Unleased Blocks Near Biologically Sensitive Topographic Features. According to Section 2.3.2.2, this alternative would exclude "only a small percentage of the total number of blocks to be offered under Alternative A" and "it is assumed that the levels of activity for Alternative B would be essentially the same as those projected for the proposed action." Alternative B would assure that there would be no disturbance from oil and gas activity to these important geological formations and associated biodiversity.

3.0. IMPACT-PRODUCING FACTORS AND SCENARIO

Service Vessels, Page 3-18

USEPA-12

Certain discharges from vessels are covered under the EPA Vessel General Permit (http://cfpub.epa.gov/npdes/vessels/vgpermit.cfm). The Vessel General Permit (VGP) applies to discharges incidental to the normal operation of all non-recreational, non-military vessels of 79 feet or greater in length which discharge in waters of the United States. In addition, the ballast water discharge provisions also apply to any non-recreational vessel of less than 79 feet or commercial fishing vessel of any size discharging ballast water.

It is projected in the DSEIS that approximately 137,000–220,000 trips will be required by service vessels to support activities covered under the 40-year life of the proposed action. EPA recommends that BOEMRE include additional discussion in the FSEIS that considers the VGP requirements and fully evaluates the potential impacts associated with such discharges.

Summary of the Catastrophic Spill OSRA Run, Page 3-35

USEPA-13

This section concludes by noting that the catastrophic modeling was completed using a BOEMRE oil spill risk analysis model that was not designed to model a spill over a period of time and that the approach employed for the DSEIS assessment is still under review and analysis. Although it is not uncommon to make certain NEPA analyses based on uncertain or unavailable data, the document should clarify whether the model verification effort could reasonably be expected to be concluded prior to publication of the FSEIS and the Record of Decision.

USEPA-14

Dredged Material Disposal, Page 3-59, paragraph one, sentence three

Please correct the reference to existing offshore dredged material disposal sites as "banks." The EPA designated Ocean Dredged Material Disposal Sites (ODMDS) are typically dispersive sites and are managed in a fashion that should not be conducive to the formation of topographic highs, or banks. This sentence also suggests that there are two types of offshore disposal areas for maintenance dredged material. The ODMDS are the only such offshore sites.

Dredged Material Disposal, Page 3-59, paragraph two

USEPA-15

This discussion about ODMDS should be clarified. The statement is made that dredged materials disposed offshore are not available for beneficial uses to restore and create habitat. These dredged materials often could be used for beneficial use projects if funds were available for that purpose.

USEPA-16

The listings of ODMDS appear erroneously to combine other types of disposal sites (possibly placement areas designated under the Clean Water Act) with ODMDS designated under the Marine Protection, Research, and Sanctuaries Act. The U.S. Army Corps of Engineers (USACE) New Orleans and/or Mobile Districts would be good sources of information.

USEPA-17

The ODMDS designated by EPA are for specific dredged materials from specific channels and are not for "general purpose" or for "cumulative activities." This discussion should be corrected.

Offshore Liquefied Natural Gas Projects and Deepwater Ports, Page 3-63

USEPA-18

This section should be corrected. The required new National Pollutant Discharge Elimination System permit and air permits for the Gulf Gateway Energy Bridge LNG terminal were not applied for and the terminal is in the process of be de-commissioned.

Maintenance Dredging and Federal Channels, Page 3-69

USEPA-19

This section should be corrected. The Mississippi River Gulf Outlet, although a former federally maintained navigation channel, has been de-authorized by the USACE in 2009 and is no longer a maintained navigation channel. Therefore, it should be deleted from the list of federal channels in Louisiana.

4.0. DESCRIPTION OF THE ENVIRONMENT AND IMPACT ANALYSIS

Page 4-3, paragraph one

As stated in the DSEIS, "The DWH event off the Louisiana coast resulted in the largest oil spill in U.S. history. Approximately 4.9 million barrels flowed into the Gulf over a period of 87 days. An event such as this has the potential to adversely affect multiple resources over a large area."

6

USEPA-20

EPA continues to be concerned about response capabilities during catastrophic events such as the DWH. We recommend that additional information be included in the FSEIS that addresses the difficulties of responding to deep water spills in the GOM. EPA recommends inclusion of recommendations and analysis provided in the National Commission on the BP DWH Oil Spill and Offshore Drilling's Final Report in the FSEIS (please see http://www.oilspillcommission.gov/final-report).

Air Quality, Page 4-6

EPA Region 4 is responsible for implementing and enforcing Clean Air Act (CAA) requirements for OCS sources offshore the state seaward boundaries of all areas of the Gulf of Mexico east of 87'30" (*see* CAA section 328). Pursuant to the CAA and applicable federal regulations, OCS activities, such as exploratory drilling operations, are subject to EPA requirements to obtain air quality preconstruction and operating permits. As such, EPA Region 4 will be using the DSEIS prepared by BOEMRE for Lease Sale 216/222 as a decision making document for our required permitting actions.

NO_2 & SO_2 1-hr National Ambient Air Quality Standards, Pages 4-6 thru 4-19

The DSEIS concludes that: "emissions of pollutants into the atmosphere from the routine activities associated with the CPA proposed action are projected to have minimal impacts to onshore air quality because of prevailing atmospheric conditions, emission heights, emission rates, and the distance of these emission from the coastline and the emissions are expected to be well within the NAAQS." The DSEIS further indicates that "these emissions are not expected to have concentrations that would change onshore air quality classifications" and that as "indicated in the Gulf of Mexico Air Quality Study and other modeling studies, the proposed action would have only a small effect on ozone levels in nonattainment areas and would not interfere with the States schedule for compliance with the NAAQS."

USEPA-21

EPA has reviewed the analyses provided and does not believe the stated conclusions are supported without exception by the analyses or referenced Gulf of Mexico Air Quality Study. In particular, the referenced studies and analyses do not appear to address compliance with the new short term 1-hr NO_2 and SO_2 National Ambient Air Quality Standards (NAAQS). In EPA Region 4's experience, exploratory drilling operations have relatively short stack heights and high concentrations of NO_x emissions. Given prevailing atmospheric conditions, especially in summer months, such activities could in fact, cause exceedances of the short term NO_2 standards in the adjacent states when such activities are located in close proximity to shore – i.e. the lease sale includes areas immediately adjacent to the state seaward boundaries. Our review of source specific modeling for our recent permitting activities in the Gulf, lead us to believe that the short term SO_2 NAAQS is not likely to be a concern due to the required use of low sulfur fuels. However, it is EPA Region 4's experience that emissions of NO_x from facilities employing even the best available control technologies may have significant impacts on the NAAQS from near-shore drilling activities. Impacts or exceedances of the particulate matter standards would also be possible for near-shore operations. The impacts on these short-term standards cannot be evaluated by average emissions and average facility fuel use data.

USEPA-22

It is EPA Region 4's observation that source specific modeling and source testing of individual facilities is not routinely conducted in BOEMRE permit reviews nor in NEPA evaluations. While the applicants provide some projected emissions data, which the BOEMRE provides to the State air pollution control agency for review – impacts to the NAAQS cannot be assessed without impact modeling. It is not realistic to assume that States have the source specific data or resources to conduct project specific modeling for OCS drilling and production projects. EPA is concerned that without source specific modeling performed by the applicants using refined data, BOEMRE and the adjacent states will not have the necessary information to ensure compliance with the NAAQS. EPA requests that the BOEMRE address in the FSEIS how and when analyses will be conducted to ensure compliance with the short term standards, especially the new 1-hr NAAQS.

Reliance on BOEMRE Air Regulations for NAAQS Protection and Mitigation, Page 2-8

USEPA-23

The DSEIS does not appear to explicitly address air quality mitigation measures. The DSEIS indicates that "regulations, monitoring, mitigation, and development of emission related technologies would ensure these levels stay within the NAAQS." The BOEMRE air quality regulations, at 30 CFR 250.303, however, do not require air pollution control technology, modeling, or monitoring unless the facility is above fairly large pollutant and distance based exemption thresholds. The exemption thresholds and significance levels relied upon in the regulation to protect the NAAQS were established more than 30 years ago and were not established to protect the new more stringent NAAQS. Plus significant advances have been made in air quality modeling techniques since these thresholds were established. Hence, EPA recommends that the FSEIS not rely upon compliance with the existing BOEMRE regulations as adequate to ensure that the proposed projects will not significantly impact the NAAQS, nor as the only proposed air quality mitigation contemplated by the FSEIS. EPA recommends the FSEIS identify appropriate air quality mitigation measures, at a minimum for common sources of criteria pollutants, such as fuel combustion, flaring, VOC transfer, as well as include a discussion of when such mitigation will be required.

Description of Affected Environment, Page 4-7

USEPA-24

The DSEIS accurately indicates that since the time the EIS was prepared for the 2007-2012 5-Year OCS Program, new NAAQS have been adopted, including short term 1-hr standards for nitrogen dioxide and sulfur dioxide and a revised 8-hours ozone standard. Specifically, the DSEIS indicates that "In early 2008, the USEPA promulgated a new more restrictive NAAQS 8-hour standard of 0.075ppm, which has been *fully implemented.*" While EPA has promulgated these standards, they have not been fully implemented by EPA and the States. EPA is concerned that the choice of the term "fully implemented" implies air quality protections are currently in place. However, the non-attainment areas have not yet been designated under these standards nor have states been required to revise their State Implementation Plans to implement the new standards. EPA recommends this section be revised to indicate that the standards have been "promulgated."

The DSEIS accurately describes that EPA has proposed but not finalized a new lower 8-hour O_3 standard and that designation of Gulf Coast counties to nonattainment would likely

USEPA-25

generate renewed interest in OCS sources to mitigate the OCS contribution to ozone nonattainment. In turn, this would likely require BOEMRE to conduct additional air quality studies to more accurately determine the OCS contribution. The States of Mississippi, Alabama, Florida, and Texas have already identified several coastal counties that currently do not meet the existing 8–hour standard, irrespective of the lower standard. Hence, EPA recommends that the DSEIS is the appropriate venue to accurately determine and fully disclose the OCS contribution of the proposed projects, as well as to discuss viable options for mitigating these contributions.

Best Available and Safest Technologies, Page 1-28

USEPA-26

The DSEIS indicates that "to assure that oil and gas exploration, development, and production activities on the OCS are conducted in a safe and pollution free manner, 43. USC 1347(b) of the Outer Continental Shelf Lands Act (OCSLA), as amended, requires that all OCS technologies and operations use **the best available and safest technology** (BAST) whenever practical." The DSEIS gives the impression that such technologies, including air pollution control technologies, are routinely required. However, in our role as an air permitting authority in the eastern Gulf, and in our oversight role with our states, it has been EPA Regions 4's observation that exploratory drilling rigs operating in the Gulf are often not equipped with best available air pollution technologies and are not routinely required by BOEMRE to used air pollution technologies that are cost effective and readily available. Applicants, for example, have not opted to install lower polluting EPA certified marine engines on foreign flagged vessels operating extensively in US waters, despite such engines meeting ABS and IMO requirements. In addition, air pollution control technology review is not required under BOEMRE regulations unless the project exceeds very large emissions thresholds, often in the range of 2000-4000 tons per year. EPA recommends that best available air pollution control technologies, and operations, such as monitoring engine combustion parameters to ensure optimal combustion efficiency, be discussed in the FSEIS, as well as applied to projects resulting from this lease sale.

Water Quality, Page 4-20, paragraph three

It is stated in the DSEIS that "Small spills (< 1,000 bbl) are not expected to significantly impact water quality in coastal or offshore waters. Large spills (> 1,000 bbl), however, could impact water quality in coastal waters. Accidental chemical spills, release of SBF, and blowouts would have temporary localized impacts on water quality."

USEPA-27

Depending on the location of a spill (example: close to shore – near sensitive coastal wetlands) a small spill (<1,000bbl) could potentially have significant environmental impacts. EPA believes that smaller incidents (<1,000bbl) such as a pipeline ruptures should not be minimized, especially considering the cumulative nature of such events on already impacted resources in the CPA.

River Channelization and Beach Protection, Page 4-55, paragraph three

This discussion provides a good description of the range of impacts that were initially projected by leading scientists which could potentially result from the construction of the Louisiana barrier berms. These structures were built as a defensive response to the DWH oil spill. Construction of the berms to the east and the west of the Mississippi River required over 19 million cubic yards of fill material dredged from the near shore water bottoms. Over 15 miles of sand berms were built to an elevation of roughly six feet. The effort involved not only dredging sand as the construction material but also stockpiling and re-handling the dredged materials, which had the potential to incur additional coastal impacts. There were initial concerns regarding impacts to tidal inlet velocities, water quality, near shore hydrology, sediment budgets, and natural sediment transport patterns.

USEPA-28

Although the discussion in the DSEIS indicates that the potential cumulative and continuing impacts could be measured through long-term monitoring, no description is provided as to what monitoring is currently being conducted or monitoring that has yielded results to date. If preliminary results are available, it would be appropriate to incorporate them into the DSEIS. As mentioned above on page one of this comment letter, the "Deepwater Horizon: A Preliminary Bibliography of Published Research and Expert Commentary," would be a credible source for information.

Dredging, Page 4-68, sentence one

USEPA-29

The sentence could be clarified by modifying it to read: "This method usually produces positive topographic relief in the placement area, though the effects may often be temporary."

Summary and Conclusion, Page 4-74 through 4-80, paragraph one

The DSEIS states that, "Offshore oil spills resulting from the CPA proposed action are not expected to significantly damage wetlands along the Gulf Coast. This is because of the distance from the spill to the coast and because wetlands are generally protected by barrier islands, peninsulas, sand spits, and currents." Recent events have shown that oil spills can have impacts on coastal wetlands far from the site of the spill. Some wetlands may be protected by the features described, but many are not, and barrier islands, peninsulas, and sand spits are often integral parts of ecosystems that warrant protection, as well. Many barrier islands have wetlands themselves. Currents may provide localized deflection in some locations, but also generally serve to circulate spilled materials and may bring them to wetlands and other coastal resources.

The DSEIS goes on to describe that cleanup efforts can cause greater impacts to wetland habitats and surrounding seagrass communities than an oil slick. Whereas this is true in some cases, it does not negate the impacts of the spill itself or make them minimal. Wetlands and seagrass communities left to recover unassisted may take years to reach a healthy state. Media reports from April 2011 showed marshes, particularly in Louisiana, with considerable oil remaining.

The DSEIS concludes of wetlands, "Overall, impacts to wetland habitats from an oil spill associated with activities related to the CPA proposed action would be expected to be low and temporary because of the nature of the system, regulations, and specific cleanup techniques."

Similarly, on page 4-219, the report concludes that impacts to seagrass communities "would be considered short term in duration and minor in scope" and impacts to birds would be "negligible." However, NRDA teams conducted surveys of the Gulf Coast and identified over 1,050 miles of oiled shoreline. The April 2011 *Deepwater Horizon Response Consolidated Fish and Wildlife Collection Report*, by the USFWS, gave to-date totals of living and dead wildlife collected from the impact area that included over 4,000 visibly oiled birds, over 450 visibly oiled sea turtles, and more than 150 marine mammals that, although most were not visibly oiled, may have been impacted by the spill. The severity of impacts to wetlands and related aquatic resources, particularly long-term effects, have yet to be determined.

USEPA-30

In general, it is unclear what additional information was used in drawing the conclusions about potential impacts to wetlands, seagrass beds, and wildlife. Recent events have shown that spills from offshore drilling can have considerable impacts. The environmental impacts of potential spills need to be given due consideration in evaluating the proposed activities and emergency preparedness.

Development of Wetlands, Page 4-79, paragraph four, sentence one

USEPA-31

Not all of the wetlands impacted by the post-Katrina hurricane and storm damage risk reduction projects being conducted by the USACE were considered to be marginal wetlands, as indicated in this discussion. For instance, the construction of the West Closure Complex required an unprecedented modification of a Clean Water Act Section 404(c) designation in order to minimize impacts to the nationally significant Bayou aux Carpes wetland, which is also part of the Jean Lafitte National Historical Park and Preserve. A reference may be found under the heading for Environmental Protection Agency Documents at the website: http://www.nolaenvironmental.gov/projects/usace_levee/IER.aspx?IERID=12.

Threatened and Endangered Species, Page 5-8

USEPA-32

The DSEIS indicates that BOEMRE has re-initiated consultation under the ESA for the GOM Oil and Gas Lease Sales 2007-2012 5-Year OCS Program, and that such consultation is currently on hold pending release of environmental baseline data. In addition, BOEMRE requests annual concurrence from both the U. S. Fish and Wildlife Service and National Marine Fisheries Service (the Services) to ensure current activities remain consistent with the Biological Opinion. Since EPA will be issuing air quality permits to facilities covered by the subject DSEIS, EPA recommends that BOEMRE formally identify in the FSEIS and to the Services in the annual concurrence request that BOEMRE is the lead agency for the purpose of the ESA review for these projects covered under the 5-Year Program. ESA regulations provide that when a particular action involves more than one federal agency, the conference responsibilities may be fulfilled through a lead agency. Such clarification will avoid unnecessary delay and redundancy in effort for the Services and OCS applicants. To the extent that BOEMRE resumes consultation with the Services in the near term, EPA requests that the results be included in FSEIS.

Environmental Justice, Pages 4-337 thru 355

The DSEIS provides great detail about the coastal and deepwater oil exploration and extraction processes and possible implications involved. Oil spills, discharges, vessel collisions, pipeline ruptures etc, could take place the entire Louisiana coastline and its residents could potentially be affected to some degree, depending on the distance from shore and other factors. If a catastrophic spill or a blowout similar to the DWH event should occur, all the coastal residents would feel the impact, regardless of income or social status. The DSEIS acknowledges, however, that low-income and minority populations (including tribal communities in Lafourche, Terrebonne and Plaquemines Parishes) would undoubtedly be impacted by these events more severely than middle or upper-class populations. Moreover, because of the particular way of life of the low-income coastal residents who engage in subsistence fishing, hunting/trapping, gathering, etc., they would have less resiliency in such a disaster, just as was the case with the DWH in Louisiana and Mississippi.

The DSEIS recognizes this fact and provides comprehensive analysis of these low-income populations. The DSEIS is clear that in the event of a similar catastrophe to the DWH blowout, environmental justice communities (including coastal tribal groups, like the Houma and Chitimacha) would be disproportionately and adversely impacted, in all likelihood.

USEPA-33

The FSEIS should include data pertaining to populations and persons with Limited English Proficiency (LEP) along the Gulf Coast who may be affected by a catastrophic spill event. The FSEIS should ensure that language-appropriate communication is supplied to LEP populations during the event and during recovery efforts. Examples of tools that could be utilized include supplying interpreters at public meetings and safety trainings and ensuring that English language documents are translated to other languages. Resources and tools regarding LEP populations can be found at the U.S. Department of Health and Human Services website: http://www.hhs.gov/ocr/civilrights/resources/specialtopics/lep/ and at the Federal Interagency Website for LEP: http://www.lep.gov/.

Tribal Considerations

USEPA-34

According to Chapter 5, the federally recognized tribes were contacted and consultation was requested, but only two tribes responded. These two tribes should have been listed. There are five coastal tribes in Louisiana, but the State only recognizes one. These tribes live along the coast and make their living from the coastal waters, and the tribes have survived through subsistence practices for over 600 years. The analysis of the tribal way of life (and that of other ethnic groups) was comprehensive. Because of their practice of subsistence fishing, trapping, and oyster and crab harvesting, they are very susceptible to the impacts of activities and accidents caused by the coastal oil industry. The coastal tribes have been and will be among the groups most affected by natural and man-made disasters in the Louisiana coastal area. As a result of this and the policy of controlling the Mississippi River and the construction and on-going dredging of the Intercoastal Waterway, their land is subsiding, and many villages have had to relocate. The Houma Nation, the only State-recognized coastal tribe, will be impacted possibly more than any community in the event of a major oil industry disaster in the Gulf.

USEPA-35

Special outreach efforts to the five tribes of coastal Indians should be undertaken in the interest of transparency, of serving the affected public, and to promote full public participation. The Houma have been affected by hurricanes, by land subsidence, and by the DWH more than any tribal group, as previously mentioned. Special outreach to them and to other tribal groups would be beneficial, since they will be among the most impacted in the event of severe accidents.

The following is the contact information for the coastal Louisiana coastal tribes:

- Point au Chien Indian Tribe, Chief Albert Naquin, 985-856-5336, www.lctci.com
- Grand Cailou/Dulac Band of Biloxi-Chitimacha, Chairwoman Marlene Foret, 985-709-4161 www.lctci.com
- Bayou Lafourche Band of Biloxi-Chitimacha, Chief Randy Verdun, 225-485-8765 www.lctci.com
- Isle de Jean Charles Band of Biloxi-Chitimacha, Chief Charles Verdin, 985-232-1286 www.lctci.com
- United Houma Nation, Chief Thomas Dardar, 985-665-4085, www.unitedhoumanation.org

USEPA-1 The BOEM developed the “Catastrophic Spill Event Analysis” (**Appendix B**) to assess impacts from a potential catastrophic spill event. In the assessment of accidental impacts in the impact analysis (**Chapter 4**), **Appendix B** was incorporated by reference, where applicable. Additionally, expanded discussions of the impact of a catastrophic event was included in the analysis if it was determined relevant. The purpose of this Supplemental EIS was to update analyses since the Multisale EIS and the 2009-2012 Supplemental EIS with any newly available information, including but not limited to the DWH event, and to determine if baseline conditions have changed since the publication of the previous EIS’s. The BOEM acknowledges that information regarding the DWH event is still being developed and compiled, primarily through the NRDA process, and that much of this information may not be available for years. In this Supplemental EIS, BOEM has identified pending research and its determination whether the pending information may be relevant to reasonably foreseeable significant impacts and may be essential to a reasoned choice among alternatives, consistent with CEQ regulations.

USEPA-2 The assessment of chronic impacts specifically resulting from the DWH event is a process that may take many years of study and research. Although the findings, which are based on previous spills, have provided information on potential chronic effects, there are no completed studies that considered a spill of the volume of the DWH event. **Chapter 4.1**, “Incomplete or Unavailable Information,” has been expanded since the publication of the Draft Supplemental EIS. Where relevant information on reasonably foreseeable significant adverse impacts is incomplete or unavailable, the need for the information was evaluated to determine if it was essential to a reasoned choice among the alternatives and, if so, was either acquired or, in the event that it was impossible or exorbitant to acquire the information, accepted scientific methodologies were applied in its place. In addition, individual resource analyses highlight where information was incomplete or unavailable. Where appropriate, BOEM subject-matter experts did reference to chronic impacts resulting from prior spills, such as the *Exxon Valdez* spill and the *Ixtoc* spill, in their accidental events analyses in **Chapter 4** and in **Appendix B**.

USEPA-3 Since publication of the Draft Supplemental EIS, BOEM subject-matter experts have incorporated relevant information and have updated this Supplemental EIS accordingly. The incorporation of relevant information is time consuming, as it must be obtained and reviewed by subject-matter experts in the context of the source of the data, research methodology, and data quality. As is necessary under every NEPA analysis, at some point the subject-matter experts had to finalize their analyses to allow time for this Final Supplemental EIS to be prepared and presented to the decisionmaker.

USEPA-4 The structure of this Supplemental EIS was revised from the Multisale EIS and 2009-2012 Supplemental EIS to better present the proposed action, alternatives, and impact assessment in a clear comparative form and to provide decisionmakers a clear choice among options. The proposed action here is a single lease sale, and the action alternatives are limited to a reduction in the scope of leases offered. The BOEM feels that issues are clearly defined and that information to determine a reasoned choice among the alternatives is clear. The BOEM also feels that reducing these impacts to a table would be potentially more confusing and repetitive.

USEPA-5 Comment noted. If the ASLM’s decision is to hold a lease sale under either Alternative A, B, or C, it will be announced in the Final Notice of Sale

USEPA-6 This Supplemental EIS updates information made available since the Multisale EIS and the 2009-2012 Supplemental EIS, including but not limited to information relating to the DWH event. When these prior NEPA documents were finalized, a spill of the magnitude of the DWH event was not considered to be a reasonably foreseeable event. The likelihood of another event on this scale remains exceedingly low, made even more so by BOEM’s and

BSEE's promulgation of new drilling and safety regulations and the ongoing endeavors to advance containment technologies. Two new appendices, however, were added to this Supplemental EIS to provide more information about potential impacts of a catastrophic spill: **Appendix B**, "Catastrophic Spill Event Analysis" and **Appendix C**, "BOEM-OSRA Catastrophic Run." The summaries provided in **Chapter 2.3.1.2** are for the analyses in **Chapter 4** concerning routine impacts, impacts from accidental events described in the development scenario, and cumulative impacts. Clarifying language has been added to **Chapter 2.3.1**, indicating that catastrophic spill event impacts are discussed in **Appendix B**.

USEPA-7 See the response to Comment USEPA-6.

USEPA-8 As noted in the response to USEPA-6, the information referred to in **Chapter 2.3.1.2** (Summary of Impacts) is only intended to provide a summary of the potential impacts of routine and accidental impacts associated with the proposed action on wetlands. More detailed information is presented in **Chapter 4.1.1.3.**

The BOEM disagrees with USEPA's comment that oil- and gas-related transportation is one of the greatest uses of federally maintained navigation channels along the central Gulf Coast. As noted in **Chapter 4.1.1.4.2**, OCS-related traffic is only a small portion (approximately 9%) of the total commercial traffic in the Gulf, and the average contribution of the CPA proposed action to OCS-related vessel traffic in navigation canals is expected to be small (3-4%). Therefore, the total contribution of the CPA proposed action to total commercial traffic is from 0.2 to 0.4 percent.

USEPA–9 This language has been clarified. In this Supplemental EIS, BOEM concludes that there is a potential for a low-probability catastrophic event to result in significant, population-level effects on affected sea turtle species. The BOEM has reinitiated consultation with NMFS and FWS, is complying with reasonable and prudent measures and the terms and conditions of an existing Biological Opinion, and is working on an interim coordination program with these agencies while consultation is ongoing to protect endangered species, including sea turtles. The NMFS has collected a number of sea turtles both before and after the DWH event, but to date has not provided a suspected cause of death for many or all of them. Given that current data indicate that the emergency berms in Louisiana were not effective in minimizing impacts from the DWH event and that the Presidential Oil Spill Commission counseled against future use of such berms (Oil Spill Commission, 2011a), BOEM does not expect that similar berms would be used as a response measure if a low-probability catastrophic event were to occur in the future.

USEPA-10 The language has been clarified in this Supplemental EIS.

USEPA-11 As noted in the response to USEPA-6, the information referred to in **Chapter 2.3.1.2** (Summary of Impacts) is only intended to provide a summary of the potential impacts of routine and accidental impacts associated with the proposed action on topographic features. More detailed information, including referenced studies, is presented in **Chapter 4.1.1.22**. The BOEM notes USEPA's preference for Alternative B. If the ASLM's decision is to hold a lease sale under either Alternative A, B, or C, it will be announced in the Final Notice of Sale.

USEPA-12 The impacts of routine events on water quality related to the proposed action are discussed in **Chapters 4.1.1.2.1.2 and 4.1.1.2.2.2**, as related to coastal and offshore waters, respectively. Information on the VGP is provided in those chapters. The VGP is also discussed in the cumulative impacts analyses in **Chapters 4.2.1.2.1.4 and 4.2.1.2.2.4**, as related to coastal and offshore waters, respectively.

USEPA-13 Comment noted. The BOEM realizes that this paragraph may have been unduly confusing to the reader; therefore, the BOEM subject-matter expert has revised the text to clarify what the catastrophic-spill OSRA run was designed to do, as well as to provide a reference to Appendix C of the Supplemental EIS for more information regarding the catastrophic-spill OSRA run. At this point in time, there is no continuing model verification effort for a catastrophic-spill OSRA run unless or until new information warranting reevaluation becomes available. The BOEM subject-matter experts have applied the OSRA modeling run identified in **Appendix C** where appropriate in their individual resource analyses in **Chapter 4**, including what information is currently available on the impacts from the DWH event.

USEPA-14 Comment noted. The information was revised to reflect that materials from maintenance dredging are primarily disposed of offshore in ocean dredged-material disposal sites. The reference to "disposal banks" was removed from the text.

USEPA-15 **Chapter 3.3.3** ("Dredged Material Disposal") of this Supplemental EIS was revised to explain that dredged material is available for beneficial use if funds are available.

USEPA-16 **Chapter 3.3.3** ("Dredged Material Disposal") of this Supplemental EIS was revised to clarify that the ocean dredged-material disposal sites listed in **Table 3-13** are those sites utilized by COE.

USEPA-17 Comment noted. Information was removed from this Supplemental EIS in response to the suggested changes.

USEPA-18 Comment noted. Information related to the Gulf Gateway Energy Bridge LNG terminal was deleted from this Supplemental EIS as it is in the process of being decommissioned.

USEPA-19 Comment noted. The Mississippi River Gulf Outlet was removed from the list of federally maintained navigation channels.

USEPA-20 The difficulties of responding to deepwater spills are identified and addressed within the spill response section in **Chapter 3.2.1.5.2** and within the catastrophic spill analyses in **Appendix B**. The BOEM has identified several task forces to examine and implement, where advisable, the recommendations made by numerous groups subsequent to the DWH event; however, much of this work is still pending. Once the recommendations identified within the National Commission on the BP DWH Oil Spill and Offshore Drilling's final report are assessed and potentially implemented, this information will be included in future NEPA documents.

USEPA-21 Comment noted. See **Chapter 1.5** ("Air Emissions") for information on BSEE's criteria for modeling. Clarifying language has also been added to **Chapter 4.1.1.1.2** indicating that, during exploratory drilling operations (which, depending on the circumstances, may be classified as a temporary activity under BSEE's air regulation at 30 CFR 250.302), air emissions may contribute to onshore air exceedances of the new short-term, 1-hour NO_x and SO_x NAAQS and, hence, may affect the onshore air quality. As noted in the response to USEPA-22, however, BSEE requires those operators subject to OCD modeling to demonstrate compliance with the new 1-hour NAAQS standards.

USEPA-22 See language in **Chapter 1.5** ("Air Emissions") and in **Chapter 4.1.1.1.2**. If the estimated annual air emissions for facilities exceed the exemption level for a specific pollutant (i.e., a screening process), the operator is required to submit the source-specific modeling using the OCD model and air emission sources from individual facilities to BOEM/BSEE for air quality plan reviews. For those operators required to submit NO_x OCD modeling, BSEE now requires the operator to conduct the OCD modeling to also ensure compliance with the new short-term, 1-hour NO_x NAAQS. Because USEPA has recently finalized the short-term NAAQS standards, BOEM plans to conduct a full impacts modeling study to look at annual and short-term standards. The BOEM has performed impacts modeling using the 2005 emissions inventory and the ozone standard in place at that time.

USEPA-23 The BOEM enforces air quality mitigation measures through Air Quality Reviews. The air quality regulations at 30 CFR 550.303 require air pollution control technology (including BACT) and the OCD modeling if the exemption level is exceeded. In air quality plans submittals, the air quality regulations require appropriate air quality mitigation measures, such as fuel use certifications and run time documentation for activities such as fuel combustion and flaring

Regulations provide for some limited volume, short duration flaring or venting of oil and natural gas upon approval by BSEE (2-14 days, typically). Through 30 CFR 250.1160, BSEE may allow operators to burn liquid hydrocarbons if they can demonstrate that transporting them to market or re-injecting them into the formation is not technically feasible or poses a significant risk of harm to the environment.

USEPA-24 Comment noted. The suggested change has been made in this Supplemental EIS.

USEPA-25 The USEPA has announced that the proposed 8-hour ozone standard will not be finalized at this time, pending completion of the regular 5-year NAAQS review. As described in **Chapter 4.1.1.1.2**, BOEM subject-matter experts have evaluated the potential impacts of the proposed action's routine activities on onshore ozone levels (at the previous NAAQS standard of 0.08 ppm) and found only minimal contributions likely to result from the proposed action. As discussed in **Chapter 1.5**, based on modeling results, BSEE may require BACT and other control measures.

USEPA-26 Comment noted. The section on "Air Emissions" in **Chapter 1.5** describes the screening levels for modeling and the application of BACT. If any of the modeled concentrations exceed BOEM significance levels, regulations require the lessee to apply BACT and, if necessary, additional emission controls or emission offsets may be required.

USEPA-27 The subject paragraph has been removed as it was confusing to readers. Impacts from spills on coastal water quality and proximity to shore are described in better detail in **Chapter 4.1.1.2.1.3** ("Impacts of Accidental Events"). The BOEM subject-matter experts had addressed the factors that USEPA cites in the Draft Supplemental EIS, and they do not feel that these factors were in any way minimized.

USEPA-28 The BOEM subject-matter experts have included the scientifically credible information that is available and relevant to update their analyses in this Supplemental EIS, including certain sources in NOAA's *Deepwater Horizon: A Preliminary Bibliography of Published Research and Expert Commentary* (NMFS, 2011e). Clarifying language, including Lavoie et al.'s (2011) recommendations on monitoring, are included in **Chapter 4.1.1.3.4** of this Supplemental EIS. To date, preliminary monitoring results have not been made available to the public, and BOEM has identified what information remains incomplete or unavailable at this time, whether it is essential to a reasoned choice among alternatives and whether it can be obtained or if the costs of obtaining it are exorbitant.

USEPA-29 Comment noted. The suggested change has been made in this Supplemental EIS.

USEPA-30 The USEPA's comment refers to "Summary and Conclusion, Page 4-74 through 4-80, paragraph one." Please note, however, that on page 4-74 is the summary and conclusion for accidental events based on an analysis of potential accidental events from the proposed action and not from a catastrophic oil spill such as the DWH spill, which is analyzed in

Appendix B. The citations supporting the conclusions made in this paragraph are included in the bulk of the accidental events analysis on the preceding pages. The remaining text referred to by USEPA on pages 4-74 through 4-80 consists of the cumulative analysis of wetlands, which includes a discussion of oil-spill impacts generally, including from the DWH spill. The comment further states that the Draft Supplemental EIS concludes that impacts to seagrass communities "would be considered short term in duration and minor in scope" and that impacts to birds would be "negligible." The BOEM subject-matter experts based these conclusions on the analysis of potential oil spills and cleanup activities associated with the proposed action and not with a catastrophic spill such as the DWH spill, which is addressed in **Appendix B**.

The USEPA has stated that it is unclear what additional information was used in drawing conclusions about potential impacts to wetlands, seagrass beds, and wildlife; that recent events have shown that spills from offshore drilling can have considerable impacts; and that the environmental impacts of potential spills need to be given due consideration in evaluating the proposed activities and emergency preparedness. The BOEM believes that potential impacts of the proposed activities, including accidental spills, have been adequately considered in this Supplemental EIS. For example, concerning the impacts to wetlands, **Chapter 4.1.1.4.3** ("Impacts of Accidental Events") includes an analysis of oil-spill impacts, along with an evaluation of cleanup methods. Numerous references are supplied supporting the conclusions provided in this Supplemental EIS.

In addition, BOEM subject-matter experts have included scientifically credible information that has become available since the publication of the Draft Supplemental EIS, where appropriate. The publication of the OSAT reports, previously unavailable at the time of the preparation of the Draft Supplemental EIS, also indicate that there may be less damaging treated oil reaching the wetlands. However, much of the NRDA data remain unavailable, along with other ongoing studies. The BOEM has identified where information remains incomplete or unavailable, whether it is relevant to reasonably foreseeable significant adverse impacts, whether it is essential to a reasoned choice among alternatives, and whether it can be obtained or whether the costs of doing so are exorbitant.

USEPA-31 Comment noted. The information referenced by USEPA in **Chapter 4.1.1.4.4** has been revised in response to this comment.

USEPA-32 The reinitiated consultations are not complete at this time, although BOEM and BSEE are in discussions with both agencies. In the meantime, the current consultation remains in effect and recognizes that required mitigations and other reasonable and prudent measures should reduce the likelihood of impacts from BOEM- and BSEE-authorized activities. Further, BOEM has determined, under Section 7(d) of the ESA, that the proposed action is not an irreversible or irretrievable commitment of resources, which has the effect of foreclosing the formulation or implementation of any reasonable and prudent alternative measures. The BOEM and BSEE are also developing an interim coordination program with NMFS and FWS while consultation is ongoing. As BOEM moves ahead on the next 5-Year Program (2012-2017) and associated consultations, it will clarify language to avoid redundancy and unnecessary delay.

USEPA-33 Comments noted. Additional information was added to **Chapter 4.1.1.21.4.3** to address information related to persons with limited English proficiency and to efforts that were made by USCG (in their lead role in the Incident Command Center) to distribute news and information following the DWH event.

USEPA-34 As is stated in **Chapter 5.9**, letters were sent to coastal Tribes and SHPO's on November 12, 2011, requesting consultation on lease sales in both the CPA and WPA, which included proposed CPA Lease Sale 216/222. Only two responses were received, one of which was from the Louisiana SHPO. The only tribe to respond was the Seminole, whose tribal interests do not extend into the CPA; therefore, they were not specifically identified in this Supplemental EIS. Letters also were sent to the Poarch Band of Creek Indians, The Chitimacha Tribe of Louisiana, the Alabama Coushatta Tribe of Texas, the Choctaw Nation of Oklahoma, the Coushatta Tribe of Louisiana, the Caddo Nation, the Jena Band of Choctaw Indians, the Mississippi Band of Choctaw Indians, and the Tunica-Biloxi Tribe of Louisiana in the belief that these tribes would likely have a historical interest in the Gulf Coast and could perhaps share information on Traditional Cultural Properties or traditional relationships with the Gulf of Mexico.

USEPA-35 This comment does not seem to relate so much to a Section 106 issue as it does to environmental justice, which is addressed in **Chapter 4.1.1.21.4**. The Houma and the coastal tribes identified by USEPA are not federally recognized and are not accorded the same status for government-to-government consultation. While the Houma may well have been affected by the DWH event, hurricanes, and land subsidence, it is unlikely that they were disproportionately affected in comparison to other coastal ethnic groups such as Isleños, Cajuns, Vietnamese, African Americans, or other inhabitants of South Louisiana. The BOEM, through its public hearings, has actively sought public input into its NEPA processes and has specifically requested input for compliance with Section 106.

United States Department of the Interior

FISH AND WILDLIFE SERVICE
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Lafayette, Louisiana 70506

August 10, 2011

To: Chief, Environmental Assessment Section
Leasing and Environment (MS 5410)
Bureau of Ocean Energy Management, Regulation and Enforcement
Gulf of Mexico Outer Continental Shelf (OCS) Region
New Orleans, Louisiana

From: Acting Supervisor
U.S. Fish and Wildlife Service
Louisiana Ecological Services Office
Lafayette, Louisiana

Subject: Review of Draft Supplemental Environmental Impact Statement for the Proposed OCS Oil and Gas Lease Sale 216/222 in the Gulf of Mexico's Central Planning Area

The U.S. Fish and Wildlife Service (Service) has reviewed the subject Draft Supplemental Environmental Impact Statement (DSEIS) for the Gulf of Mexico OCS Oil and Gas Lease Sale 216/222 in the Central Planning Area (CPA), administered by the Bureau of Ocean Energy Management, Regulation and Enforcement (BOEMRE), Gulf of Mexico OCS Region. Comments regarding the DSEIS are provided below by the Louisiana Ecological Services Office in behalf of the Service. This response does not address any Endangered Species Act section 7 consultation issues that may apply to this action. We will continue to work to address those issues as part of the reinitiation of consultation requested by BOEMRE dated July 30, 2010. These comments mirror many of our comments provided for your recent DSEIS for Lease Sale 218 in the Western Planning Area.

The DSEIS document is a notable improvement and provides greater discussion than past EIS documents for the OCS oil and gas lease sale program. We note the DSEIS discussion incorporates some of our comments found in our letters to you dated January 7, 2007, and January 24, 2011. We also note your reference to the new policies and regulations created in response to the *Deepwater Horizon* event that are designed to reduce the likelihood of another catastrophic spill occurring and improve spill response if such an event were to occur again. To further clarify and to improve the analyses of impacts discussed in the DSEIS, we strongly recommend information provided or derived from the *Deepwater Horizon* response (e.g., the number of birds, turtles and marine mammals collected) be updated as much as feasible. Including the most recent data collected on the oil spill and response/clean-up activities in your analyses may change your assessment of impacts to certain natural resources. We note clean-up efforts are on-

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going and continue to impact natural resources. Therefore, those effects to natural resources, such as wetlands, coastal barrier beaches, migratory birds and threatened and endangered species have yet to be fully realized. Specific comments follow.

Specific Comments

FWS-1

Page 1-12: Please include the U.S. Fish and Wildlife Service as one of the key agencies identified in the first paragraph that was involved in early discussions and coordination of the prelease process. We provided scoping comments for the subject DSEIS in a letter dated January 24, 2011, and met with BOEMRE representatives January 26-27, 2011, to improve early coordination of future activities.

FWS-2

Page 1-16 and 1-18: Please clarify the third paragraph (p. 1-16) and the second paragraph (p. 1-18) under the *Exploration Plans* section that states categorical exclusion rules or selected exploration plans may include recommendations from the Service (under provisions of a DOI agreement). We are unfamiliar with the referenced DOI agreement.

FWS-3

Page 1-24: We recommend you identify what environmental information (e.g., location and descriptions of threatened and endangered species habitat) is available to oil spill response personnel prior to a spill occurring. For example, as highlighted on page 43 of your 2007 Biological Assessment for the 2007-2012 Programmatic Section 7 Consultation, BOEMRE provides annual updates to the U.S. Coast Guard (USCG) of threatened and endangered species locations beforehand to improve their response times to oil spills and to reduce the time required to gather information from multiple agencies.

FWS-4

Page 1-31: The reference to Appendix C in the first sentence of the second paragraph should be changed to Appendix E.

FWS-5

Page 2-4: Please update your discussion in the third paragraph under Section *2.2.1.2. Alternatives Considered but Not Analyzed* to reflect that, to our knowledge, no drilling pause or delay in future lease sales currently exists.

FWS-6

Page 2-9: If current air quality models used by BOEMRE are not appropriate for the assessment of air quality from OCS emission sources (as suggested in the third paragraph), we recommend BOEMRE fund efforts to properly model OCS air quality.

FWS-7

Page 3-14: We recommend you revise the first sentence of the second paragraph under the *Spills* section to read "…were responsible for 45 percent of the total *reported* spillage in …." When discussing spill data collected from the USCG, please clarify that data is of reported spills to the USCG, not necessarily all spills that occur.

FWS-8

Page 3-33: We recommend BOEMRE develop a method similar to Fraser and Ellis (2008) to estimate the difference between predicted oil spills versus actual oil spills that occur in the Gulf of Mexico.

FWS-9

Page 3-36: We recommend you indicate in the seventh and eighth paragraph that the spill data is of reported spills to the USCG, not necessarily all spills that occur.

FWS-10 Page 4-196: Similar to the discussion entitled **Factors Influencing Cetacean Distribution and Abundance**, we recommend a discussion on West Indian manatee (*Trichechus manatus*) distribution and abundance be presented.

FWS-11 Page 4-197: We recommend the discussion on the potential impacts of routine events (Chapter 4.1.1.11.2) to manatees be broadened. Although manatees do not occur within OCS boundaries, they may be impacted by coastal and near-shore support activities (e.g., loss of seagress beds, strikes from OCS support vessels, ingestion or entanglement from marine debris, etc.).

FWS-12 Pages 4-200 and 4-203: Please note in your discussion of impacts from accidental events (p. 4-200) and cumulative impacts (p. 4-203) that manatee sightings are increasing during the summer months (June to September) in Alabama, Mississippi, Louisiana and Texas waters.

FWS-13 Pages 4-208, 4-210 and 4-211: Please discuss the potential impacts of routine (section 4.1.1.12.2) and accidental events (section 4.1.1.12.3) and the cumulative impacts (section 4.1.1.12.4) to nesting sea turtles and their nesting habitat.

FWS-14 Page 4-213: We recommend you analyze the impacts of the CPA proposed action to beach mice from coastal and near-shore OCS support activities.

FWS-15 Pages 4-222 and 4-224: Please update the information regarding the presence of endangered whooping cranes (*Grus Americana*) in Louisiana. A total of 10 whooping cranes were reintroduced to Louisiana in the White Lake Conservation Area during Winter 2011 as a non-essential experimental population.

FWS-16 Page 4-222: We recommend you include a brief discussion of general information on all raptors that may occur within the area of impact for the proposed CPA action. Please note that the bald eagle (*Haliaeetus leucocephalus*) is also protected under the Bald and Golden Eagle Protection Act.

FWS-17 Page 4-223: We recommend you include a discussion of the endangered Mississippi sandhill crane (*Grus canadensis pulla*) and wood stork (*Mycteria Americana*) under the section **Endangered and Threatened Species**. Both bird species occur within coastal areas of the CPA.

FWS-18 Page 4-153: Please add to the discussion of raptors in the second paragraph that the bald eagle (*Haliaeetus leucocephalus*) is also protected under the Bald and Golden Eagle Protection Act.

FWS-19 Pages 4-384 and 4-385: Under the diamondback terrapin chapter, please clarify the second sentence of the second paragraph (p. 4-384) and the first complete sentence of p. 4-385, "…on the affected marine mammal environment." We believe you mean reptile or diamondback terrapin environment.

FWS-20 Page B-13: We recommend you identify and discuss actions (e.g., the new policies and regulations implemented as a result of the *Deepwater Horizon* event) that may reduce the

FWS-20 BOEMRE's predicted duration of a catastrophic spill event in shallow water (2-4 months) and deep water (4-5 months) if any exist. Improved spill contingency planning may reduce the response time from that seen with the *Deepwater Horizon* event, possibly resulting in shorter spill durations or reduced impacts.

FWS-21 Page B-33: Please note that only the interior population of the least tern *(Sterna antillarum)* is listed as endangered. The coastal population is not listed. Therefore, the least tern may be removed from the discussion of endangered and threatened species. We recommend you add a discussion of the endangered whooping crane (which occurs in Texas, Louisiana and Florida), Mississippi sandhill crane (which occurs in Mississippi) and wood storks which are listed as endangered in Alabama, Florida, Georgia and South Carolina.

FWS-22 Page B-36: We recommend you complete the last sentence of the diamondback terrapin discussion by listing examples of chronic effects to terrapins from oil contact.

FWS-23 Page C-3: You term the probabilities associated with your OSRA catastrophic spill run as *conditional probabilities*, meaning those probabilities are assuming a catastrophic event actually occurs. It may be possible to include a catastrophic event, such as the *Deepwater Horizon* event into BOEMRE's traditional OSRA model since historical spill data should now be able to capture that event. If that is not possible, we recommend BOEMRE evaluate the probability of a catastrophic event occurring using an alternative model.

Thank you for the opportunity to review the DSEIS. Please contact Rob Smith (337-291-3134) of this office if you have any questions regarding our comments.

Cc: NMFS, St. Petersburg, FL
FWS, Washington, DC (attn.: Rick Sayers)

Literature Cited

Fraser, G.S. and J. Ellis. 2008. Offshore hydrocarbon and synthetic hydrocarbon spills in eastern Canada: The Issue of follow-up and experience. Journal of Environmental Assessment Policy and Management 10(2):173-187.

FWS-1 A revision was made to the document to include FWS as one of the key agencies that BOEM conducted early key coordination related to this Supplemental EIS.

FWS-2 The references have been deleted.

FWS-3 The FWS comment was noted, and revisions were made to the referenced text.

FWS-4 A revision was made to this Supplemental EIS to reflect the correct appendix, which is now **Appendix D**.

FWS-5 The FWS comment was noted, and a revision was made to the text.

FWS-6 Comment noted. The subject paragraph was deleted in response to other comments and due to the confusion it caused. As noted in **Chapter 1.5**, operators are required to submit modeling data when certain screening thresholds are exceeded. The BOEM Environmental Studies Program (ESP) funds studies to obtain information needed for NEPA assessment and for the management of environmental and socioeconomic impacts on the human, marine, and coastal environments that may be affected by OCS oil and gas development. The ESP studies were used by BOEM's Gulf of Mexico OCS Region analysts to prepare this Supplemental EIS. In the absence of available ESP data, BOEM utilizes credible data from other State and Federal agencies where applicable.

FWS-7 The FWS comment was noted, and a revision was made to the text.

FWS-8 The BOEM subject-matter experts have used the relevant and scientifically credible information available at the time to prepare their analyses. Fraser and Ellis (2008) compared oil-spill frequency predictions in advance of a project with observed data during and after. For this proposed action, the predicted number of spills is based on the estimated range of crude oil volume to be handled as a result of the lease sale. Because nearly all of the spills are ≤1 bbl (based on historical data) and because the scenario includes such a wide range in oil production, BOEM's ability to correctly predict spills resulting from the proposed action in a manner similar to Fraser and Ellis (2008) is not compatible with a single lease sale within the context of multiple lease sales over time in a single planning area.

FWS-9 The text has been edited in multiple locations in this Supplemental EIS to indicate that the discussion is of reported spills, which may not include all spills.

FWS-10 A discussion on manatee distribution and abundance is provided in the threatened and endangered species subsection in **Chapter 4.1.1.11.1**.

FWS-11 Language in **Chapter 4.1.1.11.2** indicates that coastal and nearshore support activities, such as marine debris and vessel strikes, could impact marine mammals, which includes manatees. In addition, Chapter 4.2.2.1.5 of the Multisale EIS provides a discussion of vessel strikes and manatees.

FWS-12 Clarifying language has been added to this Supplemental EIS.

FWS-13 Clarifying language has been added to this Supplemental EIS, and additional information is presented in Chapter 4.2.2.1.6 of the Multisale EIS.

FWS-14 Clarifying language has been added to **Chapter 4.1.1.13.2**.

FWS-15 Clarifying language has been added to **Chapter 4.1.1.14.1**.

FWS-16 Clarifying language has been added to **Chapter 4.1.1.14.1**.

FWS-17 Additional language on the Mississippi sandhill crane and wood stork has been added to **Chapter 4.1.1.14.1**.

FWS-18 Clarifying language has been added to **Chapter 4.1.1.14.1**

FWS-19 The language in this Supplemental EIS has been corrected.

FWS-20 To date, the primary equipment need identified by BOEM that could greatly reduce spill duration and spill impacts is subsea containment equipment. To address this need, BOEM issued NTL 2010-N10, which provides that an operator should submit information demonstrating that it has access to and can deploy containment resources that would be adequate to properly respond to a blowout or other loss of well control while conducting activities that require approval of a permit to drill (APD/RPD, AST/RST, or ABP/RBP) and involve the use of a subsea BOP system, a floating drilling rig equipped with a surface BOP system, or a drilling rig on a floating platform. Having this equipment available and onsite within weeks instead of months, as was the case during the DWH spill, should greatly reduce the spill duration and associated spill impacts. These new requirements and details regarding this equipment are included in **Chapter 3.2.1.5.1**. Although these new regulatory programs and increased containment capabilities reduce both the risk of a catastrophic spill and the duration of such an event, **Appendix B** includes an analysis of the potential impacts of such a spill in the unlikely event that it occurs and is meant to be conservative in its approach.

FWS-21 Clarifying language on the least tern has been added to **Appendix B**. A discussion of the endangered whooping crane, Mississippi sandhill crane, and wood stork has been added to **Appendix B**.

FWS-22 The language has been corrected.

FWS-23 A special OSRA run was conducted in order to estimate the impacts of a possible future catastrophic spill. Thus, the goal of this analysis was to emphasize a spill that continued for 90 consecutive days.

The traditional OSRA run does use historical spill rates based on Anderson and LaBelle (2000) and earlier work. The Anderson and LaBelle (2000) study has recently been updated. Although it is still in draft form, the new information has been incorporated into **Table 3-5**. Future OSRA runs will use this updated historical spill rate information.

LANCE R. LEFLEUR
DIRECTOR

ADEM

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ROBERT J. BENTLEY
GOVERNOR

August 15, 2011

Mr. Joseph A. Christopher, Regional Supervisor
Leasing and Environment (MS 5400)
Bureau of Ocean Energy Management
Gulf of Mexico OCS Region
1201 Elmwood Park Boulevard
New Orleans, LA 70123-2394

RE: Alabama Response to the Gulf of Mexico (GOM) Outer Continental Shelf (OCS) Central Planning Area Oil & Gas Lease Sale 216/222
Draft Supplemental Environmental Impact Statement (SEIS)
ADEM Tracking ID: 2011-306-BOEMRE

Dear Mr. Christopher:

This office has completed its review of the Bureau of Ocean Energy Management Regulation and Enforcement (BOEMRE) Draft SEIS for the proposed consolidated lease sale 216/222 for OCS Central Planning Area activities in the Gulf of Mexico. The ADEM offers the following comments for your consideration.

ADEM-1

The ADEM continues to recognize that, historically, Alabama Governors have been opposed to leases within 15 miles of the Baldwin County, Alabama coast. Therefore, the ADEM supports *Alternative C* for proposed Central Planning Area GOM Lease Sales which offers for lease all un-leased blocks in the Central Planning Area as described for the proposed action with the exception of any un-leased blocks within 15 miles of the Baldwin County, Alabama coast. Further, the ADEM requests that BOEMRE provide adequate protection for the live bottom areas, pinnacle reefs, chemosynthetic communities and other sensitive environments within the OCS off Alabama's coast.

Call or write Allen Phelps anytime with questions. He may be reached by phone [251] 432-6533 or e-mail at: cap@adem.state.al.us.

Sincerely,

Steven O. Jenkins, Chief
Field Operations Division

c: Dr. Berry (Nick) H. Tew, Jr., Geological Survey of Alabama
Phillip Hinesley, ADCNR Coastal Section
Bonnie Johnson, BOEMRE Leasing & Environment

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ADEM-1 Comment noted. If the ASLM's decision is to hold a lease sale under either Alternative A, B, or C, it will be announced in the Final Notice of Sale. The BOEM may apply a number of lease sale mitigations and stipulations to minimize the impacts of oil and gas exploration and development. **Chapter 2.2.2.1** discusses these mitigations and stipulations, including the Topographic Features Stipulation. Additionally, a number of site-specific mitigations for environmental protection and safety are routinely applied by BSEE at the post-lease stage. All exploration plans, development plans, and pipeline applications are thoroughly reviewed to determine what protective measure(s) should to be included as a condition of plan or permit approval. Mitigations and stipulations are developed as conditions warrant and are subject to a review and approval process.

From: Beth Altazan-Dixon [mailto:Beth.Dixon@LA.GOV]
Sent: Friday, July 15, 2011 10:06 AM
To: Goeke, Gary
Subject: DEQ SOV 110711/1825 US Dept of Interior-Gulf of Mexico OCS

July 15, 2011

Joseph A. Christopher, Regional Supervisor
US Dept. of the Interior-Gulf of Mexico-OCS Region
1201 Elmwood Park Blvd
New Orleans, LA 70123
gary.goeke@boemre.gov

RE: 110711/1825 US Dept of Interior-Gulf of Mexico OCS
Oil and Gas Lease Sale: 2012-Draft Supplemental EIS
Central Planning Area Lease Sale 216-222
Coastal Parishes

Dear Mr. Christopher:

The Department of Environmental Quality (LDEQ), Business and Community Outreach Division has received your request for comments on the above referenced project.

LADEQ-1

After reviewing your request, the department has no objections based on the information provided in your submittal. However, for your information, the following general comments have been included. Please be advised that if you should encounter a problem during the implementation of this project, you should immediately notify LDEQ's Single-Point-of-contact (SPOC) at (225) 219-3640.

- Please take any necessary steps to obtain and/or update all necessary approvals and environmental permits regarding this proposed project.
- If your project results in a discharge to waters of the state, submittal of a Louisiana Pollutant Discharge Elimination System (LPDES) application may be necessary.
- If the project results in a discharge of wastewater to an existing wastewater treatment system, that wastewater treatment system may need to modify its LPDES permit before accepting the additional wastewater.
- All precautions should be observed to control nonpoint source pollution from construction activities. LDEQ has stormwater general permits for construction areas equal to or greater than one acre. It is recommended that you contact the LDEQ Water Permits Division at (225) 219-3181 to determine if your proposed project requires a permit.
- If your project will include a sanitary wastewater treatment facility, a Sewage Sludge and Biosolids Use or Disposal Permit application or Notice of Intent must be submitted no later than June 1, 2011. Additional information may be obtained on the LDEQ website at http://www.deq.louisiana.gov/portal/tabid/2296/Default.aspx or by contacting the LDEQ Water Permits Division at (225) 219- 3181.
- If any of the proposed work is located in wetlands or other areas subject to the jurisdiction of the U.S. Army Corps of Engineers, you should contact the Corps directly regarding permitting issues. If a Corps permit is required, part of the application process may involve a water quality certification from LDEQ.
- All precautions should be observed to protect the groundwater of the region.
- Please be advised that water softeners generate wastewaters that may require special limitations depending on local water quality considerations. Therefore if your water system improvements

include water softeners, you are advised to contact the LDEQ Water Permits to determine if special water quality-based limitations will be necessary.

- Any renovation or remodeling must comply with LAC 33:III.Chapter 28, Lead-Based Paint Activities; LAC 33:III.Chapter 27, Asbestos-Containing Materials in Schools and State Buildings (includes all training and accreditation); and LAC 33:III.5151, Emission Standard for Asbestos for any renovations or demolitions.
- If any solid or hazardous wastes, or soils and/or groundwater contaminated with hazardous constituents are encountered during the project, notification to LDEQ's Single-Point-of-Contact (SPOC) at (225) 219-3640 is required. Additionally, precautions should be taken to protect workers from these hazardous constituents.

Additionally, based on the information provided, the Assessment Division has no comments regarding this project. However, if the project scope changes in the future, please notify LDEQ before implementation.

Please send all future requests to my attention. If you have any questions, please feel free to contact me at (225) 219-3958 or by email at beth.dixon@la.gov.

Sincerely,

Beth

Beth Altazan-Dixon
Performance Management
LDEQ/Business and Community Outreach Division
Office of the Secretary
P.O. Box 4301 (602 N. 5th Street)
Baton Rouge, LA 70821-4301
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Fx: 225-325-8148
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LADEQ-1 Comment noted. It is the applicant's responsibility to comply with all applicable Federal, State, and local laws and regulations.

BOBBY JINDAL
GOVERNOR

SCOTT A. ANGELLE
SECRETARY

State of Louisiana
DEPARTMENT OF NATURAL RESOURCES
OFFICE OF COASTAL MANAGEMENT

August 3, 2011

Mr. Gary D. Goeke, Chief
Environmental Assessment Section, Leasing and Environment (MS 5410)
Bureau of Ocean Energy Management, Regulation and Enforcement
Gulf of Mexico OCS Region
1201 Elmwood Park Boulevard
New Orleans, Louisiana 70123-2394

RE: **C20110279 -** Comments on the Draft Supplemental Environmental Impact Statement (DSEIS) for Proposed OCS Oil and Gas Consolidated Lease Sale 216/222 in the Gulf of Mexico's Central Planning Area (CPA)

Dear Mr. Goeke:

The Office of Coastal Management (OCM) has been invited to comment on the DSEIS which will update the April, 2007, Multisale Environmental Impact Statement (EIS) and the September, 2008, Supplemental Environmental Impact Statement (SEIS) for proposed Lease Sale 216/222 in the CPA. We anticipate the receipt of your consistency determination but here provide some preliminary remarks.

The State of Louisiana strongly supports offshore oil and gas development in the Gulf of Mexico, and the above referenced OCS Lease Sale in particular. We look forward to a full return to responsible exploration and the resulting increase in economic and energy security. The recent retreat in offshore drilling has not only impacted communities and businesses in Louisiana, but its effects have reverberated throughout the nation and will continue to be felt for some time. Energy prices and associated insecurity issues have undoubtedly contributed to the nation's difficult economic climate. A continued drop in Gulf energy production compromises not just our strength in Louisiana, but also the nation's position globally. Energy production is critical to the economic recovery of this country and Gulf of Mexico resources, along with the onshore infrastructure of this State, are a vital part of the comeback.

OCM finds that in general, this DSEIS provides a credible assessment of the significant direct impacts to the natural and human environments of the Gulf. OCM believes that the Bureau of Ocean Energy Management, Regulation, and Enforcement (BOEMRE) must better address the potential indirect and secondary impacts to coastal resources that may result from proposed Lease Sale 216/222 through its National Environmental Policy Act (NEPA) evaluation.

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LADNR-1

As stated in our 2009 white paper, *Minerals Management Service Environmental Documents for Outer Continental Shelf Lease Sales in the Gulf of Mexico*, the data sources, predictive techniques and impact analyses used in this DSEIS, as in the earlier EIS and SEIS, are not well validated and their descriptions lack detail. In order to be fully compliant with NEPA, BOEMRE must adequately address all potential impacts that may result from a lease sale: direct, indirect and cumulative. Furthermore, OCM strongly encourages BOEMRE to develop plans to mitigate for these secondary and cumulative impacts through the NEPA process.

LADNR-2

Onshore impacts associated with these lease sales should be thoroughly quantified during the NEPA process. OCM is encouraged that BOEMRE has dedicated considerable resources to the study of land loss associated with navigation canals heavily utilized by the oil and gas industry. OCM urges BOEMRE to fully quantify the full suite of secondary and cumulative onshore environmental impacts likely to result from this Lease Sale. While impacts may sometimes be attributed to specific petroleum activities, it is often not possible to identify the specific activity responsible because many such losses result along waterways traveled in common by all users, and from a multitude of indirect and secondary effects of petroleum development activities. A thorough NEPA process should explore all options to mitigate to the full extent, and we urge BOEMRE to recognize this need and use the NEPA process to provide for the means to offset these losses.

Thank you for providing the opportunity to comment on the DSEIS for proposed Lease Sale 216/222. We appreciate your continued willingness to address Louisiana's concerns, and hope to see further improvements in BOEMRE's NEPA documents for future Lease Sales. Insuring that the best information is available to guide decision-making for oil and gas activity in the Gulf of Mexico facilitates offshore energy development in a safe and environmentally sustainable manner.

If you have any questions concerning these comments, please contact Jeff Harris of the Interagency Affairs/Field Services Division at (225) 342-7949.

Sincerely,

Louis E. Buatt, Assistant Secretary
Department of Natural Resources/Office of Coastal Management

LEB:pso

LADNR-1 The purpose of this Supplemental EIS is to evaluate any changes in baseline conditions, including those as a result of the DWH event and several hurricanes, and to determine if any of the impact conclusions presented in the Multisale EIS and the 2009-2012 Supplemental EIS need to be modified in light of these events. This Supplemental EIS is tiered from those EIS's and includes any additional information available since their publication. The issues identified by LADNR in this comment (i.e., data sources, predictive techniques, and impact analyses; direct, indirect, and cumulative impacts; and mitigation of direct, indirect, and cumulative impacts) have been responded to thoroughly in Chapter 5 of those EIS's, and those responses remain valid, as supplemented by the additional information and analyses included in this Supplemental EIS. As noted in **Chapter 2**, BOEM and BSEE may apply appropriate mitigations either as part of the lease sale, through stipulations, or at the post-lease stage, respectively.

LADNR-2 In comments on the Multisale EIS and the 2009-2012 Supplemental EIS, the State previously provided comments on the issue of onshore impacts associated with lease sales and the mitigation thereof. These comments have been responded to thoroughly in Chapter 5 of those EIS's, and those responses remain valid, as supplemented by the additional information and analyses included in this Supplemental EIS. The BOEM and BSEE would like to reiterate that we are neither the permitting agency nor the applicant for onshore pipelines, canal dredging, dredged material placement, or infrastructure construction. The primary permitting agencies for these onshore activities are COE and the State. Nevertheless, these and other potential onshore impacting factors are accounted for in the routine and cumulative impact analyses for resources in **Chapter 4**, where relevant.

West Florida
Regional Planning Council

J. D. Smith, Chair
Grady Hester, Vice-Chair

Terry A. Joseph, Executive Director

MEMORANDUM

DATE: August 17, 2011

TO: Gary Goeke
U.S. Department of the Interior
Bureau of Ocean Energy Management, Regulation and Enforcement
Gulf of Mexico OCS Region (MS 5410)
1201 Elmwood Park Blvd
New Orleans, LA 70123-2394

FAX: N/A

FROM: Terry Joseph, Executive Director, WFRPC
850-332-7976 Extension 201
terry.joseph@wfrpc.org

RE: WFRPC: Grant Application Project Description:

MJ848 07-07-11	Gulf of Mexico OCS Oil & Gas Lease Sale: 2012 Draft Supplemental Environmental Impact Statement Lease Sale 216/222

The Florida State Clearinghouse referred your grant application to the WFRPC Regional Clearinghouse for review. Section 4 of Gubernatorial Executive Order 95-359 provides that all federal applications which originate from non-state agencies, such as local governments and not-for-profit organizations, and which will have no significant effect on Florida's environment, are exempted from the intergovernmental coordination and review process overseen by the State Clearinghouse. Your application was referred to the WFRPC for review because the State Clearinghouse determined it meets exempted review requirements.

WFRPC-1

As required by the Executive Order, the staff of the West Florida Regional Planning Council has reviewed the above referenced proposed project under the Intergovernmental Coordination & Review Process (IC&RP) for consistency with the West Florida Strategic Regional Policy Plan (WFSRPP). **Based upon review of the information submitted, the Planning Council staff finds the proposal generally consistent with the WFSRPP, adopted July 15, 1996.** A finding of consistency with the West Florida Strategic Regional Policy Plan does not neccesarily affect eligibility or obligate funding of your project. For information about the WFSRPP, please see the WFRPC's web page www.wfrpc.org

X	Staff had no additional comments.
	Please find attached staff comments.

Pensacola
P.O. Box 11399
Pensacola, FL 32524-1399
P: 850.332.7976 • 1.800.226.8914
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F: 850.784.0456

www.wfrpc.org

2

If you have any questions concerning this communication, please refer to the WFRPC # listed above.

WFRPC-1 Comment noted.

ANADARKO PETROLEUM CORPORATION

TEL. 832/ 636-1000
P.O. BOX 1330 • HOUSTON, TEXAS 77251-1330

Anadarko

August 15, 2011

Mr. Gary D. Goeke *via e-mail at CPASupplementalEIS@boemre.gov*
Chief, Environmental Assessment Section
Leasing and Environment (MS 5410)
Bureau of Ocean Energy Management, Regulation and Enforcement
Gulf of Mexico OCS Region
1201 Elmwood Park Boulevard
New Orleans, LA 70123-2394

RE: Draft Supplemental Environmental Impact Statement for Lease Sale 216/222, Central Planning Area Gulf of Mexico

Dear Mr. Goeke:

Anadarko Petroleum Corporation (Anadarko) submits these comments for your consideration as the Bureau of Ocean Energy Management Regulation and Enforcement (BOEMRE) finalizes its analysis of the above-captioned draft supplemental environmental impact statement (DSEIS) released for public comment on July 1, 2011. 76 Fed. Reg. 38676. Anadarko is one of the largest independent oil and gas exploration companies, and we hold substantial lease interests in the Gulf of Mexico. As such, we have a strong interest in the continued orderly development of the oil and gas resources in the Gulf of Mexico.

The DSEIS supplements prior analyses conducted by BOEMRE for lease sales in the Gulf as set out in the document. In particular, this analysis supplements that prepared by the BOEMRE for the eleven lease sales proposed in the five year program for the years 2007-2012. Gulf of Mexico OCS Oil and Gas Lease Sales: 2007-2012 Western Planning Area Sales 204, 207, 210, 215 and 218; Central Planning Area Sales 205, 206, 208, 213, 216 and 222 Final Environmental Impact Statement (Multisale EIS, USDOI MMS 2007b) (Multisale EIS). BOEMRE further supplemented the analysis in the Multisale EIS with a supplemental EIS released in 2008, which analyzed the potential impacts from lease sales not yet held in the Central Planning Area (CPA) including 216 and 222. USDOI, MMS, 2008a (2008 Supplement).

The DSEIS for lease sale 216/222 analyzes the same three alternatives that were analyzed in the Multisale EIS and the 2008 Supplement. Under Alternative A, BOEMRE would offer for lease all unleased blocks within the Central Planning Area except for those blocks directly south of Florida and within 100 miles of the Florida coast; and those blocks that are beyond the U.S. Exclusive Economic Zone in the area known as the northern portion of the Eastern Gap.

Mr. Gary D. Goeke
Bureau of Ocean Energy Management, Regulation and Enforcement
August 15, 2011
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Alternatives B and C are the same as Alternative A but would further restrict blocks available for leasing. Alternative B would remove blocks near biologically sensitive topographic features, while C would remove blocks located within 15 miles of the Baldwin County, Alabama coast line. In addition to these three alternatives, as required by the National Environmental Policy Act (NEPA), 42 U.S.C. §§ 4321 *et seq.* BOEMRE also included a no action alternative as Alternative D. Under this alternative, none of the available lease blocks would be offered for lease.

ANAD-1

Anadarko strongly urges the BOEMRE to adopt Alternative A. The analysis in the document fully supports this alternative, especially when viewed in light of the extensive new regulations BOEMRE has put into place over the last year to address potential impacts from a spill similar to the Deepwater Horizon event. Alternative B and C are not reasonable given the acreage that would be removed from leasing. We strongly object to Alternative D as not supported by the analysis which found that the conclusions in the Multisale EIS and the 2008 Supplement remain valid. DSEIS at 4-5.

ANAD-2

In addition to adopting Alternative A, Anadarko urges BOEMRE to include the potential impacts of Lease Sale 213 in its final analysis. Lease Sale 213 was one of the eleven lease sales contemplated in the Multisale EIS, and it was included in 2008 Supplement. Prior to holding Lease Sale 213, BOEMRE prepared an environmental assessment in October of 2009 (Lease Sale 213 EA) for a scheduled sale in 2010. The environmental assessment was "prepared to aid in the determination of whether or not new available information indicates that the proposed lease sale would result in new significant impacts not addressed in the Multisale EIS or the Supplemental EIS." Lease Sale 213 EA at 1. "In preparation for this EA, the U.S. Department of the Interior (USDOI), MMS reexamined the potential environmental effects of proposed Lease Sale 213 and the alternatives based on any new information regarding potential impacts and issues not available at the time MMS published the Supplemental EIS in September 2008." *Id.* MMS determined that "[n]o new information was found that would necessitate a reanalysis of the impacts of proposed Lease Sale 213 upon any of the environmental or socioeconomic resources," and "[t]he analyses, potential impacts, and conclusions detailed in the Multisale EIS and the Supplemental EIS apply for proposed Lease Sale 213." *Id.* BOEMRE held CPA Lease Sale 213 in 2010, and accepted bids until March 16, 2010; thereafter, BOEMRE individually analyzed and approved bids. Several of these bids were accepted after the Deepwater Horizon incident.

The regulations implementing NEPA instruct agencies to prepare supplements to environmental impact statements if "[t]here are significant new circumstances or information relevant to environmental concerns and bearing on the proposed action or its impacts." 40 C.F.R. §1502.9(c)(1)(ii). In accordance with this regulation, the DSEIS states that it "was prepared because of the potential changes to baseline conditions of the environmental, socioeconomic, and cultural resources that may have occurred as a result of (1) the Deepwater Horizon (DWH) event between April 20 and July 15, 2010 …; (2) the acute impacts that have been reported or surveyed since that time; and (3) any new information that may be available."

Mr. Gary D. Goeke
Bureau of Ocean Energy Management, Regulation and Enforcement
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Page 3

ANAD-3

DSEIS at 1-3. Based on this analysis, BOEMRE will determine if new information is substantial enough to alter conclusions contained in the Multisale EIS and the 2008 Supplement and, if so, to disclose those changes. DSEIS at vii. Although the DSEIS assesses new information to update the Multisale EIS and the 2008 Supplement, the DSEIS currently limits the analysis to the potential impacts of Lease Sale 216/222. We believe this is unnecessarily restrictive and should be remedied in the final document.

ANAD-4

The DSEIS provides analyses of the impacts of oil and gas development generally; however, the DSEIS does not stand alone, nor is it intended to. In announcing its intention to prepare this DSEIS, BOEMRE stated that the SEIS would "update the environmental and socioeconomic analyses" in the Multisale EIS and the 2009-2012 SEIS. 75 Fed. Reg. 69122 (November 10, 2010). The DSEIS also states that it "tiers from the following EIS's: the Outer Continental Shelf Oil and Gas Leasing Program: 2007-2012, Final Environmental Impact Statement (5-Year Program EIS; USDOI, MMS, 2007c), which defined the national program; the Multisale EIS, which defined the 5-Year Program in the GOM; and the 2009-2012 Supplemental EIS." DSEIS at 1-4. Finally, the DSEIS states that it analyzes "*all new information available for the CPA* since the publication of the Multisale EIS and the 2009-2012 Supplemental EIS." DSES at vii (emphasis added). Because the EA for Lease Sale 213 is tiered to these same documents and was specifically included in the broader analyses, any supplementation of these documents reasonably applies to all of the lease sales analyzed in the previous documents.

<u>CPA Lease Sale 213 is Similar to the Proposed Lease Sale 216/222</u>

CPA Lease Sale 213 shares many characteristics with proposed Sales 216 and 222, and should also be covered by the DSEIS. CPA Lease Sales 213, 216, and 222 previously were considered jointly based upon shared characteristics and in accordance with applicable NEPA regulations. CEQ regulations provide that agencies may consider broad actions geographically, including actions occurring in the same general location, such as body of water, region, or metropolitan area, or generically, including actions which have relevant similarities, such as common timing, impacts, alternatives, methods of implementation, media, or subject matter. 40 C.F.R. §1502.4. BOEMRE has applied this concept in previous NEPA documents. For example, the Multisale EIS states that "[f]ederal regulations allow for several related or similar proposals to be analyzed in one EIS (40 CFR 1502.4). Since the proposed lease sales in each lease sale area and their projected activities are very similar, MMS prepared a single EIS for the 11 WPA and CPA lease sales in the proposed 5-Year Program." Multisale EIS at 1-3. The proposed sale area reviewed by this DSEIS encompasses the same area as that reviewed in the CPA Lease Sale 213 EA. *See* DSEIS at A-3; Lease Sale 213 EA at 3. Both the DSEIS and the Lease Sale 213 EA use virtually identical descriptions of the lease sale area and substantially similar estimates of the amount of estimated resources projected to be developed. *Compare* DSEIS at 1-4 *with* Lease Sale 213 EA at 5. The DSEIS accounts for possible additional production as a result of the additional leases under Lease Sale 216/222, and reviews impacts for similar alternatives, including Alternative B - Proposed Action Excluding the Unleased Blocks

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Near Biologically Sensitive Topographic Features - and Alternative C - Proposed Action Excluding the Unleased Blocks Within 15 Miles of the Baldwin County, Alabama, Coast. The cumulative impact analysis includes consideration of "all activities that are projected to occur from past, proposed, and future lease sales during the 40-year analysis period." DSEIS at x. Moreover, any drilling whether done pursuant to a lease issued under Lease Sale 216/222 or Lease Sale 213 would be subject to the same lease stipulations addressed in the DSEIS, *id.* at 1-7, as well as any new requirements and mitigation measures established in response to the *Deepwater Horizon* incident. And, "each exploration and development plan, as well as any pipeline applications that may result from the lease sale, will undergo a NEPA review, and additional project-specific mitigations are routinely applied as conditions of plan approval." *Id.* at 2-5. Thus, the findings in the DSEIS would similarly be considered in approvals for any activities conducted pursuant to the leases issued under Lease Sale 213.

ANAD-5

The Conclusions in the DSEIS Apply Equally to Lease Sale 213

ANAD-6

As noted above, the purpose of the DSEIS is to determine whether new information necessitates changes in the conclusions reached in the Multisale EIS and the 2008 Supplement. As Lease Sale 213 was considered under both the Multisale EIS and the 2008 Supplement, the conclusions in this supplement have a direct bearing on the leases covered under Lease Sale 213. The DSEIS concludes that "[n]o substantial new information, with the exception of archaeological resources, was found that would alter the impact conclusions as presented in the Multisale EIS and the 2009-2012 Supplemental EIS *for a CPA lease sale*."[1] DSEIS at x (emphasis added). This conclusion applies equally to Lease Sale 213, a substantially similar CPA lease sale.

Indeed, a comparison of the DSEIS with the Multisale EIS, upon which Lease Sales 213, 216, and 222 all tier, demonstrates that both reviews have reached many similar conclusions. For example, the DSEIS concludes that "[t]he routine activities of the CPA proposed action are unlikely to have significant adverse effects on the size and recovery of any sea turtle species or population in the Gulf of Mexico." DSEIS at xii. The 2008 Supplement similarly states that "routine activities of a proposed action are unlikely to have significant adverse effects on the size and recovery of any sea turtle species or population in the Gulf of Mexico." 2008 Supplement at xiii. With regards to air quality, both documents conclude that "[e]missions of pollutants into the atmosphere … are projected to have minimal impacts to onshore air quality…." 2008 Supplement at xi; DSEIS at x (same). Both conclude that proposed activities "are not expected

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[1] BOEMRE reexamined the analysis for archaeological resources presented in the Multisale EIS and the 2009-2012 Supplemental EIS, and found substantial new information that alters the impact conclusion for archaeological resources presented. DSEIS at 2-22. This new information stems from BOEMRE-sponsored studies and industry surveys; specifically, reports of damage to significant cultural resources (i.e., historic shipwrecks) have been confirmed in lease areas >200 m (656 ft) deep where no survey data was available. *Id.* at 2-23. BOEMRE found that the exact cause of this damage is unknown, but it may be linked to postlease, bottom-disturbing activities. The DSEIS notes that, "[a]s part of the environmental reviews conducted for postlease activities, available information will be evaluated regarding the potential presence of archaeological resources within the proposed action area to determine if mitigation is warranted." *Id.*

Mr. Gary D. Goeke
Bureau of Ocean Energy Management, Regulation and Enforcement
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ANAD-7

to have long-term adverse effects on the size and productivity of any marine mammal species or population endemic to the northern Gulf of Mexico." 2008 Supplement at xiii; DSEIS at xii (same). Both assessments are replete with these types of similar, in some cases identical, conclusions. Applying these conclusions to Lease Sale 213 would demonstrate that BOEMRE has considered the environmental impacts of this lease sale in a post-*Deepwater Horizon* setting and has determined that it has taken all appropriate actions to ensure that the lease sale fully complies with all environmental statutes and regulations.

ANAD-8

In numerous locations throughout the DSEIS, BOEMRE states that it is conducting a general update and supplement of past environmental assessments. In phrasing its findings, BOEMRE states that it has considered whether past conclusions should be altered for "a CPA lease sale." DSEIS at x. Yet, BOEMRE seems to limit its findings to just Lease Sale 216/222, rather than the entirety of the past assessments or, even, all CPA activities. This muddies the water and unnecessarily restricts the scope of BOEMRE's work. In the final SEIS, BOEMRE should clarify that the analysis is not confined to Lease Sale 216/222, but applies more broadly to other oil and gas leasing activities in the Gulf of Mexico, particularly Lease Sale 213.

Anadarko urges BOEMRE to expeditiously complete this document and issue a record of decision in accordance with the above comments.

Sincerely,

Ernest Leyendecker
Vice President, Gulf of Mexico Exploration

ANAD-1 Comment noted. The decision on which alternative will be selected will be made after the Supplemental EIS is finalized and, if the decision is to hold a lease sale under either Alternative A, B, or C, it will be announced in the Final Notice of Sale.

ANAD-2 The proposed action of this Supplemental EIS is proposed CPA Lease Sale 216/222, and the impact analysis was conducted on this proposed action. The CPA Lease Sale 213 was analyzed in the Multisale EIS, the 20007-2009 Supplemental EIS, and an Environmental Assessment, and the determinations made at that time still apply to that action. The CPA Lease Sale 213 was held in 2010; therefore, the Federal action is complete and not subject to any additional prelease NEPA evaluation. It would be inappropriate to include previously completed lease sales in this Supplemental EIS, as there is no Federal action to be taken on those lease sales at this time. Nevertheless, while CPA Lease Sale 213 is complete and not subject to additional NEPA review at this time, BOEM acknowledges that this Supplemental EIS covers environmental concerns that may be equally applicable to other lease sales in the CPA, as it includes new information available since the preparation of prior NEPA documents and the DWH event. As such, the information in this Supplemental EIS may likewise be relevant to an analysis of potential environmental impacts of CPA Lease Sale 213.

ANAD-3 See the response to Comment ANAD-2.

ANAD-4 See the response to Comment ANAD-2.

ANAD-5 See the response to Comment ANAD-2.

ANAD-6 See the response to Comment ANAD-2.

ANAD-7 See the response to Comment ANAD-2.

ANAD-8 See the response to Comment rANAD-2.

August 16, 2011

Mr. Gary D. Goeke
Chief, Environmental Assessment Section
Leasing and Environment (MS 5410)
Bureau of Ocean Energy Management, Regulation and Enforcement
Gulf of Mexico OCS Region
1201 Elmwood Park Boulevard
New Orleans, Louisiana 70123-2394

Via E-mail to CPASupplementalEIS@boemre.gov

Dear Mr. Goeke:

The American Petroleum Institute (API) offers the following comments on the Draft Supplemental Environmental Impact Statement (SEIS) for Gulf of Mexico (GOM) Central Planning Area (CPA) Lease Sale 216/222 in the 2007–2012 Five-year OCS Leasing Program that the Bureau of Ocean Energy Management, Regulation, and Enforcement (BOEMRE or Agency) published in the Federal Register on November 10, 2010 and corrected November 16, 2010. The API is a national trade association that represents over 470 members involved in all aspects of the oil and natural gas industry, including exploring for and developing oil and natural gas resources in the GOM.

API supports the analysis made by the BOEMRE in the Central Planning Area Lease Sale 216/222 Draft Supplemental Environmental Impact Statement (OCS EIS/EA BOEMRE 2011-027). Last November, when announcing this Draft Supplemental Environmental Impact Statement (DSEIS), BOEMRE stated that the SEIS is intended to "update the environmental and socioeconomic analyses" in prior "tiering" EIS documents by considering "new circumstances and information arising, among other things, from the Deepwater Horizon blowout and spill." Corrected Notice of Intent to Prepare a Supplemental Environmental Impact Statement, 75 Fed. Reg. 70023 (Nov. 16, 2010). When completed, the SEIS will be used to "inform future decisions regarding the approval of operations, as well as leasing." *Id.* API believes that the detailed analysis provided in the DSEIS, along with the other supporting environmental documents and additional assessments being conducted by BOEMRE, provide a thorough analysis upon which to make decisions related to Lease Sale 216/222, new or revised exploration and development plans in the Central Planning Area, and future permit applications, without delay. API also supports BOEMRE's continued practice of tiering Environmental Impact Statements and Environmental Assessments (EISs/EAs) under the National Environmental Policy Act (NEPA).

Alternatives Considered in the SEIS

API-1

The alternatives that the DSEIS considers are those that were included in the Multisale EIS and the 2009-2012 Supplemental EIS. Of these, API supports Alternative A – the proposed action. Alternative A would offer for lease all unleased blocks within the Central Planning Area for oil and gas operations, except:

1. blocks directly south of Florida and within 100 miles of the Florida coast; and,
2. blocks that are beyond the U.S. Exclusive Economic Zone in the area known as the northern portion of the Eastern Gap.

API is opposed to alternatives B, C, and D. Alternative B is the proposed action except that blocks near biologically sensitive topographic features (subject to the Topographic Features Stipulation) would be excluded from Leasing. Alternative C is the same as the proposed action except that OCS blocks located within 15 miles of the Baldwin County, Alabama coast line would be excluded from leasing. Alternatives B and C would needlessly remove potential lease blocks from future leasing. Alternative D is the "No Action Alternative" and would result in no OCS blocks being offered in Lease Sales 216/222. The analysis in the DSEIS does not support the adoption of such restrictive alternatives. API strongly urges BOEMRE to adopt Alternative A.

Key Conclusions of the SEIS

API fully supports the Agency's fundamental conclusion in the DSEIS that, *"The data obtained to support the conclusions within this Supplemental EIS indicate that, even though the environmental baseline in the CPA was changed by the DWH event, the expected level of impacts to the physical, environmental, and socioeconomic resources due to the proposed CPA Lease Sale 216/222 are substantially the same as those presented in the Multisale EIS and the 2009-2012 Supplemental EIS, the documents from which this Supplemental EIS is tiered. There is no reason to believe that any additional information would alter the conclusions."* (CPA 216/222 DSEIS at page 4-5). In addition, BOEMRE concludes that adequate information is available today to support the conclusions in the DSEIS (DSEIS at page 4-5). API further believes that the regulatory and operational changes that have been implemented since the DWH event effectively minimize the potential of future accidents to result in any significant effects providing support for both BOEMRE's conclusions and the adoption of Alternative A.

Many studies and data collection efforts are currently underway as a part of the Natural Resources Damage Assessment process. These along with other studies that have been or are being conducted will contribute to the scientific understanding of the DWH event. The ongoing nature of these studies, which are likely to continue for decades, does not diminish or adversely affect the Agency's ability to conclude that *"There is no incomplete or unavailable information that is deemed relevant to making a determination regarding reasonably foreseeable significant adverse impacts* [of new leasing operations in the CPA] *or that is essential to a reasoned choice among alternatives."* (See DSEIS at pages 4-5 and 4-6). API agrees with BOEMRE's conclusion at page 4-6 that *"... based on the information known at this time, there is no reason to believe that the conclusions reached in the Multisale EIS, which included proposed CPA Lease Sale 216/222, have been altered or changed by the DWH event."*

Suggestions for Finalizing the SEIS

API-2

While API believes that BOEMRE's DSEIS for CPA Lease Sale 216/222 is well written and supported by references to applicable scientific studies, as with any such endeavor, the document could be made even stronger. In particular, there is more recent scientific information related to the DWH oil spill that should be discussed. API recognizes the need for a "cut-off point" for new information so that the administrative process for finalizing the SEIS can proceed. Nonetheless, many of the scientific reports that have been published since the DSEIS for Lease Sale 216/222 was originally prepared would be helpful in understanding the effects of the DWH event and could further inform the NEPA process for Lease Sale 218. Updating the SEIS to include reports published through the close of the DSEIS comment period will provide for a more complete public disclosure.

To this end, API submits two enclosures to this letter that provide additional detailed comments citing additional sources and information for consideration in enhancing the draft SEIS issued for public comment. Enclosure 1, *API General Comments on the DSEIS for Lease Sale 216/222*, is a table that presents API comments that generally reference a specific section or page within the DSEIS or, in some cases, address more general issues. Enclosure 2, *Detailed Technical Comments on CPA Lease Sale 216/222 DSEIS*, is focused on describing recent scientific findings that are helpful in understanding the impacts of oil and gas operations on specific resource areas (e.g., water quality, air, fish, marine mammals, etc.). Enclosure 2 describes a large body of recent scientific research concerning the DWH event that will be helpful in more fully describing the potential consequences of a large offshore oil spill. API offers both Enclosures 1 and 2 for the Agency's consideration in developing the final SEIS for Lease Sale 218.

In addition to the comments included in the enclosures, API offers the following additional suggestions for consideration by BOEMRE.

1. Particular areas in which additional information is available.

The following discussion identifies sources that we believe provide information that would be of particular value in updating the SEIS.

API-3

API notes that the Operational Science Advisory Team (OSAT) produced two important reports for the U.S. Coast Guard Federal On-Scene Coordinator, which should be included in the final SEIS. The OSAT I report, *Summary Report for Sub-Sea and Sub-Surface Oil and Dispersant Detection: Sampling and Monitoring* (December 17, 2010), provides information on the behavior of oil spilled during the DWH incident and presents the results of extensive water column and sediment sampling for both oil and dispersant indicators. A recent Ecotoxicity Addendum to the OSAT I report was published on July 8, 2011 that provides additional information on subsea and subsurface oil and dispersant detection and toxicity. The OSAT II report, *Summary Report for Fate and Effects of Remnant Oil in the Beach Environment* (Feb. 10, 2011), includes the results of extensive sampling and predictive modeling regarding the fate and effects of oil spilled during the DWH incident that subsequently stranded on Gulf Coast beaches. Taken together, the two reports (and the Ecotoxicity Addendum) provide substantial information regarding oil

API-3

and dispersants associated with the DWH oil spill. API recommends that the important information contained in these reports be summarized in the final SEIS to help provide a more complete picture of the environmental consequences of a large oil spill in deep water.

Importantly, the OSAT reports, and other additional sources cited in the Enclosures, provide further information addressing a number of key issues referenced in the draft SEIS. Thus, in discussing subsea benthic communities (and, more generally, the fate and distribution of oil released as a result of the DWH event), the OSAT I report provides far more comprehensive water sampling data, and data characterizing impacts on subsea sediments than was available at the time the CPA Lease Sale 216/222 DSEIS was prepared. This additional data allows analysis of such questions as (1) to what extent have concentrations of oil and/or dispersants that exceed aquatic toxicity benchmarks been detected outside the area surrounding the DWH well, and for what time period did such concentrations persist after the well was capped, (2) at what distances from the well site, and over what time periods, have concentrations of oil been detected in subsea sediments, and (3) what does sampling data indicate as to the amounts of oil that may remain in the subsea environment today. Similarly, the OSAT II report provides information about the extent and effectiveness of shoreline response activities in removing oil from near-shore and onshore environments and what potential impacts may be anticipated from oil that remains in these areas.

Moreover, sampling data collected by EPA and by OSHA/NIOSH provide extensive information indicating whether air quality was impacted at levels of regulatory concerns at myriad locations along the Gulf coastline, and at locations where response workers were. This data provides an objective basis to evaluate whether, and to what extent, coastal residents and response workers may have been exposed to harmful concentrations of air contaminants attributable to the DWH event. Similarly, data collected by the FDA provides much information helpful in evaluating whether seafood from the Gulf area has been found to contain detectable oil or dispersant residue.

2. Impacts from a catastrophic spill event

API-4

Appendix B represents an analysis of the potential environmental effects of a high-volume, extended-duration, catastrophic oil spill from a well blowout in the Gulf of Mexico. This information is a critical component of the SEIS and should be more effectively highlighted in the Executive Summary and appropriate sections of the document. API recommends that a brief summary of the findings of Appendix B, *Catastrophic Spill Event Analysis,* be included in the executive summary (currently at pages vii through xiv) and in Section 2. While the term, "catastrophic spill," is described in Appendix B, it is used in several places in Chapter 2 and beyond without prior definition (see page 2-10 at Coastal Barrier Beaches and Associated Dunes). At some point before these discussions, it would be helpful to refer the reader to the *Catastrophic Spill Event Analysis* in Appendix B, where a catastrophic spill is defined on pg. B-3.

3. Discussion of BOEMRE's recent rule changes

API suggests that BOEMRE enhance Section 1.3.1, Rule Changes Following the Deepwater Horizon Incident (see page 1-6), to more completely describe the

API-5

administrative and regulatory changes made by the Agency following the DWH blowout and oil spill. Collectively, these changes have been implemented in an effort to further reduce the risk of future blowouts and oil spills on the U.S. Outer Continental Shelf. In particular, API suggests that this section summarize the intent and requirements of Notice to Lessees (NTL) 2010-N06, and NTL 2010-N10. These NTLs are listed but not summarized or explained in Section 1.3.1. In addition, the document should discuss the new capabilities being provided by the Marine Well Containment Company and Helix Energy Solutions Group to substantially improve the industry's ability to effectively respond to subsea oil spills, including blowouts. The SEIS should note that these new systems have been developed to meet BOEMRE requirements for deepwater spill control technology outlined in NTL 2010-N10.

Further, Section 1.3.1 describes the fact that the BOEMRE will institute "enhanced inspection procedures" but does not discuss any specifics regarding these enhancements. Any recent updates to the Agency's organization, procedures or regulations since publication of the DSEIS for Lease Sale 216/222 should also be discussed. It would be helpful to have a paragraph at the end of this section that summarizes BOEMRE's recent regulatory, administrative, and procedural changes made to address the issues that have been identified with respect to the DWH incident and further reduce the risk of similar incidents in the future. The SEIS for Lease Sale 216/222 needs to fully describe the substantial actions taken by BOEMRE since the DWH incident to minimize the risk of future blowouts and oil spills.

4. References to potential future impacts from the DWH event

API-6

When discussing several resource categories, the DSEIS mentions potential future impacts from the DWH event that are not fully supported by existing information and in a number of cases are inconsistent with such information. In discussing air quality impacts, for example, the DSEIS refers to a workshop held in New Orleans on June 22-23, 2010, and summarizes reports made there that *"[d]ue to volatile chemicals that evaporated from the oil spill into the atmosphere, people in the coastal areas have been experiencing sickness, fever, coughing, and lethargy."* (refer to page 4-18) This claim is inconsistent with the extensive body of personal breathing zone air quality data collected by the Unified Area Command, the US Coast Guard, and OSHA, for which the vast majority of the results were either non-detect or well below relevant occupational exposure limits. Other examples are discussed in Enclosures 1 and 2. API suggests that statements discussing future effects that are not supported by reliable, scientific information be corrected or removed.

5. Discussion of "Incomplete or Unavailable" Information

API's comments on the Draft SEIS for Western Planning Area, submitted on June 6, 2011, addressed in some detail the analysis in that document of instances in which the information available to BOEMRE was "incomplete or unavailable" within the meaning of 40 C.F.R. § 1502.22 ("Section 1502.22"). Like the Draft SEIS for the Western Planning Area, the Draft SEIS for the Central Planning Area that is the subject of this comment letter acknowledges numerous instances in which the information currently available to BOEMRE is "incomplete or unavailable" in this sense. API incorporates its comments in the June 6 letter on that subject, and adds the following further discussion with regard to the Draft SEIS for the Central Planning Area.

In the current Draft SEIS, BOEMRE acknowledges the requirement set forth in Section 1502.22 that, where potentially relevant information is incomplete or available, "the agency shall always make it clear that such information is lacking." (CPA 216/222 DSEIS, at 4-5). Throughout this document, BOEMRE has been careful to identify where particular information is not currently available, and to assess the possible relevance and importance of this information. Having done so, BOEMRE determined, after careful analysis, that there is "no incomplete or unavailable information that is deemed relevant to making a determination regarding reasonably foreseeable significant adverse impacts or that is essential to a reasoned choice among alternatives." (*Id.*, at 4-5 to 4-6). Moreover, after examining "the existing, credible scientific evidence that is relevant to evaluating the reasonably foreseeable, significant adverse impacts" of the proposed CPA Lease Sale 216/222, BOEMRE found "no reason to believe that any additional information" would change the conclusions in the current Draft SEIS. Through the foregoing analysis, BOEMRE has appropriately addressed the requirements of Section 1502.22.

API-7

BOEMRE's final SEIS for the Western Planning Area, issued on August 3, 2011, significantly expanded its analysis of "incomplete or unavailable" information compared to the Draft SEIS issued several months earlier. The changes made in the WPA final SEIS are similar in a number of respects to the enhanced analysis of "incomplete or unavailable" information in BOEMRE's draft Chukchi Sea SEIS, issued on May 20, 2011. In both cases, BOEMRE developed, and applied, a thoughtful and useful framework to evaluate information that is not currently available, and to make any required findings under Section 1502.22. API believes that a similar enhancement of the "incomplete or unavailable" information discussion in the current Draft SEIS would further strengthen BOEMRE's analysis of this issue, and could prove very helpful in further explaining and supporting its conclusions in this regard.

Three elements of BOEMRE's analysis in the final SEIS for the Western Planning Area seem most applicable here. First, in that document, BOEMRE grouped together into categories those Gulf of Mexico resources for which certain information is not currently available. (WPA final SEIS, at 4-6 to 4-9). These included (1) physical resources in the WPA, (2) non-mobile biological resources within the WPA, (3) mobile biological resources within or migrating through the WPA, (4) endangered and threatened species, (5) socioeconomic and cultural resources, and (6) resources for which data is being developed through the NRDA process. BOEMRE then addressed the "incomplete or unavailable" information issues presented by each category. (*Id.*) This grouping process allowed BOEMRE to drill down to a further level of specificity and precision in its analysis of the currently unavailable information.

Second, in addition to its analysis in the WPA Draft SEIS addressing whether information that is not currently available was "relevant" to significant adverse impacts and "essential to a reasoned choice among alternatives," BOEMRE provided an analysis of whether such information could be obtained at a cost that is not exorbitant or whether it could be obtained at all within a time frame pertinent to completing the NEPA process. (*See* WPA final SEIS, at 4-5 to 4-6). In doing so, BOEMRE was able to identify particular kinds of information (that currently being developed through the NRDA process, for example) that, even if relevant to the NEPA analysis, is simply not available within the time available or could not be obtained except at an exorbitant cost. (*Id.*, at 4-6 to 4-9).

Finally, in cases where potentially relevant information is not available within the time needed to complete the NEPA process, BOEMRE's subject matter experts applied "generally accepted scientific methodologies" and their "best professional judgment" to "extrapolate baseline conditions" and prepare "impact analyses" based on already existing credible data. (*See* WPA final SEIS, at 4-10). By doing so, BOEMRE's experts provided additional valuable information to the final SEIS.

API-8

Each of these three elements of BOEMRE's enhanced "incomplete or unavailable" information analysis in the Western Planning Area final SEIS is fully consistent with the requirements of Section 1502.22, and each served to further strengthen the analysis provided in that document. API recommends that BOEMRE apply these same elements in finalizing the current Draft SEIS.

In closing, the American Petroleum Institute strongly urges BOEMRE to expedite completion of the SEIS to allow for a resumption of regular lease sales in the Central Gulf of Mexico. Should you have any questions on these comments please contact me at (202) 682-8584 or by email at radforda@api.org.

Sincerely,

Andy Radford

API-1 Comment noted. If the ASLM's decision is to hold a lease sale under either Alternative A, B, or C, it will be announced in the Final Notice of Sale.

API 1-2 The BOEM has updated this Supplemental EIS since the publication of the Draft Supplemental EIS in order to consider relevant new information that has become available since the Draft Supplemental EIS; this includes published information relating to the DWH event. The incorporation of relevant information is time consuming, as it must be obtained and reviewed by subject-matter experts in the context of the source of the data, research methodology, and data quality. As is necessary under every NEPA analysis, at some point the subject-matter experts had to finalize their analyses to allow time for this Final Supplemental EIS to be prepared and presented to the decisionmaker.

API 1-3 The BOEM has updated this Supplemental EIS since the publication of the Draft Supplemental EIS in order to consider relevant new information related to the OSAT I and II reports. However, BOEM does not agree that this Supplemental EIS is the appropriate place to provide a summary of documents such as OSAT I and II. The full range of environmental consequences cannot be characterized at this stage by two documents that were specific to impacts to certain resources. The BOEM subject-matter experts have referenced the OSAT reports and other information, where relevant, in their individual resource analyses. The complete picture of the impacts of the DWH event will not emerge for several years, and this will be the result of much research. As such, BOEM subject-matter experts have identified where relevant information on significant adverse impacts remains incomplete or unavailable, have determined whether the information is essential to a reasoned choice among alternatives, and if so, whether the information can be obtained or whether the costs of doing so are exorbitant. If the information could not be obtained, what scientifically credible information was available was applied using accepted scientific methodologies.

API-4 Language has been added to the "Summary" and elsewhere in this Supplemental EIS, where appropriate, to clarify that the "Catastrophic Spill Event Analysis" is found in **Appendix B**.

API 1-5 This Supplemental EIS provides detailed descriptions of the administrative and regulatory changes made by BOEMRE following the DWH event and oil spill (**Chapter 1.3.1**), which are in effect to minimize the risk of future blowouts and oil spills. This chapter describes the regulatory framework already in place, requiring that the OCS leasing process and all activities and operations on the OCS comply with other Federal, State, and local laws and regulations. Since these documents are generally applicable and readily available from BOEM or on the Internet, detailed descriptions are unnecessary and duplicative in this Supplemental EIS. All NTL's are updated and fully described on BOEM's website. Where relevant to the NEPA analysis, BOEM has included information on containment capabilities, including but not limited to, the Marine Well Containment Company and Helix Energy Solutions Group.

API-6 Where the BOEM subject-matter experts felt it was appropriate, the document was revised to reflect newly available information or to clarify language.

API-7 **Chapter 4.1**, "Incomplete or Unavailable Information," has been revised. Where relevant information on reasonably foreseeable significant adverse impacts is incomplete or unavailable, the need for the information was evaluated to determine if it was essential to a reasoned choice among the alternatives and, if so, was either acquired or, in the event it was impossible or exorbitant to acquire the information, accepted scientific methodologies were applied in its place. In addition, individual resource analyses highlight where information was incomplete or unavailable.

API- 8 Comment noted. Similar revisions have been made to **Chapter 4.1** where appropriate.

API ENCLOSURE 1 (API1) C OMMENTS 1-6

API General Comments on the DSEIS for Lease Sale 216/222

NO.	DSEIS Section No.	PAGE NO.	COMMENT
1	General	N/A	API's comments provided on June 6, 2011 on the Draft Supplemental DEIS for Lease Sale 218 in the Western Planning Area are incorporated by reference. The comments provided are equally relevant to the CPA document.
2	General	N/A	The DWH event has drawn attention to the catastrophic spill event, which is slowly being recognized as a rare event yet one that cannot be ignored. BOEMRE in its NTLs and regulations published over the past year has required that applicants provide a more robust discussion of actions intended to reduce the frequency and severity of such events in their permit applications. A discussion of the new required risk management actions toward spill prevention and more importantly increased response resources and new technology should be addressed. A starting point could be the newly formed Marine Well Containment Company (MWCC), describing its mission, research and response programs. The MWCC resources should be considered reasonable and prudent mitigation for resource impacts if there is a catastrophic spill event. The Helix Energy Solutions Group deepwater spill containment capabilities should be discussed in similar fashion.
3	Summary	x	Recommend summarizing here what is "unavailable information" and why it is not essential or how decisions are made without this information. See the revised Chukchi Sea SEIS for Lease Sale 193 Appendix A as an example.
4	2.3.1.2	2-19	The Section 7 consultation among BOEMRE, USFWS and NMFS regarding the Gulf sturgeon is described as ongoing: "BOEMRE is in discussions with both agencies". In other sections of the document, different language is used: "discussions are on hold given the environmental baseline needing to be updated by the results of the NRDA process" (pp. 2-16, 2-17, 5-8). We suggest removing the inconsistency of the status in other parts of the document by using the former text rather than the later.
5	Section 4	4-3	In the second paragraph, first sentence, suggest revising "substantial enough" to "relevant and essential" new information as this is the applicable standard under NEPA. Recommend summarizing findings from DWH event since it is included but within "Catastrophic Spill Event" in Appendix B, or at a minimum, specifically referencing Appendix B.
6	Section 4.1	4-5	The nature of the incomplete and unavailable information is not specified. Especially in light of the DWH event, information is incomplete and could take years to become available yet we do know the

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API General Comments on the DSEIS for Lease Sale 216/222

API 1 COMMENTS 7-11

NO.	DSEIS Section No.	PAGE NO.	COMMENT
	Incomplete and Unavailable Information		kind of data that is being gathered (See Enclosure 2). BOEMRE should explain therefore how decisions are reached (as per API comments on previous WPA DSEIS) and in light of "incomplete and unavailable information".
7	4.1.1.3.4	4-58	The results of an investigation on the effects of the disposal of oiled sand on dune vegetation in Texas showed no deleterious impacts on existing vegetation or colonization of the sand by new vegetation (Webb, 1988). Hence, projected oil contacts to small areas of lower elevation sand dunes are not expected to result in destabilization of the sand dune area or the barrier landform. This study was specific to salt marsh not dunes.
8	4.1.1.11.2	4-200	The paragraph beginning with "The NMFS sets the 180-dB…" contains incorrect information. The following is a suggested correction: *The NMFS sets the 180-dB, root-mean-squared isopleth where on-set of auditory injury or mortality (level A harassment) to cetaceans may occur. Southall et al. (2007) suggest ~~this~~ a level ~~should rather be at~~ of 230 dB ~~root mean squared~~ (peak) (flat) for a nonpulsed discrete single event sound, such as drilling noise. Richardson et al. (1995) cited Greene (1986) and stated that drilling from semisubmersible vessels have estimated broadband frequencies from 80 to 4,000 Hz, with an estimated source level of 154 dB re 1µPa at 1 m.*
9	4.1.1.15	4-242	This section on Gulf sturgeon should be reviewed and adjusted to improve the discussion on this species. A 2009 Report by USFWS and NMFS "*Gulf Sturgeon: 5-Year Review: Summary and Evaluation*" could be referenced for additional information. Statements should be verified or cited if not common knowledge in the public literature.
10	4.1.1.15.3	4-249	Gulf sturgeon. The section pertains to **Impacts of Accidental Events**, but the second paragraph lists impact factors that are not relevant to this heading. For instance, produced-water discharges, vessel traffic, etc., would not be considered accidental events. BOEMRE should revise to exclude those factors.
11	4.1.1.15.3	4-249 & 250	Gulf sturgeon. The section pertains to **Impacts of Accidental Events**. It is unclear why this subsection contains so much information on the historical distributions of Gulf sturgeon. This would

API General Comments on the DSEIS for Lease Sale 216/222

API 1 COMMENTS 12-15

NO.	DSEIS Section No.	PAGE NO.	COMMENT
			more appropriately be considered existing condition information. BOMRE should move this information to the general discussion of Gulf sturgeon at the beginning of this section.
12	4.1.1.15.3	4-251	Gulf sturgeon. Under the heading **Proposed Action Analysis**, the section goes into detailed analysis of issues not related to the major heading, **Impacts of Accidental Events**. As noted above, the categories presented would not be considered under accidental events. Also, the majority of this section deals with impact information on PAHs. This is the only section that goes into this much detail on this single group of oil-related compounds. Is there a reason Gulf sturgeon will be any more susceptible to PAH contamination than other fish species? In the absence of such a connection, BOEMRE should revise this discussion to either shorten or delete the PAH portions. In addition, the potential PAH exposure of Gulf sturgeon should be reexamined in light of the findings of the OSAT 1 report and the recently published OSAT 1 Ecotoxicity Addendum (July 8, 2011) showing few exceedances of EPA's aquatic life benchmarks for PAHs in water following the DWH spill. The **Proposed Action** should provide a list of the number of facilities expected, as in other similar sections throughout the DSEIS to provide a better context for the analysis.
13	4.1.1.15.3	4-253	Gulf sturgeon. Several statements are made on the risk of hydrocarbons to human consumers of seafood without then relating this discussion back to sturgeon which is the focus of this section. Gulf sturgeon are a protected species and can not be legally harvested or eaten in the United States. BOEMRE should revise to provide the missing link or delete the references to risk from human consumption. Also, a statement is made about the dispersant causing oil to sink. This does not corroborate with information in the public forum that indicates dispersants were used for breaking up the oil so that microbial decomposition would be enhanced. Other sections of the DSEIS correctly state that dispersants were used to disperse oil within the water column. BOEMRE should remove the incorrect statement in this section.
14	4.1.1.15.4	4-254	Paragraph 1 indicates that there will be discussion on impact-producing factors later in the section, but fails to address produced-water discharges, and only vaguely mentions pipeline emplacement.
15	4.1.1.16.4	4-268	**Background/Introduction** – This section begins with a statement regarding cumulative impacts on 'commercial fishing'. This appears to be a section cut and pasted from 4.1.1.17.4. BOEMRE should review this section to verify that the information provided does, in fact, relate to fisheries and EFH

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API 1 COMMENTS 16-20

API General Comments on the DSEIS for Lease Sale 216/222

NO.	DSEIS Section No.	PAGE NO.	COMMENT
			specifically.
16	4.1.1.17	4-271	Please explain more clearly in the first paragraph the statement "Indirect impacts from routine activities to inshore...on commercial fisheries." This is confusing and there is no further explanation on what is intended by this statement.
17	4.1.1.17	4-273	First Paragraph: There are two statements regarding oil and its relevance to dissolved oxygen levels that are redundant. Omit one or the other.
18	Section 4- No Action	4-389	The reasoning behind not selecting this alternative should be strengthened beyond merely that the lease sale would be postponed. Additionally, the statement that "the cancellation of one lease sale would not significantly change the environmental impacts of overall OCS activity" seems to imply that there are environmental impacts nonetheless. By canceling the proposed lease sale, the opportunity is postponed (should this word be changed to avoided?) for development of the estimated 0.801-1.624 BBO and 3.332-6.560 Tcf of gas and the documents need to specify that this represents revenue of XXX to the private sector and tax/royalties to the public sector of XXX. Note that reported economic costs of the 6-month moratorium (postponement) on oil/gas activities imposed May 30, 2010 by BOEMRE due to DWH event effected 45 rigs, 5 drillships, 14 semisubmersibles, and 6 platform rigs in deepwater and XXX permitting activities; 9,450 direct offshore jobs; 13,797 indirect and induced jobs, rental and other costs; lost gross production revenues of $2.6 billion; and lost government revenues from taxes/royalties of $692 million, according to BOEMRE's assessment (DOI WDC –B05-00001-0007).
19	Appendix B Air Quality	B-6	BOEMRE should address 2010 NOAA study, "Organic Aerosol Formation Downwind from the Deepwater Horizon Oil Spill," by A. Middlebrook et al. that the lightest compounds in the oil from DWH blowout evaporated within hours, and that the heavier compounds, which took longer to evaporate, contributed most to the formation of air pollution particles downwind.
20	Appendix B	B-10	Section on Hard Bottom Habitats. BOEMRE should update reference to include NTL 2009 G40 (that supersedes NTL 2000 G20) as it broadens the scope to cover all high-density deepwater benthic communities (not just high-density chemosynthetic communities), changes the definition of deepwater from 400 meters (1,312 feet) to 300 meters (984 feet), increases the separation distance from muds and cuttings discharge locations from 1,500 feet to 2,000 feet, provides clarification on conditions of

ENCLOSURE 1

API1 COMMENTS 21-23

API General Comments on the DSEIS for Lease Sale 216/222

NO.	DSEIS Section No.	PAGE NO.	COMMENT
			approval, and provides for an additional 1,000-foot buffer area beyond maximum anchor areas. This NTL is mentioned in Deepwater Habitats on B-11.
21	Appendix B Archeological	B-12	In Section 2.2.3.1, BOEMRE states "The inadequacy of data related to these historic ship losses creates uncertainty in determining how many shipwrecks might be located near existing or planned oil and gas wells." BOEMRE should revise this sentence to reference BOEMRE's existing requirement for shallow hazard and ROV surveys in connection with individual plans as the data acquired to date will provide information needed to avoid significant impacts to archeological resources.
22	Appendix B	B-22	Localized areas of lethal effects would be recolonized by populations from neighboring soft-bottom substrate once the oil in the sediment has been sufficiently reduced to a level able to support marine life (Sanders et al., 1980). Update references, any results from the Ixtoc spill or other more recent studies.
23	Appendix B	B-37	In coastal wetlands, address use of booms, skimmers, etc. as mitigation effects, not precautions, and address their effectiveness in avoiding and minimizing impacts to these resources.

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API 1-1 Comment noted. Please see Chapter 5.11 of the WPA Lease Sale 218's Final Supplemental EIS for the letters of comment on the Draft Supplemental EIS and BOEMRE's responses (USDOI, BOEMRE, 2011b). For any revisions to the WPA Lease Sale 218's Final Supplemental EIS in response to public comments that were also appropriate for a CPA lease sale Supplemental EIS, BOEM attempted to carry forward these revisions to this CPA Lease Sale 216/222 Final Supplemental EIS. In addition to these document revisions, the subject-matter experts updated this Supplemental EIS with newly available and relevant information since publication of the Draft Supplemental EIS on July 1, 2011.

API 1-2 This Supplemental EIS provides detailed descriptions of the administrative and regulatory changes made by BOEM following the DWH event and oil spill (**Chapter 1.3.1**); these changes are in effect to minimize the risk of future blowouts and oil spills. This chapter describes the regulatory framework already in place, requiring that the OCS leasing process and all activities and operations on the OCS comply with other Federal, State, and local laws and regulations. Since these documents are generally applicable and readily available from BOEM or on the Internet, detailed descriptions are unnecessary and duplicative in this Supplemental EIS. All NTL's are updated and fully described on BOEM's website. Where relevant to the NEPA analysis, BOEM has included information on containment capabilities, including but not limited to, the Marine Well Containment Company and Helix Energy Solutions Group.

API 1-3 The discussion on unavailable information is discussed in **Chapter 4.1**. **Chapter 4** contains the impact analysis, and BOEM feels that this is the best location to discuss this issue.

API 1-4 Clarifying language on the current status of consultation has been incorporated into this Supplemental EIS where appropriate.

API 1-5 This sentence has been clarified. The BOEM subject-matter experts have included analyses of the DWH event where appropriate, whether in their individual resource analyses in **Chapter 4** or in **Appendix B**.

API 1-6 A general discussion on incomplete and unavailable information (**Chapter 4.1**) has been revised since the Draft Supplemental EIS. This revised version addresses API's comment. In addition, clarifying language has been added where appropriate in the individual resource analyses in **Chapter 4**.

API 1-7 Comment noted. Webb's 1988 paper, referenced in this Supplemental EIS in **Chapters 4.1.1.3.3 and 4.1.1.3.4**, is entitled "Establishment of Vegetation on Oil Contaminated Dunes." The purpose of this study was to determine if dune vegetation could grow in oiled dunes. The discussion here is related to dunes and beaches and not to salt marshes.

API 1-8 Clarifying language was added in **Chapter 4.1.1.11.2**.

API 1-9 In the Draft Supplemental EIS, the "Gulf Sturgeon: 5-Year Review" (USDOI, FWS and USDOC, NMFS, 2009) was utilized; however, the authors referenced within that report were individually cited. Therefore, in this Final Supplemental EIS, citations to the "Gulf Sturgeon: 5-Year Review" were modified to refer to the report as a whole rather than to the individual authors.

API 1-10 Revisions have been made to the text.

API 1-11 Revisions have been made to the text.

API 1-12 The API comment was noted, and revisions were made to the text regarding unnecessary information included with the "Impacts of Accidental Events" section. The PAH's have a history of occurrence in Gulf sturgeon tissue. The PAH's are insoluble in water but remain available in the bottom sediment. Various life stages of sturgeon are benthic feeders, making them more susceptible to uptake. Gulf sturgeon, being fish predators during parts of their life history, makes them more susceptible for at least bioconcentrating and possibly biomagnifying PAH's in their tissues.

Since the publication of the Draft Supplemental EIS on July 1, 2011, BOEM subject-matter expert have incorporated relevant information and have updated this Supplemental EIS accordingly, including information from both OSAT reports, which were not available at the time the Draft Supplemental EIS was prepared.

API 1-13 Comment noted. References to human consumption effects were removed from the Gulf sturgeon chapter. This Supplemental EIS has been updated to better describe the behavior of dispersed oil in relationship to effects on benthic habitat. Notably, the description acknowledges that generally, dispersed oil does not form an oil mat (usually emulsified and then easily biodegraded by existing microbial activity) on the bottom nor on the important benthic habitat used for forage by the Gulf sturgeon.

API 1-14 Produced water was only briefly mentioned since OCS wells are generally far removed from Gulf sturgeon habitat and their known ranging areas. There has been little to no current information collected acknowledging the occurrence of Gulf sturgeon in these deeper OCS waters.

Pipeline installation in OCS waters is not expected to impact Gulf sturgeon due to proximity of the work to the areas of known documented Gulf sturgeon occurrence. The following language was provided in the Draft Supplemental EIS:

> Pipeline placement may have the greatest potential for impact to Gulf sturgeon and their critical habitat from OCS pipeline connections to state pipelines or the potential for the one OCS pipeline landfall associated with the proposed action. Typical methods to lay pipeline can result in bottom and sediment disturbance, burial of submerged vegetation, reduced water clarity, reduced light penetration, and the resulting reduction of seagrass cover and productivity.

API 1-15 The API 1 comment was noted, and the revision was made to the text.

API 1-16 Comment noted. The sentence was revised.

API 1-17 Comment noted. Information was deleted to resolve the redundancy.

API 1-18 This Supplemental EIS is not a decision document; therefore, there is no reasoning "for not selecting" Alternative D, the No Action Alternative. No decision has been made at this time on which alternative may be chosen following completion of this Supplemental EIS. That decision is up to the decisionmaker and, if the ASLM's decision is to hold a lease sale under either Alternative A, B, or C, it will be announced in the Final Notice of Sale. The economic effect of the suspension of Gulf operations post-DWH are not the same as cancelling one lease sale. The suspension stopped ongoing operations, which resulted in economic costs to both the industry and government. These same impacts were not realized in the cancellation of previous lease sales and would not be expected in the event that this or other future lease sales are cancelled or postponed. Therefore, BOEM feels that the No Action Alternative discussion provided in **Chapter 4** adequately describes the effect of the cancellation of proposed CPA Lease Sale 216/222.

API 1-19 Comment noted. Additional language was added to Section 2.2.1.1 of **Appendix B**.

API 1-20 Comment noted. The comment references hard-bottom habitats but discusses the information discussed in the next section, which is Deepwater Habitats. The Deepwater Habitats section discusses NTL 2009 G40. The Hard Bottom Shelf Habitats section discusses the hard-bottom features found on the continental shelf. Clarification of the water depth was added to the Hard Bottom Shelf Habitats section.

API 1-21 Commend noted. Clarifying language was added to **Appendix B** to describe actions that may be required to identify and avoid archaeological resources that may be present within the proposed action area.

API 1-22 Comment noted. Additional relevant and updated references were added to **Appendix B**.

API 1-23 This language has been replaced and clarified in **Appendix B**.

August 16, 2011

Detailed Technical Comments on CPA Lease Sale 216/222 Draft Supplemental Environmental Impact Statement ("DSEIS")

General Statements

Analysis:

API 2-1

1. The DSEIS states that only a "few months of post-DWH data" are available. DSEIS at 3-27. API recommends that this statement be updated in light of the considerable research that has been produced in the year since the DWH event.

API 2-2

2. The DSEIS discusses estimates of gas volume released as a result of the DWH event. DSEIS at 3-45, 3-46. API recommends that this statement be updated to reflect the findings of Kessler et al. in their Sciencexpress Jan. 6, 2011 paper and Valentine et al.'s (2010) finding that gas emitted from the well contained 87.5% methane.

- References
  - Kessler, J. et al., A Persistent Oxygen Anomaly Reveals the Fate of Spilled Methane in the Deep Gulf of Mexico, Sciencexpress, (Jan. 6, 2011) (1199697)
  - Valentine, D. et al., Propane Respiration Jump-Starts Microbial Response to Deep Oil Spill, Science, (October 8, 2010) (1196830)

API 2-3

3. The DSEIS cites to certain internet resources for general information concerning the DWH event. DSEIS at 4-22, 4-33. Should these citations be updated to reflect current URLs?

- References
  - http://www.bp.com/sectionbodycopy.do?categoryId=41&contentId=7067505
  - http://www.restorethegulf.gov/

API 2-4

4. The DSEIS states, "Limited research is available for the biogeochemistry of hydrocarbon gases in the marine environment." DSEIS at 4-23. Does this statement reflect papers such as Kessler et al. Sciencexpress (Jan. 6, 2011), Kessler et al. Science (May 27, 2011), Valentine et al. (2010), and Yvon-Lewis et al (2011)?

- References
  - Kessler, J. et al., A Persistent Oxygen Anomaly Reveals the Fate of Spilled Methane in the Deep Gulf of Mexico, Sciencexpress (Jan. 6, 2011) (1199697)

- Kessler, J., et al., Response to Comment on "A Persistent Oxygen Anomaly Reveals the Fate of Spilled Methane in the Deep Gulf of Mexico", Science, (May 27, 2011)
- Valentine, D., et al., Propane Respiration Jump-Starts Microbial Response to Deep Oil Spill, Science, (October 8, 2010) (1196830)
- Yvon-Lewis, S.A. et al., Methane flux to the atmosphere from the Deepwater Horizon oil disaster, Geophysical Research Letters, (Jan.11, 2011)

API 2-5

5. The DSEIS states that "As a result of the DWH event, remnant oil is still being found either in the water column or on the bottom in some areas." DSEIS at 4-49. Should this statement be revised to reflect the conclusions of the Operational Science Advisory Team Summary Report for Sub-Sea and Sub-Surface Oil and Dispersant Detection: Sampling and Monitoring (December 17, 2010) ("OSAT I"), which indicates that very little oil remains in the Gulf environment with the potential to impact humans or natural resources, and no remnant oil is being found in the water column other than in certain shoreline areas? In addition, should the reference to "the bottom" be clarified to specify deepwater or nearshore environments? OSAT I reports that impacted sediment samples were limited to the deepwater zone within two miles of the wellhead, with isolated tar mats in some nearshore areas.

API 2-6

6. The DSEIS references "daily maps of the current location of spilled oil." DSEIS at 4-195, 4-202, 4-205, 4-211. Should these statements be updated in light of the findings of OSAT I to clarify that there is no longer a spill-related surface slick or a subsurface feature?

- References
  - Operational Science Advisory Team, Summary Report for Sub-Sea and Sub-Surface Oil and Dispersant Detection: Sampling and Monitoring, (Dec. 17, 2010) ("OSAT I")

API 2-7

7. The DSEIS states, "Most of the seafloor is not anticipated to experience any impact from the event." DSEIS at 4-363. Should this important statement be stated more prominently? In particular, could the OSAT I report results be summarized to support this finding?

Resources

Air

Analysis:

1. The DSEIS states, "In response to the recent DWH event, USEPA, and the affected States conducted extensive air quality monitoring along the Gulf Coast. The air monitoring conducted to date has found that the levels of ozone and particulates were at levels well below those that would cause short-term health problems (USEPA, 2010a). The air monitoring also did not find any pollutants at levels expected to cause long-term harm. However, it has been reported in the news that people along the coastal areas felt the effect of the toxic chemicals released from the DWH event and the sprayed dispersant." DSEIS at 4-7.

API 2-8

- Monitoring results reported by EPA, the State of Louisiana, and others (e.g., http://www.deq.state.la.us/portal/LinkClick.aspx?fileticket=zYigIsL2zQA%3D&tabid=2460 and http://www.epa.gov/bpspill/taga.html#dispdata) indicate no evidence that airborne chemical concentrations were sufficiently elevated to result in acute health effects. Instead, observed health effects may have been due to stress and other factors. The last sentence of Section 4.1.1.1.1 from the DSEIS should be deleted unless there is more definitive support for the statements. The SEIS should use the best available science and generally avoid references to news articles reporting anecdotal information.

API 2-9

- Did these findings on air monitoring pertain to USEPA data only, or include other agencies and organizations? Are further citations available?

- References
  - BP Oil Response Air Monitoring, National Air Toxics Workshop (April 5, 2011) (available at http://www.epa.gov/ttn/amtic/files/ambient/airtox/2011workshop/day2DaveShelowBPOilSpill.pdf)

API 2-10

2. The DSEIS states, "Tables 4-26 and 4-27 of the Multisale EIS list the highest predicted contributions to onshore pollutant concentrations from OCS activities, as well as the maximum allowable increases over a baseline concentration established under the air quality regulations." DSEIS at 4-12. Should this statement include the year the baseline concentration was established?

API 2-11

3. The DSEIS states, "Measurements of dioxins and furans during the DWH event in-situ burning were made (Aurell and Gullett, 2010)." DSEIS at 4-15. This statement should be clarified to state that these measurements were taken within the smoke plumes, far off-shore.

- The screening risk assessment published by EPA in ES&T (Schaum et al.) indicated that shoreline dioxin concentrations from in situ burns would be "much less than the measured air concentrations in rural locations in the United States" and found that incremental cancer risks for workers and the general public were below levels of regulatory concern.

- References

  - Schaum J. et al., Screening Level Assessment of Risks Due to Dioxin Emissions from Burning Oil from the BP Deepwater Horizon Gulf of Mexico Spill, Environmental Science & Technology (2010)

API 2-12 AND 13

4. The DSEIS states, "Following the DWH event, USEPA provided the TAGA bus, a mobile laboratory, to perform instantaneous analysis of air in coastal communities. Two ingredients in the Corexit dispersant were measured. Very low levels of dispersants were identified. Due to the distance to shore and an assumed accidental spill size of 15,000 bbl, it is unlikely that dispersants would be carried to onshore areas." DSEIS at 4-15. In addition, the EIS should be revised to include the following:

- As EPA has noted (http://www.epa.gov/bpspill/taga.html#dispdata), the Corexit ingredients that were monitored during the DWH event are also common ingredients in a number of household products. Therefore, their detection onshore does not equate to the detection of dispersants.

- Further, EPA has noted that there is no evidence that dispersant application resulted in a significant impact in onshore air quality (http://www.epa.gov/bpspill/taga.html#dispdata).

API 2-14

5. The DSEIS refers to "short-term and long-term effects" of the DWH event on public health, describes some short-term effects, and notes that "little is known about the long-term health effects of direct exposure to oil from the DWH event." DSEIS 4-21. Are the short-term effects described documented in connection with the spill? Is there a source that can be referenced for this? With respect to long-term effects, is there evidence that there will be such effects as a result of the spill? If not, API recommends that this statement be revised to refer to possible rather than actual effects, e.g., "any" long-term health effects rather than "the" long-term health effects.

API 2-15

6. The DSEIS states that the "VOC's [sic] benzene, a cancer-causing agent, has been found to be above Louisiana's ambient air quality standards." DSEIS at 4-18. This statement does not appear to be accurate and BOEMRE provides no citations to support this statement. In light of this, it should either be deleted or revised based on the following:

- This appears to be a comparison of short-term monitoring results taken during the response to Louisiana's annual ambient air quality standard for benzene. As Louisiana has noted, it is inappropriate to compare short-term samples to the annual average standard

API 2-15 (CONTINUED)

(http://www.deq.state.la.us/portal/LinkClick.aspx?fileticket=zYigIsL2zQA%3D&tabid=2460).

- Louisiana also reported no exceeding of state or federal standards as a result of the spill (by July 13, 2010; http://www.deq.state.la.us/portal/LinkClick.aspx?fileticket=zYigIsL2zQA%3D&tabid=2460)

- Nearly all water soluble or volatile oil components (such as benzene) had weathered away from the oil before the oil reached the shoreline. There is little potential for public exposure to benzene, given very low levels observed in near shore oil (*See, e.g.,* Gong et al. 2011 and Boehm et al. 2011 fingerprinting work and presentations at IOSC and SETAC).

    - "Benzene is highly water-soluble, suggesting that it too may have dissolved rapidly in the deep sea. Indeed, benzene concentrations were systematically elevated (0.4–21.7 μgL−1) in the 1,100-m-depth plume and nearly absent at depths shallower than 1,000 m (1) (Fig. 3, and Table S4). A comprehensive survey of hydrocarbons in air above the Macondo well site revealed that very little benzene reached the sea surface (24). Taken together, water column and surface measurements suggest that benzene was predominantly retained in the deep water column." Reddy, C. M. et al. 2011, Science Applications in the Deepwater Horizon Oil Spill Special Feature: Composition and fate of gas and oil released to the water column during the Deepwater Horizon oil spill. Proceedings of the National Academy of Science. July 18.

    - "For benzene (a known human carcinogen), essentially all of the leaked mass dissolved … and likely remained co-located below 800 m with the similarly soluble CH_4." "Benzene, ethane, and methane data are off scale due to negligible or zero atmospheric flux." Ryerson et al. 2011.

    - References

        - Boehm, P. et al., Aromatic Hydrocarbon Concentrations in Seawater: Deepwater Horizon Oil Spill, 2011 International Oil Spill Conference, (January 20, 2011)

        - Gong, C. et al., The Significant Impact of Weathering on MC252 Oil Chemistry and Its Fingerprinting of Samples Collected from the Sea Surface and Shore between May and November 2010, International Oil Spill Conference, (May 23-26, 2011)

        - Reddy, C. et al., Composition and fate of gas and oil released to the water column during the Deepwater Horizon oil spill, Proceedings of the National Academy of Science, (July 18, 2011)

- Ryerson, T, et al., Atmospheric emissions from the Deepwater Horizon spill constrain air-water partitioning, hydrocarbon fate, and leak rate, Geophys. Res. Lett., 38, (April 14, 2011).

API 2-15 (CONTINUED)

- Any elevations observed in on-shore benzene concentrations may have been the result of factors unrelated to the release. Benzene is released by vehicle emissions and a number of other background sources, and is considered the predominant background toxic air pollutant in Louisiana. http://www.deq.state.la.us/portal/LinkClick.aspx?fileticket=zYigIsL2zQA%3D&tabid=2460). Any elevated measurements may be due to weather conditions during the hot summer of 2010, different sampling methodologies, or the addition of such a large number of new monitoring locations. In general, background air monitoring stations are placed away from roads and potential background point sources (e.g., refineries). DWH air monitoring may have been conducted in locations that normally have higher benzene levels than background monitoring locations.

API 2-16

7. The DSEIS states, "In a catastrophic spill, dispersants may be sprayed to break up the slick. The dispersant mist would temporarily degrade the air quality. Health complaints were received from workers on adjacent rigs following dispersant application during the DWH event." DSEIS at 4-18. These statements should be revised to clarify that this discussion focuses on aerial dispersant application. During the DWH event, application of subsea dispersants was generally considered to prevent oil from reaching the surface and reduce VOC concentrations. (Atlas and Hazen 2011). Unless BOEMRE can provide citations to reliable documentation regarding the health complaints, these statements should be stricken from the document.

API 2-17

8. The DSEIS states, "Due to the volatile chemicals that evaporated from the oil spill into the atmosphere, people in the coastal areas have been experiencing sickness, fever, coughing, and lethargy." DSEIS at 4-18. Unless BOEMRE can cite to reliable documentation to support these statements, they should be stricken from the document. Moreover, this statement fails to account for the results of air monitoring conducted by EPA, which notes that volatile chemical concentrations "have been well below levels that would cause temporary discomfort, irritation, or other minor effects." http://www.epa.gov/bpspill/taga.html#tagadata.

API 2-18

9. The DSEIS states, "Some of these very dangerous compounds can remain in the air for a long period of time; therefore, no one can say with certainty that people will not have long-term effects from the DWH event." DSEIS at 4-18. This statement does not appear to be accurate with respect to the danger from the chemicals or their duration in the air. Normal atmospheric conditions would disperse any compounds in air quickly once the source was removed, and many of these compounds also have short half-lives in air due to photochemical breakdown. Available data suggests no evidence of "dangerous" exposures as a result of the DWH event. Given the distance to populated areas from the DWH, it is unlikely that there will be any health effects felt onshore.

10. The DSEIS states, "The DWH event may have the potential to cause effects on air quality and public health and the environment, which may occur from the application of dispersants

API 2-19

to an oil spill, in-situ oil burning, evaporation of toxic chemicals from oil spill, and cleanup activities." DSEIS at 4-17 - 4-18. This statement should be removed or clarified as it's not supported by any of the current data gathered by EPA, BP, OSHA, NIOSH, and others which indicate that neither worker nor public exposures of concern resulted from air emissions during the spill, in part because of the distance from the shoreline to the release point during DWH.

API 2-20

11. The DSEIS states, "Although there are minimal studies, some lessons can be learned from the 1991 Kuwaiti oil-field fires and the effects of oil burning to the DWH event." DSEIS at 4-18. It is inappropriate to relate effects from Kuwait to DHW, and this statement should be deleted. The Kuwaiti oil fires were widespread, uncontrolled burns on land while the DWH event involved controlled burns offshore. Studies of emissions from the DWH burns have been conducted, and past studies have been conducted on at sea burns (as referenced separately in the DSEIS). Further, health effects observed in military personnel deployed to the Persian Gulf were likely due to combined exposures to elevated particulate matter, other regional pollutants, and military-specific exposures rather than the oil fires alone, and health effects observed in the military population cannot be readily extrapolated to the Gulf Coast.

API 2-21

12. The DSEIS states, "The USEPA monitoring data has so far shown that the use of dispersants during the DWH event did not result in a presence of chemicals that surpassed human health benchmarks (Trapido, 2010)." DSEIS at 4-348. The reference to the Trapido presentation should be deleted as it does not directly support the statement. Instead, BOEMRE should cite to EPA's study found at http://www.epa.gov/bpspill/dispersant-air-sampling.html. Should the statement also provide further context regarding the term "benchmarks"?

API 2-22

13. The DSEIS states, "Studies of possible long-term health effects from exposure to either the DWH event's oil or dispersants, such as the possible bioaccumulation of toxins in tissues and organs, are lacking and the potential for the long-term human health effects are largely unknown (although the National Institutes of Health has proposed such a study)." DSEIS at 4-348. *See also* DSEIS at 4-354 and B-48. The EIS should be revised to note that components of the dispersants and oil are also common ingredients of other consumer products and that there is an existing background of these compounds in tissue.

API 2-23

14. There is a substantial database of new air quality information, both offshore and onshore, collected by BP and governmental agencies during the DWH response. Was this data reviewed in the preparation of the DSEIS? Overall, the EIS should be revised to note that, air quality monitoring data collected during the DWH response showed no evidence of a broad-scale impact onshore. Though oil and dispersant components were periodically detected onshore, it is not clear whether these results are associated with their release or background sources (e.g., vehicle emissions, refineries, etc.). http://www.epa.gov/bpspill/taga.html#tagadata.

Beach Mice

Analysis:

API 2-24

1. The DSEIS states, "A study is pending (due out in January or February 2011) in part investigating events where bulldozers in Florida allegedly breached possible beach mouse dune habitat. . ." DSEIS at 4-216. The EIS should be revised to include an update on the status of the study given that it should have been completed prior to the release of the EIS. If the study has been completed, the results of the study should also be included.

API 2-25

2. The OSAT II report discusses an exposure assessment of the Alabama beach mouse. The assessment included the digging of 1,501 trenches in the beach mouse habitat, where 97% of the trenches were categorized as no oil observed/light/very light oiling. Based on conservative assumptions, the report concluded a low risk from incidental exposure to small surface residue balls (SSRBs) by the beach mouse. Should this information be incorporated into the DSEIS at 2-18 to indicate the low risk of exposure to oil, and at 4-216 to indicate the shoreline habitat conditions for Alabama? The OSAT II conclusion that there was minimal risk to the Alabama beach mouse from incidental exposure to SSRBs should also be included in the DSEIS.

API 2-26

3. The beach mice discussion at DSEIS 4-216 should be updated to include NOAA's comment from July 30, 2010 that no significant oil was expected to enter the Loop Current (http://response.restoration.noaa.gov/dwh.php?entry_id=815) thus minimizing any potential for impact from the oil to the two sub species of beach mice on the Atlantic Coast of Florida.

Birds

Analysis:

API 2-27

The DSEIS states that certain oceanic conditions create "veritable oases for foraging seabirds" in the Gulf of Mexico. DSEIS at 4-220. What literature or data support this characterization? Would it be more accurate to state that these oceanic conditions may represent "improved seabird habitat"?

API 2-28

1. The Endangered Species Act ("ESA") requires the federal government to designate "critical habitats" for species that it lists under the ESA. See NOAA Fisheries, Critical Habitat Overview, available at http://www.nmfs.noaa.gov/pr/species/criticalhabitat.htm. The characterization of certain habitats as "critical" at DSEIS at 4-221 therefore has legal connotations that are possibly unintended by BOEMRE. Should the use of this term be reconsidered?

API 2-29

2. DSEIS at 4-221 contains speculative statements regarding impacts of the DWH event on birds that do not appear to be supported by data. E.g., "Coastal sandpipers may not find adequate food in nontidal habitats with a static shoreline because of insufficient size of invertebrate forage populations." Are there any specific studies supporting this point?

API 2-30

3. The DSEIS states, "When oil gets into vegetated or unvegetated sediment, low redox potentials, absence of light, and waterlogged substrate may mean that the oil can neither be oxidized by bacteria and sunlight nor evaporate. The oil may remain in its unweathered toxic state indefinitely." DSEIS at 4-223, 4-230. Is there any data to suggest that DWH oil penetrated sediments or that oil has remained in an unweathered state outside of a very localized area in Bay Jimmy, which has now been cleaned? (See OSAT I and OSAT II).

- References:
  - Operational Science Advisory Team, Summary Report for Sub-Sea and Sub-Surface Oil and Dispersant Detection: Sampling and Monitoring, (Dec. 17, 2010) ("OSAT I")
  - Operational Science Advisory Team Gulf Coast Incident Management Team, Effects of Remnant Oil in the Beach Environment, (Feb. 10, 2011) ("OSAT II")

API 2-31

4. The DSEIS states that oil from the DWH event has had "serious direct and indirect impacts to coastal and marine birds." DSEIS at 4-223. Is there data to support the characterization of impacts as "serious"? Other reports indicate bird populations are healthy. (*See, e.g.,* Island off Alabama coast bursting with birds after oil spill (July 10, 2011), *available at* http://uk.reuters.com/article/2011/07/10/us-oil-alabama-birds-idUKTRE7692FL20110710).

API 2-32

5. Generally, should recent reports impacting bird conclusions be referenced more broadly?

- References
  - Operational Science Advisory Team, Summary Report for Sub-Sea and Sub-Surface Oil and Dispersant Detection: Sampling and Monitoring, (Dec. 17, 2010)
  - NMFS Commercial and Recreational Fisheries Data for the Northern Gulf of Mexico, http://www.st.nmfs.noaa.gov/st1/index.html
  - Seafood Fishing and Monitoring Data, *available at* http://www.noaa.gov/deepwaterhorizon/data/seafood_safety.html
  - Wakefield, J., Reilly, P., Swindell, W, Hansen, A., Bass, A., Clare, A., Deepwater Horizon Data Collection: Telemetry Data for Use in Evaluating Acute Avian Mortality, SETAC Special Session, (April 28, 2011)[1]
  - Cardno ENTRIX, Wakefield, J, Reilly, P., Holley, L., Klosowski, R, Deepwater Horizon Ephemeral Data Collection: Carcass Stranding and Oiling Rate Data to be used in Estimating Acute Avian Mortality (March 13-16, 2011)

[1] Note: all SETAC data and analysis presented here are preliminary and subject to change.

- Cardno ENTRIX, Wakefield, J, Reilly, P., Elmore, L., LaLancette, P., Deepwater Horizon Ephemeral Data Collection: Oiling Rate Data for Use in Evaluating Acute Avian Mortality, Gulf Oil Spill SETAC Focused Topic Meeting, (March 13-16, 2011), *available at* http://gulfoilspill.setac.org/sites/default/files/abstract-book-1.pdf

- US Fish and Wildlife Service, Bird Impact Data, (May 12, 2011), *available at* http://www.fws.gov/home/dhoilspill/pdfs/Bird%20Data%20Species%20Spreadsheet%2005122011.pdf

Corals

Analysis:

API 2-33

1. The DSEIS states, "The report of damage to deepwater corals on the continental slope (USDOI, BOEMRE, 2010i) as a result of exposure to oil from the DWH probably resulted from the use of dispersant at the source of the blowout." DSEIS at 4-103. *See also* DSEIS at 4-128. Is this statement speculative? Has it been confirmed that the substance detected on the corals was oil from MC252? Is there evidence that any impact on corals was the result of the use of dispersants at the source?

API 2-34

2. The DSEIS states, "Water column sampling, however, indicated that concentrations of total petroleum hydrocarbons in the water column were less than 0.5 ppm, 40 and 45 nmi (74 and 83 km; 46 and 52 mi) northeast of the well (Haddad and Murawski, 2010) . . ." DSEIS at 4-112. Should this statement also refer to OSAT I?

API 2-35

3. The DSEIS states, "Although data have not been published at the time of this Supplemental EIS's release, the characterization of benthic and mid-water habitats was conducted from July 9 to August 7, 2010 (Pomponi, 2010)." DSEIS at 4-145. Was this research cruise conducted until August 9, 2011, as indicated in the cruise's Final Report? Are the objectives of the cruise stated at DSEIS 4-145 consistent with the objectives described in the cruise's final report?

API 2-36

4. The DSEIS states, "The circumstances of the deepwater coral exposure were not typical because the release of oil was 1,500 m (4,921 ft) below the sea surface at high pressure, which caused the formation of a subsea plume of oil that was treated with dispersant, allowing it to remain at a water depth between 1,100 and 1,300 m (3,609 and 4,265 ft) (Joint Analysis Group, 2010a)." DSEIS at 4-154. Should these measurements be identified as approximate measurements?

API 2-37

5. The DSEIS states, "Such an occurrence should not occur on the continental shelf where the topographic features are found because, even though stratified waters called the nepheloid layer (a layer of turbid water) are found on the continental shelf, studies show that stratified water normally restricts the nepheloid layer to near the seafloor; that is, no more than 20 m (66 ft) up into the water column (Bright et al., 1976; Bright and Rezak, 1978)."

DSEIS at 4-154. Can direct quotations or more specific page citations from the references cited be provided to confirm this statement?

API 2-38

6. The DSEIS states, "Oil plumes reaching chemosynthetic communities could cause oiling of organisms, resulting in the death of entire populations on localized sensitive habitats. These potential impacts would be localized due to the directional movement of oil plumes by the water currents and because the sensitive habitats have a scattered, patchy distribution." DSEIS at 4-182. Would impacts also be localized because oil dissolves, dilutes, and biodegrades as it moves away from the wellhead, limiting the range for which habitats may be affected?

API 2-39

7. The DSEIS states, "Recent BOEMRE analyses of seafloor remote-sensing data indicate over 15,000 locations in the deep GOM that represent potential hard-bottom habitats. While it is likely that any subsea oil plume traveling more than a few miles on the seafloor would encounter at least one of these potential habitats, it would result in a localized effect that is not expected to alter the wider population of the GOM." DSEIS at 4-185. *See also* DSEIS at 4-193. Should these statements be clarified to reflect the fact that not all locations that have potential for hard ground communities will necessarily contain hard ground communities? Are there specific citations available for these statements?

API 2-40

8. "The mucus layers on coral resist penetration of oil and slough off the contaminant." DSEIS at 4-187, B-25. Should this statement be reworded because the mucus layers themselves do not resist penetration, but rather, the mucus absorbs oil to prevent it from penetration into the coral where it could affect the coral tissue?

API 2-41

9. The DSEIS states, "The most common deepwater coral, *Lophelia pertusa*, is a branching species." DSEIS at 4-187. Should this statement be revised to note that *Lophelia pertusa* is "one of" the most common deepwater corals? Is the connection drawn elsewhere on this page between *Lophelia pertusa* and Gorgonians accurate? *Lophelia pertusa* is a stony coral, while Gorgonians are soft corals.

10. The DSEIS states, "Corals with branching growth forms appear to be more susceptible to damage from oil exposure (Shigenaka, 2001). . . . Tests with shallow tropical gorgonians indicate relatively low toxic effects to the coral, suggesting deepwater gorgonians may have a similar response (Cohen et al., 1977)." 4-187.

API 2-42

- The tests in the referenced Cohen study were not conducted on gorgonians, but rather, they were *conducted* on Heteroxenia fuscescens, which are of the order Alcyonidae; gorgonians are of the order Gorgonacea.

API 2-43

- The referenced Shigenaka article states that "different species and even different life stages within the same species can react in dramatically different ways to oil exposure" and that "there is reasonable doubt about how well information for one area or one species extends across other areas". Based on this statement, is it accurate to conclude that gorgonians in a drastically different environment would have a similar response?

API 2-44

11. The DSEIS refers to "[c]oral forms structures that protrude up into the water column. . ." DSEIS 4-188. Should this statement be revised to pertain only to "branching corals" as only some species form structures that protrude up into the water column?

API 2-45

12. The DSEIS discusses possible detrimental effects to coral communities as a result of the DWH event at 4-187 - 4-188. Are specific citations available to support these statements?

API 2-46

13. In several places, the DSEIS states that "It appears some impacts have occurred to corals within 7 mi (11 km) of the well." DSEIS 4-112, 4-136, 4-381. As the draft acknowledges, definitive testing of samples is necessary to link the observed damage to the DWH spill. DSEIS 4-117. However, the word "impacts" may be understood to imply that the link is confirmed. Should this statement be amended to clarify that to date, there are no known data demonstrating that damaged corals are attributable to the DWH event?

API 2-47

14. The DSEIS states, "A recent report documents damage to a deepwater coral community in an area that oil plume models predicted as the direction of travel for subsea oil plumes from the DWH event. Results are still pending but it appears that a coral community about 15 m x 40 m (50 ft x 130 ft) in size was severely damaged, possibly the result of oil impacts (USDOI, BOEMRE, 2010j)." DSEIS at 4-192. *See also* DSEIS at 4-112, 4-116, 4-136, 4-176, 4-180, 4-187, 4-188, 4-193, 4-360, 4-361. The OSAT I report indicates that a NOAA deepwater coral study found oil in sediments near distressed coral 11 km southwest of the DWH wellhead; however, this quantity of oil did not exceed aquatic life benchmarks. Although the cited BOEMRE report describes the area as approximately seven miles southwest of the wellhead, the NOAA-sampled area appears to refer to this same area of apparently damaged coral.

API 2-48

15. There are several statements in the DSEIS suggesting that the application of dispersants is the primary cause of the formation of "plumes" of oil that could impact deepwater communities. DSEIS at 4-184 ("Subsea oil plumes resulting from a seafloor blowout could affect sensitive deepwater communities. This is especially true if dispersants are applied at depth."), 4-190 ("A catastrophic spill, like the DWH event, could affect nonchemosynthetic community habitat if dispersants are applied on the sea surface or at depth. The dispersed oil would be suspended in the water column and would begin to flocculate with particulate matter until it becomes heavy enough to sink and contact the seafloor."), 4-193 ("Subsea oil plumes resulting from a seafloor blowout could affect sensitive deepwater communities. This is especially true if dispersants are applied at depth."). Available research indicates that oil released at depth will become suspended in the water column regardless of dispersant application. Should these statements be revised to reflect that dispersants are only one possible contributor to the suspension of oil in the subsurface?

- References

  - Johansen, O., et al. 2003. DeepSpill – Field Study of a Simulated Oil and Gas Blowout in Deepwater. Spill Science & Technology Bulletin. 8(5-6): 433–443

- Reed, M., et al. Deepwater Blowouts: Modeling for Oil Spill Contingency Planning, Monitoring, and Response. International Oil Spill Conference. http://www.iosc.org/papers/00429.pdf
- Johansen, O., et al. 2001. Deep Spill JIP – Experimental Discharges of Gas and Oil at Helland Hansen – June 2000. http://www.boemre.gov/tarprojects/377.htm;
- Zheng, L., et al. 2002. A model for simulating deepwater oil and gas blowouts – Part I: Theory and model formulation. Journal of Hydraulic Research. 41(4): 339-351. http://www.iahr.org/publications/assets/jhr41- 4/2397-i.pdf.

Dispersant Toxicity

Analysis:

API 2-49

1. In several sections (e.g., in Sections 4.1.1.1.1, 4.1.1.1.3, 4.1.1.1.4, 4.1.1.21.4.3, Appendix B.5.2.3.7), the SEIS mentions potential short-term and long-term effects of dispersant application on response workers and residents along the coast. However, the report does not discuss that several health assessments of worker exposures have already been completed. NIOSH Health Hazard Evaluation reports are available for a variety of response worker tasks. OSHA also issued a fact sheet statement based on its sampling efforts. This discussion of worker exposure is also relevant to discussion of the possible health effects on residents along the coast.

- Symptoms such as headache, upper respiratory irritation or congestion, nausea, elevated self-monitored blood pressure, fatigue, and chest pain or pressure were reported in some workers. The symptoms were initially attributed to dispersants, but NIOSH investigators later concluded that dispersant use was unlikely to be the cause; instead, unpleasant odors, heat, and fatigue played a significant role (Interim Report #1). NIOSH monitored response workers in different roles (e.g. skimming, decontamination) for VOCs, dispersant compounds, CO, and other compounds, and found that personal and area concentrations were below occupational exposure limits. The NIOSH reports discuss their evaluation of acute health effects (NIOSH 2010).
- "Exposure to any of these hazards depends on what you are actually doing and where you are working. For example, heat stress is a real concern for all outdoor activities because the weather is hot and humid. If you are pulling in oil-covered booms, then contact with weathered oil, drowning, and back injuries are also concerns. Most jobs will only involve contact with weathered oil, which no longer has high levels of hazardous chemicals that can get into the air. To make sure, OSHA is monitoring the air that workers breathe for the hazardous chemicals common in oil and dispersants, as well as other chemicals like carbon monoxide. To date, no air sampling by OSHA has detected any hazardous chemical at levels of concern" (OSHA 2010).
- In response to concerns about airborne exposures to dispersant components (particularly 2-butoxyethanol, a component of Corexit 9527), OSHA noted,

"Approximately 80% of the 1048 samples BP analyzed showed "no detectable level" of 2-butoxyethanol. Of the remaining 20% (n=213) of the samples with any detectable 2-butoxyethanol, the highest level measured was 0.8 ppm, and 90% of these were 0.2 ppm or less. Every measurement was well below the NIOSH recommended limit of 5.0 ppm…. Most exposure measurements found no exposure to the chemical, and all exposure levels detected were well below any occupational exposure limit."

- References
  - National Institute of Occupational Safety and Health ("NIOSH"), Interim Reports 1-9: Health Hazard Evaluation of Deepwater Horizon Response Workers, (2010), *available at* http://www.cdc.gov/niosh/topics/oilspillresponse/gulfspillhhe.html
  - Occupational Safety & Health Administration ("OSHA), OSHA Fact Sheet: General Health and Safety Information for the Gulf Oil Spill, (Aug. 19, 2010), http://www.osha.gov/oilspills/deepwater-oil-spill-factsheet-ppe.pdf
  - OSHA, OSHA Statement on 2-Butoxyethanol & Worker Exposure, (July 2010), *available at* http://www.osha.gov/oilspills/oilspill-statement.html

API 2-50

2. The SEIS indicates that "USEPA monitoring data has so far shown that the use of dispersants during the DWH event did not result in the presence of chemicals that surpassed human health benchmarks (Trapido, 2010)." DSEIS at 4-348, B-48. (Section 4.1.1.21.4.3). This discussion can be supplemented with findings from the Operational Science Advisory Team report on water column, sediment, and beach conditions, which includes data on the dispersant compounds 2-butoxyethanol, dipropylene glycol n-butyl ether (DPnB), propylene glycol, and dioctylsulfosuccinate (DOSS).

- OSAT explains that "Benchmarks (based on dissolved seawater concentrations) for the individual compounds are used to explain the relevance of measured concentrations of individual compounds…These benchmarks are based on available biological effects data and are conservatively designed to protect aquatic life" (OSAT, p. 13). OSAT sampling found "No exceedance of EPA's dispersant benchmarks" (OSAT, p. 2). Of the 4,850 water and 412 sediments samples collected between in the nearshore zone May 13 and October 20, 2010, "[o]nly 66 samples (60 water and 6 sediment) had detectable levels of dispersant-related chemicals. DPnB was the most common detectable dispersant-compound and was found in 57 of the 60 water samples; however, concentrations never exceeded 3 ug/L (cf. EPA screening level 1 mg/L)." (OSAT, p. 25).
- References
  - Operational Science Advisory Team, Summary Report for Sub-Sea and Sub-Surface Oil and Dispersant Detection: Sampling and Monitoring, (Dec. 17, 2010) ("OSAT I")

API 2-51

3. The SEIS mentions the potential impact of Corexit to fish (Section 4.1.1.16.3), but does not discuss any research on aquatic organisms conducted during the DWH response. DSEIS at 4-267. A report on toxicity testing conducted as part of the response was published in July 2011 as an addendum to OSAT I; this addendum found that 1% or less of sediment and water samples collected after August 3 in the near shore exceeded chronic benchmarks for PAHs, that none of these water and sediment samples exceeded dispersant toxicity benchmarks, that toxicity was present in many pre-impact samples as the result of non-DWH contaminants, that few near shore samples collected after August 8 contained measurable PAHs that could be linked to DWH, and that the toxicity testing conducted on fish and other species as part of the DWH response was the most extensive ever conducted after an oil spill. The fate and transport of the dispersant component, DOSS (dioctyl sodium sulfosuccinate), has been studied by Kujawinski et al. This study provides estimated concentrations of Corexit to which deepwater or pelagic biota would have been exposed. Information provided by the FDA indicates that for the few seafood samples in which some residue was detected, the levels were far lower than the amounts that would cause a health concern. Additionally, dispersant toxicity studies of Corexit were conducted by Judson et al. and BenKinney et al. Further, after the Deepwater Horizon spill, FDA conducted additional research on the bioaccumulation potential for select dispersant components. This research found little to no bioconcentration.

- "Our calculations of dispersant concentrations near the wellhead (or in the deepwater plume) indicate that deepwater, or pelagic, biota traveling through the deepwater plume likely encountered 1 - 10 µg/L DOSS or 10-100 µg/L Corexit, between ~ 1 and 10 km from the actively flowing wellhead, with concentration decreasing with distance. The dispersant was applied at an effective dispersant-to-oil ratio of 0.05%, based on published volume estimates for the spill, but ratios were likely ~10x higher in the plume itself, based on volume estimates for the southwestern plume. Regardless, these concentrations and dispersant-to-oil ratios are lower than those tested in published toxicology assays." (Kujawinski et al. 2011).

- FDA prepared a Questions and Answers page that reported the following: "Most of the seafood samples tested had no detectible oil or dispersant residue. For the few samples in which some residue was detected the levels were far lower than the amounts that would cause a health concern, even when eaten on a daily basis. . . In the 1% of samples in which dispersant was detected, the levels were more than 1,000 times lower than the levels of concern. To better understand what this means, the Louisiana Department of Wildlife and Fisheries and the Louisiana Department of Health and Hospitals calculated the amount of seafood the average person could eat, each day, for 5 years, based on the actual contamination levels, without there being a health concern from the oil. A person could eat, each day, the following: 63 lbs of peeled shrimp (1,575 jumbo shrimp); OR 5 lbs. of oyster meat (130 individual oysters); OR 9 lbs. of fish (18 8-ounce fish filets)" (FDA 2011).

- Laboratory experiments were conducted to assess cytotoxicity and the impact of dispersant on estrogen and androgen receptors on mammalian cells for eight different dispersants, including Corexit, at concentrations ranging from 0.01 ppm to 1,000 ppm. The study concluded that "cytotoxicity values for six of the dispersants [including Corexit] were statistically indistinguishable, with median LC50 values ~100 ppm." The study also concludes that no androgen receptor activity was seen for Corexit and "there were no indications of estrogenic activity for Corexit 9500" (Judson et al. 2011).

- SMART testing after surface dispersant application found no evidence of toxicity correlated to dispersant application, "Testing using growth and mortality of the mysid shrimp (*Mysidopsis bahia*) and mortality of the estuarine silversides (*Menidia beryllina*) as toxicity indicators show no significant observable effect at either 1 m or 10 m underneath the oil slick prior to or following dispersant application. Marine algae test results were less conclusive, with considerable scatter in the data. Based on these analyses, the team does not see any patterns that indicate a correlation between toxicity and dispersant application." (BenKinney et al. 2010)

- "The levels measured in exposed and depurated samples [of seafood] suggest that DOSS is not concentrated in the edible tissues of commercially relevant seafood species. Moreover, DOSS was rapidly eliminated from edible tissues following exposure." (Benner 2010)

- References

    - BenKinney, M. et al., Dispersant Studies of the Deepwater Horizon Oil Spill Response Surface Application Evaluations June 10-27, 2010 (July 20, 2010)
    - OSAT's Summary Report for Sub-Sea and Sub-Surface Oil and Dispersant Detection: Ecotoxicity Addendum (July 8, 2011)
    - Kujawinski, E. B. et al., Fate of Dispersants Associated with the Deepwater Horizon Oil Spill, Environmental Science and Technology, (2011)
    - Judson R.S., et al, Analysis of Eight Oil Spill Dispersants Using Rapid, In Vitro Tests for Endocrine and Other Biological Activity, Environmental Science & Technology, (July 6, 2010)
    - US Food and Drug Administration, http://www.fda.gov/food/foodsafety/product-specificinformation/seafood/ucm221563.htm
    - Benner, R., Investigation of Corexit® 9500 Dispersant in Gulf of Mexico Seafood Species, available online at: http://www.fda.gov/downloads/Food/FoodSafety/Product-SpecificInformation/Seafood/UCM250307.pdf, (November 19, 2010).

API 2-52

4. The DSEIS states, "The components of these dispersants are identical with the exception of the base solvent; Corexit 9527 has an organic solvent as a base (McDonald et al. 1984; USEPA, 2010h)." DSEIS at 4-24,4-34. The cited sources do not appear to support the statement. However, this statement is supported elsewhere. *See* Questions and Answers on Dispersants, *available at* http://www.epa.gov/bpspill/dispersants-qanda.html#chemicals.

API 2-53

5. The DSEIS states, "The amounts of dispersant sprayed at the surface and injected at the wellhead are 1,072,514 gallons and 771,272 gallons, respectively (U.S. Dept. of Homeland Security, CG, 2010c). The fate of this dispersant remains under study." DSEIS at 4-34. Should this statement note that studies on this topic have now been published? *See, e.g.,* Kujawinski et al. 2011 and OSAT I.

API 2-54

6. The DSEIS states, "With the DWH event, the oil was treated with dispersant, making the oil less toxic but causing the oil to sink and reach the benthic habitat." DSEIS at 4-255. Is there data to support the claim that dispersant causes oil to sink? If so, what is this data?

Economic

Analysis:

API 2-55

1. The DSEIS states, "The DWH event may have an effect on this year's [oyster] crop, but it is difficult to infer with the current lack of public data. Many of the beds have been closed for most of the season. The public seed ground openings for much of the area east of the Mississippi River and Hackberry Bay west of the Mississippi River that were scheduled for November 15, 2010, have been postponed indefinitely because of the small size of the stock present in that area. Although the small stock size has not been directly attributed to the spill, it may be a result of the freshwater diversions that were operated in an attempt to keep oil from reaching the inshore areas." DSEIS at 4-273. Is there any evidence to support the statement regarding freshwater diversions? Were any oyster beds in fact injured by oil released during the DWH event?

API 2-56

2. The DSEIS references a study by the Knowland group of hoteliers regarding impacts of the DWH event. DSEIS at 4-294. Should this statement clarify the fact that respondents in that study placed blame on negative media coverage for cancellations and the inability to book future rooms?

API 2-57

3. The DSEIS describes the impacts of consumer "misperceptions" on the Gulf of Mexico recreational economy after the DWH event. DSEIS at 4-298. Is it accurate to state that causally remote consumer "misperceptions" are in fact "effects" of a spill?

API 2-58

4. The DSEIS describes port tenants as "struggling with the drop in exploration drilling even 8 weeks after the July drilling suspension was lifted on October 12, 2010." DSEIS at 4-324. Is this statement current?

API 2-59

5. The DSEIS states, "Furthermore, the extent of the geographic areas that will be affected economically in the long-term is unknown, as is how long the impacts will last (e.g., if fisheries are irreparably damaged, affected fishermen will have no jobs to go back to)." DSEIS at 4-332. Are there any reports or data demonstrating that fishermen have been unable to find employment after the DWH event? All federal commercial fishing grounds have been reopened.

API 2-60

6. The DSEIS states that "anecdotal evidence from media coverage and phone survey studies suggest possible trends that may represent disproportionate effects to low-income and minority communities" as a result of the DWH event. DSEIS at 4-346. *See also* DSEIS at 4-354. Is "anecdotal" evidence sufficient to warrant such conclusions? The DSEIS also states, "An event like the DWH event could have adverse and disproportionate effects for low-income and minority communities in the analysis area." DSEIS at 2-25. *See also* 4-346, 4-349. Is there any data suggesting that low-income and minority communities were more affected by the DWH spill, or that these communities experienced greater emotional and/or health problems, as implied by the DSEIS?

API 2-61

7. The DSEIS cites a phone study regarding the effects of the DWH event on low-income and minority communities that was conducted between July 19 and July 25, 2010 by the National Center for Disaster Preparedness at the Mailman School of Public Health at Columbia University, in partnership with the Children's Health Fund. DSEIS at 4-346. Is a more recent study regarding this topic available?

API 2-62

8. Are the statements at DSEIS 4-346 - 4-348 and Table 4-42 (at A-104) regarding the Gulf Coast Claims Facility current? Are the statements regarding the grounds for compensable claims accurate? *See* Gulf Coast Claims Facility, Program Statistics, *available at* http://www.gulfcoastclaimsfacility.com/reports.

API 2-63

9. The DSEIS indicates that there will be "lingering impacts" of the DWH event. DSEIS at 4-349, 4-355. Is it accurate to assume that the impacts of the DWH event will be long-lasting?

API 2-64

10. Are there any studies to support the intimation that DWH waste disposal sites have had or will have impacts on low-income and minority communities?

API 2-65

11. The DSEIS discusses a phone survey conducted of coastal Louisiana residents at 4-354. When was this survey conducted? Are there any more recent surveys?

API 2-66

12. The Oxford Economics Report cited at various points in the DSEIS entitled "Potential impact of the Gulf oil spill on tourism" was released in summer of 2010. Should reliance on this report be reconsidered in view of more recent data? For instance, the Report cites as "uncertainties" whether flow from Macondo well will be permanently halted and where the oil goes. Uncertainty about these issues has been substantially resolved. Similarly, the NOAA oil flow scenarios relied upon in the Report are now known to be incorrect, as oil never entered the Loop Current or went beyond the panhandle of Florida. In addition, the Report's prediction that it would take 15-36 months for Gulf tourism to recover from the spill has been called into question by recent reports reflecting strong and even record levels of tourism in the Gulf in 2011.

- References
  - New Orleans Times-Picayune, "Armstrong Airport in high gear; More travelers than usual attracted," March 5, 2011
  - WBRC, "Beach tourists return home satisfied," March 18, 2011

- Miami Herald, "More for the traveler: museums, thrill rides," March 27, 2011
- Pensacola News Journal, "Tourism tide turns for Pensacola Beach," April 1, 2011
- Local15tv.com, "Beach Businesses Seeing Spring Break Boost," April 1, 2011
- New Orleans Times-Picayune, "New Orleans tourism officials expect one of the strongest springs ever," April 3, 2011
- USA Today, "Alabama: Gulf Shores," p. 6A, August 4, 2011

API 2-67

13. The DSEIS states that the "DWH event has apparently caused a noticeable fall in property values in some areas in the Gulf of Mexico . . ." DSEIS at 4-296. The DSEIS cites to information provided by CoreLogic. Does this study adequately take into account confounding variables such as national and regional recessionary trends?

Fish

Analysis:

API 2-68

1. The DSEIS states, "In the rare event contact with oil occurs, this could cause nonlethal effects including fish temporarily migrating from the affected area, irritation of gill epithelium, and an increase of liver function in a few adults, and possibly interference with reproductive activity." DSEIS at 2-19, 4-254. For which species might reproductive activities be affected?

API 2-69

2. The DSEIS states, "Although many potential effects of the DWH event on the fish populations of the Gulf of Mexico have been alleged, the actual effects are at this time unknown, and the total impacts are likely to be unknown for several years." DSEIS at 2-20, 4-268. Should this statement be revised in light of the fact that OSAT I found no samples exceeding aquatic life benchmarks? Additionally, there has been no evidence to date that Gulf fish populations are sick as a result of the spill. *See, e.g.*, DMR Says Red Snapper Stock is Safe, Biloxi Sun-Herald, (June 14, 2011). Moreover, Fodrie and Heck (2011) suggests no acute impacts to seagrass-associated juvenile fishery stocks occurred as a result of the DWH event.

- References
  - DMR Says Red Snapper Stock is Safe, Biloxi Sun-Herald, (June 14, 2011)
  - Fodrie, F. J. and Heck, Jr., K., Response of Coastal Fishes to the Gulf of Mexico Disaster, PLoS One, (July 6, 2011), *available at* http://www.plosone.org/article/info%3Adoi%2F10.1371%2Fjournal.pone.0021609

API 2-70

3. Fish kills are a common event in the Gulf and may be attributed to a variety of causes. Have the fish kills discussed at page 4-262 of the DSEIS been conclusively associated with the DWH event?

API 2-71

4. The DSEIS states, "Physical toxicity of oil to fishes depends on the application of dispersants and the toxicity of the dispersant." DSEIS at 4-267. Is it correct to say that toxicity to fish depends on toxicity of dispersant? Toxicity of dispersed oil typically results from increased dissolution of PAHs and other components from oil, rather than from the chemistry of the dispersant. *See*, EPA studies of dispersant toxicity conducted during DWH.

API 2-72

5. The DSEIS refers to freshwater diversions "that were operated in an attempt to keep oil from reaching the inshore areas." DSEIS at 4-273. Should it be clarified that the State of Louisiana implemented these freshwater diversions and that there is little evidence that these diversions were effective?

API 2-73

6. The DSEIS states that "In the case of the DWH event, the application of the dispersant (*Corexit 9500*) at the seafloor and the surface was alleged to have had the potential to produce larger areas of subsurface anoxic water because of the degradation of oil by bacteria." Should the subsequent text clarify that these allegations are speculative and that extensive water column analysis detected a temporary dissolved oxygen "sag" in certain areas, but did not detect anoxic or hypoxic conditions?

- The Joint Analysis Group report states that, "Measurements of the DO_2 depression have not approached hypoxic levels. Hypoxic conditions are not expected to occur in the deep-water layer where MC252 #1 oil has been observed." (JAG 2010). This finding is confirmed in OSAT I.

- The Joint Analysis Group report also concluded that oxygen depletion has stabilized. There is no data to suggest that anoxic conditions will develop in the future as the result of the DWH spill.

- As BOEMRE notes in its final SEIS for the Western Planning Area, "Data from David Valentine… contradict the assertion of long-term impacts to dissolved oxygen. His data indicate the methane was gone in 3 months after the Macondo well was capped, without appreciable impact to dissolved oxygen." 5-169.

API 2-74

7. The DSEIS states, "The DWH event has had a number of effects on the commercial fishing industry. The most direct manner in which the spill affects the industry is through the potential for decreased harvests of a number of species over the next few years." DSEIS at 4-275. The DSEIS also states, "The DWH event and subsequent fishing closures dealt an immediate blow to many CPA coastal communities and may have longer term impacts by damaging fish stocks or by undermining the Gulf Coast seafood 'brand.'" DSEIS at 4-340. Should these passages be revised in light of the fact that data gathered by the NOAA Fisheries Service shows increased catches for certain species following the spill through the present?

- References

- NOAA, Status Purse-Seine Landings of Gulf and Atlantic Menhaden for the 2011 Fishing Season, (July 5, 2011), *available at* http://www.st.nmfs.noaa.gov/st1/market_news/doc77.txt
- NOAA Fisheries Service, May 2011 Shrimp Statistics, *available at* http://www.st.nmfs.noaa.gov/st1/market_news/doc45.txt

Human Health

Analysis:

API 2-75

1. The DSEIS discusses post-spill clean-up efforts for previous oil spills and connections to human health effects. DSEIS at 4-354, B-48 - B-49. Should this section note that potential exposures during previous spills would be significantly different than potential exposures during the DWH event, partially as a result of the distance from the source to shore and partially as the result of weathering before the oil surfaced (removing BTEX, for example)?

Marine Mammals

Analysis:

API 2-76

1. The DSEIS states that "NRDA data have yet to be released." DSEIS at 2-16,2-17, 4-196, 4-199, 4-202, 4-204, 4-208, 4-210, 4-212, 4-254, 4-259, 5-8. Should this statement be revised to reflect the fact that some NRDA data has been made public?

API 2-77

2. Should the DSEIS reference the Unusual Mortality Event for cetaceans that began in February 2010?

- References
  - NOAA, 2010-2011 Cetacean Unusual Mortality Event in Northern Gulf of Mexico, *available at* http://www.nmfs.noaa.gov/pr/health/mmume/cetacean_gulfofmexico2010.htm

Oil Spill Trajectory/Fate and Transport of Oil

Analysis:

API 2-78

1. The DSEIS states, "[D]ata and observations from the DWH event challenged the previously prevailing thought that most oil from a deepwater blowout would quickly rise to the surface. While analyses are in their preliminary stages, it appears that measurable amounts of hydrocarbons (dispersed or otherwise) are being detected in the water column as subsurface plumes (Chapter 4.2.1.2.2.1) and perhaps on the seafloor in the vicinity of the release." DSEIS at 3-32, 3-34, 4-39. Are these statements accurate in light of OSAT I and the following facts?

- DeepSpill model simulations and field experiments conducted by SINTEF before the DWH spill indicated that not all oil droplets rise to the surface. Instead, a portion of the oil droplets (varying by droplet size) are carried by cross-currents laterally. SINTEF also found that the gas underwent dissolution before reaching the surface (Johansen et al. 2001, Johansen et al. 2003, Reed et al.)
    - References
        - Johansen, O. et al., DeepSpill JIP - Experimental Discharges of Gas and Oil at Helland Hansen - June 2000, Technical Report, (June 5, 2001)
        - Johansen, O. et al., DeepSpill - Field Study of a Simulated Oil and Gas Blowout in Deep Water, Spill Science & Technology Bulletin, (2003)
- Most of the oil released during DWH is believed to have reached the surface. *See discussion infra.* Several publications suggest this, including Ryerson et al. 2011, NOAA Oil Budget 2010.
    - References
        - Ryerson, T.B. et al., Atmospheric emissions from the Deepwater Horizon spill constrain air-water partitioning, hydrocarbon fate, and leak rate. Geophysical Research Letters (2011)
        - Federal Interagency Solutions Group, Oil Budget Calculator Science and Engineering Team, Oil Budget Calculator Technical Documentation, (November 2010)
- By mid-October, the FOSC said the highest concentrations seen in the water column were at about 0.5 ppb (http://www.restorethegulf.gov/release/2010/10/19/transcript-operational-update-fosc-rear-adm-paul-zukunft). OSAT II provides data on the limited concentrations of oil present in the sediment.

API 2-79

2. The DSEIS states, "It is expected that oil found in the majority of the proposed lease sale areas could range from medium weight oil to condensate." DSEIS at 3-39. Is there a citation to support this statement?

API 2-80

3. The DSEIS states, "Oil suspended in the water column and moving with the currents is difficult to track, and therefore recover, using standard visual survey methods (Coastal Response Research Center, 2007)." DSEIS at 3-39. Should this statement also note that oil recovery is impeded by factors other than difficulty in tracking oil, for which technology significantly improved during the DWH spill. For example, mechanical methods for recovering submerged oil have limited effectiveness. (Coastal Response Research Center. 2007)

- References:

- Coastal Response Research Center, Submerged Oil—State of the Practice and Research Needs, (July 2007), *available at* http://www.crrc.unh.edu/workshops/submerged_oil/submerged_oil_workshop_report.pdf

API 2-81

4. Should the DSEIS's discussion of submerged oil recovery at page 3-39 be clarified by noting that suspended and dissolved oil was quickly eaten by microbes during the DWH event? Should it also be clarified that there has been no published data confirming that significant oil was detected on the sea floor more than 3 km from the wellhead?

API 2-82

5. The DSEIS states, "Bacteria that break down the dispersed and weathered surface oil are abundant in the GOM in large part because of the warm water, the favorable nutrient and oxygen levels, and the fact that oil enters the GOM through natural seeps regularly (Lubchenco et al., 2010)." DSEIS at 3-42. Does the Lubchenco resource cited describe the surface oil as "weathered"? Further, should this statement be revised in light of the following?

- Petroleum consuming bacteria are also present in the deep sea, as reported by Hazen. Moreover, Hazen reported evidence of widespread biodegradation reported in the deep sea and not just in warm water.
- During the International Oil Spill Conference ("IOSC"), Ken Lee (Fisheries and Oceans Canada) reported on wave tank studies of high biodegradation rates even in nearly freezing waters. Lee also explicitly referred to high levels of biodegradation seen in the subsurface and surface for DWH oil.
- Surface oil weathering is initially dominated by dissolution and evaporation, which remove ~60% of the oil mass. Only after these relatively rapid processes complete does biodegradation become significant on the surface.
- References
  - Lee, K. et al., Field Trials of *in-situ* Oil Spill Countermeasures in Ice-Infested Waters, 2011 International Oil Spill Conference, (May 23-26, 2011), *available at* http://www.iosc.org/papers_posters/IOSC-2011-160-file001.pdf
  - Boehm, P. et al., Aromatic Hydrocarbon Concentrations in Seawater: Deepwater Horizon Oil Spill, 2011 International Oil Spill Conference, (May 23-26, 2011)
  - Boehm, P. et al., Abstract, Polynuclear Aromatic Hydrocarbons form MC252 in the Water Column: Preliminary Exposure Assessment, Weathering, and Biodegradation, Gulf Oil Spill SETAC Focused Topic Meeting, (April 26-28, 2011), *available at* http://gulfoilspill.setac.org/sites/default/files/abstract-book-1.pdf
  - Gong, C. et al., The Significant Impact of Weathering on MC252 Oil Chemistry and Its Fingerprinting of Samples Collected from the Sea Surface and Shore

between May and November 2010, International Oil Spill Conference, (May 23-26, 2011)

API 2-83

6. The DSEIS states, "Also, this oil is less toxic than other crude oils in general because this oil is lower in PAH's than many crude oils." DSEIS at 4-23, 4-33. Is there a citation available for this statement and does this statement refer to sweet Louisiana crude or specifically to MC252 oil?

API 2-84

7. The DSEIS states, "An experiment in the North Sea indicated that the majority of oil released during a deepwater blowout would quickly rise to the surface and form a slick (Johansen et al., 2001). In such a case, impacts from a deepwater oil spill would occur at the surface where the oil is likely to be mixed into the water and dispersed by wind and waves. The oil would undergo natural physical, chemical, and biological degradation processes including weathering." DSEIS at 3-32, 3-34, 4-39. Does this statement mischaracterize the DEEPSPILL test, which showed conclusively that physical dispersion from a deepsea blowout would result in the permanent dispersion of some portion of the oil into the subsurface?

API 2-85

8. "The bulk of the oil was dispersed in deep water off the shelf and was be [sic] directed by water currents in deep water." (Section 4.1.1.7.1, p. 4-145) This statement incorrectly implies that it is known that the majority of the oil remained in the subsurface. There is still significant amount of debate about this issue, with some publications noting that a substantial part of the DWH oil reached the surface, such as Ryerson et al. 2011 and Atlas and Hazen 2011.

- "However, the large surface slicks showed that a good percentage of the released oil did make it to the surface" (Federal Oil Budget 2010). The Federal Oil Budget implies that by May 17, 2010, prior to subsurface recovery and increased dispersant applications, "somewhat less than a third of the oil had reached and remained on the surface if the [USGS] report's hypothesis is correct." The Oil Budget does not find this early estimate inconsistent with its later estimates. It estimates that approximately 29% was naturally or chemically dispersed, which is not "the bulk of the oil."

- Although dissolution and biodegradation would have resulted in a portion of the surfacing oil remaining in the water column, these processes should not be classified as dispersion in the deepwater. "With regard to surface oil and shorelines, up to 40% of the oil was lost in the water column between the wellhead and the surface, largely due to dissolution and mixing as the oil moved to the surface and evaporation as soon as it reached the surface which lowered the hydrocarbon concentrations and changed the composition of the oil" (Atlas and Hazen 2011).

- References

    - Atlas, R., and Hazen, T. C., Oil biodegradation and bioremediation: A Tale of the Two Worst Spills in U. S. history, Environmental Science & Technology, (2011)

- Federal Interagency Solutions Group, Oil Budget Calculator Science and Engineering Team, Oil Budget Calculator Technical Documentation, (November 2010)
- Ryerson, T.B. et al., Atmospheric emissions from the Deepwater Horizon spill constrain air-water partitioning, hydrocarbon fate, and leak rate, Geophysical Research Letters, (2011)

API 2-86

9. The DSEIS states, "Lubchenco et al. (2010) estimated that 26 percent of the total spill volume remained at large in the GOM shortly after the Macondo well was capped on July 16, 2010 . . ." DSEIS at 4-175 - 4-176. *See also* DSEIS at 4-381. Does this statement misinterpret the NOAA oil budget (as described in Appendix D, page D-11 of the SEIS)? Further, more recent monitoring data suggests that little oil remains in the water column or on the seafloor.

API 2-87

10. The DSEIS states, "The dispersed oil would be suspended in the water column and would begin to flocculate with particulate matter until it becomes heavy enough to sink and contact the seafloor." DSEIS at 4-168, 4-182, 4-190. Should this statement be clarified because not all dispersed oil flocculates with particulate matter and sinks to the seafloor? Most oil is more likely to remain dispersed, dissolve, or be biodegraded.

API 2-88

11. The DSEIS states, "The dispersed oil mixed with the water; its movement was dictated by water currents and the physical processes of degradation." DSEIS at 4-187. Should this statement be revised because buoyancy and water density have more effect on the movement of dispersed oil (i.e. stratification) than does biodegradation?

12. Misc. References

- Liu, Y. et al., Abstract, Trajectory Forecasts Based on Numerical Ocean Circulation Models and Satellite Observations: A Rapid Response to Deepwater Horizon Oil Spill, American Geophysical Union (AGU) Convention, (2010), *available at* http://adsabs.harvard.edu/abs/2010AGUFMOS33C1480L
- Ji, Z. et al., Abstract, Oil Spill Risk Analysis Model and Its Application to Deepwater Horizon Oil Spill, American Geophysical Union (AGU) Convention, (2010), available at http://adsabs.harvard.edu/abs/2010AGUFMOS42A..01J
- Barker, C.H., Abstract, A Statistical Model of the Deepwater Horizon Oil Spill, American Geophysical Union (AGU) Convention, (2010), *available at* http://adsabs.harvard.edu/abs/2010AGUFMOS42A..02B
- MacFadyen, A. et al., Abstract, Tactical modeling of oil transport and fate in support of the Deepwater Horizon Spill Response, American Geophysical Union (AGU) Convention, (2010) *available at* http://adsabs.harvard.edu/abs/2010AGUFMOS42A..03M
- He, R. et al., Abstract, Hindcasting of the Gulf of Mexico Circulation and Age and Distribution of the Oil Plume Arising from the Deepwater Horizon Spill,

American Geophysical Union (AGU) Convention, (2010), *available at* http://adsabs.harvard.edu/abs/2010AGUFMOS42A..04H

- North, E.W. et al., Abstract, Simulating the three dimensional dispersal of aging oil with a Lagrangian approach, American Geophysical Union (AGU) Convention, (2010), *available at* http://adsabs.harvard.edu/abs/2010AGUFMOS42A..07N

Response

Analysis:

API 2-89

1. Citing a Staff Working Paper issued by the Presidential Commission, the DSEIS states that "cleanup technology used during the DWH event was outdated and inadequate." DSEIS at 3-39. Should this statement be revised to reflect the fact that technology advanced significantly over the course of the spill? As quoted in the same Staff Working Paper, technology "advanced a decade in the four months" of the response.

API 2-90

2. The DSEIS states that "only 3 percent of the total oil spilled was picked up by mechanical equipment offshore." DSEIS at 3-40. Should this statement also cite the November 2010 Oil Budget Calculator?

- References
  - Federal Interagency Solutions Group, Oil Budget Calculator Science and Engineering Team, Oil Budget Calculator Technical Documentation, (November 2010)

API 2-91

3. The DSEIS states that in-situ burning "was successfully used in 411 burns during the DWH spill response, successfully eliminating between 220,000 and 300,000 bbl of oil from the water surface. . ." DSEIS at 3-42 Should this statement be updated to reflect estimates found in the March 2, 2011 Presentation of Alan A. Allen at the Petroleum Association of Japan 2011 Oil Spill Response Workshop?

- References
  - Allen, A., The Controlled Burning of Oil During the Deepwater Horizon Oil Spill, Petroleum Association of Japan 2011 Oil Spill Response Workshop, *available at* http://www.pcs.gr.jp/doc/esymposium/2011/4Mr_AlanAllen_PPT.pdf (March 2, 2011)

API 2-92

4. The DSEIS refers to the need during the DWH response to create "separate, more detailed plans" than the Gulf of Mexico's extant Area Contingency Plans. DSEIS at 3-43. Should this statement cite the United States Coast Guard's Incident Specific Preparedness Review Final Report (January 2011)? The DSEIS also states that "hard boom often did more damage in the marsh it was intended to protect than anticipated. . ." DSEIS at 3-43, 3-44.

Should this statement refer to Admiral Thad Allen's July 30, 2010 press conference transcript, which discusses that issue?

- References
  - USCG, BP Deepwater Horizon Oil Spill Incident Specific Preparedness Review, (January 2011)
  - Admiral Thad Allen, Press Conference Transcript, (July 30, 2010), *available at* http://www.restorethegulf.gov/release/2010/07/30/transcript-press-briefing-national-incident-commander-admiral-thad-allen

API 2-93

5. The DSEIS discusses the construction of artificial sand berms in Louisiana. DSEIS at 3-62. Are statements regarding the volumes and distances actually constructed accurate? Are they consistent with statements made in Appendix D? Have these statements, such as the length of the original and approved plans, been cross-checked with the U.S. Army Corps of Engineers' approval letter for the project?

- References
  - U.S. Army Corps of Engineers, Corps decision on state's emergency permit request, (May 27, 2010), *available at* http://www.lacpra.org/assets/docs/Emergency_Permit_Documents_Compressed%5B1%5D.pdf

API 2-94

6. The DSEIS states, "However, no OCS sand was used during the construction of the emergency berms because (1) the use of hopper dredges in the Gulf was not allowed after excessive nonlethal and lethal turtle takes occurred during the first week of dredging in State waters and (2) the Federal On-Scene Coordinator for the DWH event notified the State that their request for concurrence for dredging activity at St Bernard Shoals was denied." DSEIS at 3-62. Is there a citation available to support this statement?

API 2-95

7. The DSEIS discusses various potential environmental impacts of berms and the status of berms construction. DSEIS at 4-55. Are these statements current? Are they based on the lengths of berms *actually* constructed, and not just proposed to be constructed? Do these statements reflect the fact that the State of Louisiana shifted the berm project's objectives from an oil barrier to barrier island restoration in November, 2010? *See* http://coastal.louisiana.gov/index.cfm?md=pagebuilder&tmp=home&pid=131.

API 2-96

8. The DSEIS states that the DWH oil spill "led to the closure of 36.6 percent of the fishing waters in the Gulf of Mexico . . ." DSEIS at 4-284. See also DSEIS at 4-293. Should these statements be changed to indicate that 36.6 percent of "federal waters" were closed?

API 2-97

9. Should the DSEIS's statements regarding the status of fishing closures, e.g. DSEIS at 4-293, be updated?

API 2-98

10. The DSEIS discusses lengths of oiled coastline from August 6, 2010 and October 27, 2010. DSEIS at 4-297. Are these lengths accurate? Are they current?

SAV (Submerged Aquatic Vegetation)

Analysis:

API 2-99

1. The DSEIS discusses seagrass communities at various points. *See, e.g.*, DSEIS at 4-79 - 4-80. Do these statements consider the variety of additional factors that can affect submerged aquatic vegetation beds, such as lower salinity due to high rains, high temperatures, storms, and regular boating activity?

API 2-100

2. The DSEIS states that if the Mississippi Sound "continues to accrue oil, then there is the hypothesis that there would be a decrease in seagrass cover and an adverse effect on the associated community." DSEIS at 4-81. From what source would the Mississippi Sound continue to accrue oil?

API 2-101

3. The DSEIS states, "if the temporal and spatial duration" of a potential spill "is massive, then an offshore spill could affect submerged vegetation communities as seen with the DWH event." DSEIS at 4-84. Is it accurate to state that the DWH event "affect[ed] submerged vegetation communities" in light of the fact that studies are ongoing?

Sea Turtles

Analysis:

1. Misc. References

   - National Geographic, Video, Gulf Turtle Nests Abound, But Worries Remain, *available at* http://video.nationalgeographic.com/video/player/news/animals-news/nsf-oil-turtles-2011-vin.html

Sediments

Analysis:

API 2-102

1. The DSEIS discusses a lack of studies regarding oil impacts on soft sediments and soft-bottom benthic communities. *E.g.*, DSEIS at 4-360. Do these statements take into account OSAT I, OSAT II and the OSAT Exotoxicity Addendum?

API 2-103

2. The DSEIS states that "Oil released from the DWH event may have affected some of the organisms that live on or in these sediments. Direct contact with high concentrations of oil may have resulted in acute toxicity to organisms." DSEIS at 4-176 and 4-360. While hypothetical contact with high concentrations of oil may result in acute toxicity, should this statement be revised to clarify that during the DWH spill there was no evidence of acute toxicity in data received from the Operational Science Advisory Team (OSAT) and concentrations of polycyclic aromatic hydrocarbons (PAHs) were detected in amounts below acute and chronic levels of concern in all areas except around the wellhead?

Shoreline

Analysis:

API 2-104

1. Sections 4.1.1.3.1 and 4.1.1.4.1 (pp. 4-45, 4-48, 4-52, 4-61) refer to SCAT observation maps and data available as of September and October 2010, even though more updated information is available as of July 2011. Certain sections also discuss specific shoreline areas and imply that there is no information about the current oiling status of these areas. For example, Section 4.1.1.3.1 (page 4-45) describes the shoreline of the Chenier Plain and notes that "there is no publicly available archival information on any changes to the Chenier Plain from oil exposure." Section 4.1.1.4.1 (page 4-63) mentions that shoreline near the Mississippi Delta, Barataria Bay, Terrebonne Bay, and Bay Jimmy were moderately to heavily oiled, but notes: "At this point in time, it can only be said that these coastlines and the adjacent barrier islands have had some degree of exposure to oil. This oil has either been treated and/or weathered but we do not have available data to indicate the toxicity, quantity, or spatial extent of the shoreward exposure." There are numerous maps and data available on the NOAA Environmental Response Management Application website that do not appear to have been considered in the DSEIS (NOAA 2011).

- NOAA has produced shoreline oiling summaries on an almost daily basis, and current oiling maps are available at the NOAA Environmental Response Management Application website (NOAA 2011). For example, maps showing the July 11, 2011 status of SCAT operations and oiling are available here: http://gomex.erma.noaa.gov/layerfiles/16960/files/ReducedLatestShorelineSurveyspltJul11.pdf.
- Scientists have been producing sample tracking maps based on the collection and laboratory analysis of floating oil, beach oil, oiled vegetation, tar balls, etc. from Texas to Alabama (Benton et al. 2011).
- An April 2011 presentation by Nicolle Rutherford of NOAA's Emergency Response Division provides statistics on the amount of oiled shoreline remaining as of February-March 2011. For example, in Louisiana, the maximum length of heavily oiled sand beaches and marsh/mangroves was 53 miles and 81 miles, respectively, but as of March 27, 2011, only six miles of heavily oiled sand beaches and 11 miles of heavily oiled marsh/mangrove remained (Rutherford 2011).
- References

  - Benton, L. et al., Tracking Oil Sampled for Chemical Fingerprinting Offshore and along the Louisiana and Texas Shorelines, Gulf Oil Spill SETAC Focused Topic Meeting, (April 26-28, 2011)
  - NOAA Environmental Response Management Application (ERMA), *available at* http://gomex.erma.noaa.gov

- Rutherford, N., Shoreline oiling and DWH: How much, where, and what is being done about it?, (2011), *available at* ftp://ftp.orr.noaa.gov/public/ERD/Apr_5-7-2011_SOS_Presentations_1/Apr_5-7-2011_DWH_Presentations/DWH_SCAT_Status.pdf

API 2-105

2. Sections 4.1.1.3.1 and 4.1.1.4.1 discuss SCAT oiling observations only, and do not mention that surface oil samples have also been collected and analyzed in the laboratory to verify that they are associated with MC252.

- Of the more than 1500 samples of slicks, oils, and tarballs collected, 37% were not fingerprinted to the MC252 oil spill, 57% were "probably" from the MC252 oil spill, and 6% "may be" from the MC252 oil spill. (Milkov et al. 2011).

- "Among the samples analyzed to date, those that appear to be MC252 oil occurred primarily within the areal extent of sea surface oil and along coastlines of Louisiana and Alabama where the most oil emulsion reached the shore. Oil samples outside these areas were more likely to be classified as definitively not from the MC252 spill. These non-MC252 oil samples, mostly from tar balls, were collected in all five states and apparently originated from natural petroleum seeps in the Gulf of Mexico, bypassing vessels, onshore or offshore petroleum infrastructure, destroyed asphalt roads or other sources" (Milkov et al. 2011).

- USGS collected near-surface beach and coastal sediment and tarballs from 49 sites along the shoreline from Texas to Florida before and after oil arrived at the shores. Based on chemical fingerprinting, oil-impacted coastal sediments were "confined to the shoreline adjacent to the cumulative oil slick of the Deepwater Horizon oil spill, and no impact was observed outside of this area" (Rosenbauer et al. 2010).

- References

  - Milkov, A.V. et al., Identification of the Sources of Oil Sheens, Slicks, and Tarballs Collected in Response to the MC 252 Oil Spill, International Oil Spill Conference, (May 23-26, 2011)

  - Rosenbauer, R.J. et al., Reconnaissance of Macondo-1 Well Oil in Sediment and Tarballs from the Northern Gulf of Mexico Shoreline, Texas to Florida. Reston, VA: US Geological Survey Open File Report 2010-1290. http://pubs.usgs.gov/of/2010/1290/, (2010)

API 2-106

3. The statement in Section 4.1.1.3.1 (pp. 4-48), "because these coastlines encountered some degree of oiling, oil is now part of the existing condition of the resource" does not account for the fact that shorelines were cleaned as part of the response. The statement implies that once the coastlines were oiled, the oiling remained rather than describing the distribution and concentration of the remaining oil following cleanup and natural biodegradation.

- The OSAT II report, which is not mentioned in the DSEIS, discusses the removal of remnant oil from the near shore, surf zone, and shoreline sandy beach areas. "Much of the oil residue on and near the shoreline has been cleaned during the Response phase of the oil spill" (p. 5) (OSAT II 2011).

- BP's active beach cleanup strategy for Orange Beach and Gulf Shores, Alabama, called "Operation Deep Clean," targeted amenity beaches in time for the 2011 spring break tourism season.

- The vast majority of the beach notices, advisories, and closures due to the oil spill have been lifted. A recently released NRDC report summarizes the notice and advisory days. As of June 2011, three beaches in Escambia County, Florida are still under oil spill notice and Fourchon Beach, Louisiana is the only beach along the Gulf of Mexico that remains closed due to oil impact cleanup efforts (Greater Lafourche Port Commission 2011, NRDC 2011).

- A variety of shoreline treatment options have been applied. Following the initial shoreline oil recovery that occurred during the release, surveys and bulk oil removal and treatment were conducted. In 2011, shorelines were re-surveyed and further treated if necessary (Owens et al. 2011a, Owens et al. 2011b).

- University of South Florida researchers conducted an investigation of the nearshore zone along the Alabama and northwest Florida coasts to evaluate possible oil contamination. Based on their initial report, they did not find any visually identifiable oil lying on or buried in the nearshore sediment (Wang et al. 2010). These researchers also investigated Alabama and northwest Florida beaches between early June 2010 and February 2011. Following aggressive mechanical cleanup of oiled beaches in Summer 2010 and Winter 2010, the researchers found no visible oil contamination on the beach. "Overall, negligible amount of oil contamination, mostly in the form of small tar balls (less than 1 cm (0.4 inch) in diameter) was found on the beach, below the beach surface, and in the swash zone along the shoreline during this field investigation" (Wang et al. 2011).

- A presentation at the Gulf Oil Spill SETAC Focused Topic Meeting in April 2011 described the stages of cleanup of heavily oiled marshes. During Stage I/II of the response (May-September 2010), cleanup consisted mainly of recovering floating oil adjacent to marshes, while subsequent Stage III cleanup began after the threat of re-oiling ended. Marshes that were classified as very light to moderate oiling did not require additional treatment. Wave and tidal flushing were used to remove stranded oil. Heavily oiled marshes, such as those in northern Barataria Bay required a combination of raking and cutting, which began in February 2011 (Zengel and Michel 2011).

- References

  - Atlas, R., and Hazen, T. C., Oil biodegradation and bioremediation: A Tale of the Two Worst Spills in U. S. history, Environmental Science & Technology, (2011)

- Greater Lafourche Port Commission, Crisis Communication Login, http://www.portfourchon.com/explore.cfm/latestupdates/
- Natural Resources Defense Council (NRDC), Beach Closures, Advisories, and Notices Due to the BP Oil Disaster, Testing the Waters: A Guide to Water Quality at Vacation Beaches, (2011), *available at* http://www.nrdc.org/water/oceans/ttw/gulf.pdf
- Operational Science Advisory Team Gulf Coast Incident Management Team, Effects of Remnant Oil in the Beach Environment, (Feb. 10, 2011) ("OSAT II")
- Owens, E. H. et al. 2011a. Sand Beach Treatment Studies and Field Trials Conducted During the Deepwater Horizon-Macondo Response Operation, International Oil Spill Conference, (May 23-26, 2011)
- Owens, E. H. et al., Shoreline Treatment during the Deepwater Horizon-Macondo Response, International Oil Spill Conference, (May 23-26, 2011)
- Wang, P. et. al., No Significant Visually Identifiable Oil Was Found in the Nearshore Sediment along Alabama and Northwest Florida Coasts, Unpublished manuscript, (October 2010), *available at* http://news.usf.edu/article/articlefiles/2840-Wang_horwitz_kirby.pdf
- Wang, P. et al., Florida Panhandle and Alabama Beaches Welcome Spring Break: Free of Tar Balls at Last, Unpublished Manuscript, (2011), *available at* http://news.usf.edu/article/articlefiles/3175-Wang_kirby_cheng_022411.pdf
- Zengel, S. A., and Michel, J., Testing and Implementation of Treatment Methods for Marshes Heavily Oiled during the Deepwater Horizon Spill, Abstract, Gulf Oil Spill SETAC Focused Topic Meeting, (April 26-28, 2011), *available at* http://gulfoilspill.setac.org/sites/default/files/abstract-book-1.pdf

API 2-107

4. The DSEIS states, "Aside from the hurricane effects on the barrier islands and beach resources, the DWH event exposed most of the Gulf Coast shoreline from western Louisiana to the Florida panhandle to some degree of oiling." DSEIS at 4-48, 4-52. *See* DSEIS at 4-78. *See also* DSEIS at 4-63 (claiming that "majority" of the Louisiana coast was exposed to oiling). Is it correct to say that "most" or the "majority" of the Gulf and Louisiana shorelines was oiled? The Louisiana shoreline alone is more than 7,000 miles in total. *See* http://www.census.gov/compendia/statab/2011/tables/11s0360.pdf. Moreover, NOAA data on maximum surface oiling conditions in Louisiana, Mississippi, Alabama, and Florida indicate that no oil was ever observed in 3,160 miles out of the 4,216 miles surveyed as of February 27, 2011. Rutherford 2011, ftp://ftp.orr.noaa.gov/public/ERD/Apr_5-7-2011_SOS_Presentations_1/Apr_5-7-2011_DWH_Presentations/DWH_SCAT_Status.pdf.

API 2-108

5. Section 4.1.1.3.1 (p. 4-52) discusses the mitigating factors that should greatly reduce the toxicity of incoming oil from offshore and notes "after NRDA releases the data concerning the condition of the incoming oil, long-term and local effects of the oil on the shoreline can be discussed in more detail." Although NRDA is still underway, OSAT II and other

API 2-108

publications provide data on oil samples collected as part of the beach shoreline response. The results of these chemical analyses, which demonstrate that MC252 along the shoreline was significantly depleted in the more toxic oil components, can be used to bound potential toxicity issues.

- "Recently collected weathered oil samples showed 86-98 percent depletion of total polycyclic aromatic hydrocarbons (PAHs)" (p. 2) (OSAT II 2011).
- "In most locations, models predict PAH concentrations in supratidal buried oil will decrease to 20% of current levels within 5 years. However, there are isolated conditions where PAH concentrations are predicted to persist substantially longer" (p. 2) (OSAT II 2011).
- "Based on percent depletion calculations, the majority of the oil that impacted the shoreline was substantially depleted (>80 percent) in tPAHs." (Brown et al. 2011)
- References
  - Brown, J.S. et al., PAH Depletion Ratios Document the Rapid Weathering and Attenuation of PAHs in Oil Samples Collected after the Deepwater Horizon, International Oil Spill Conference, (May 23-26, 2011)
  - Operational Science Advisory Team Gulf Coast Incident Management Team, Effects of Remnant Oil in the Beach Environment (Feb. 10, 2011) ("OSAT II")

API 2-109

6. In Section 4.1.1.4.4 (p. 4-78), the DSEIS states, "The current view of most wetland scientists in the area is that, due to the minimal penetration into the marsh, the weathered condition of the oil, and the observed resiliency of the marsh plants to oiling, the overall effect would be minor and recovery of some marsh vegetation is already being seen (Burdeau and Collins, 2010; Mascarelli, 2010; Zabarenko, 2010)." Should this statement be revised to reflect the findings of published studies? In addition to news reports, research reports, such as the USGS marsh surveys, should be mentioned in the SEIS.

- USGS researchers conducted field expeditions in July and August 2010 in southern Louisiana marshes (Barataria Bay and Bird's Foot delta). They found that the median depth of penetration of oil into the marsh was 5.5m at the Barataria Bay survey points. Fewer areas of oil-damaged canopy were observed in the Bird's Foot area. They found signs of both further degradation and recovery, which varied with site (Kokaly et al. 2011).
- References
  - Kokaly, R.F. et al., Shoreline surveys of oil-impacted marsh in southern Louisiana, July to August 2010: U.S. Geological Survey Open-File Report 2011–1022, (2011), *available at* http://pubs.usgs.gov/of/2011/1022/

7. The DSEIS refers to the length of shoreline oiled over the course of the Deepwater Horizon event. DSEIS at B-30. How was this calculated? Should the Final SEIS include

API 2-110

citations? Also, Section 4.1.3 indicates that "As seen with the *Deepwater Horizon* spill, as the spill continued, the length of oiled shoreline at any one time increased exponentially." DSEIS B-30. Should this statement be revised, as length of shoreline contacted did not exhibit exponential growth?

API 2-111

8. Should "Bayou Jimmy" mentioned at DSEIS 4-70 be changed to "Bay Jimmy"?

API 2-112

9. The DSEIS states that oiling of estuaries from the Deepwater Horizon event "depending on the severity, can destroy nutrient-rich marshes and erode coastlines that have been significantly damaged by recent hurricanes." DSEIS at 4-261, B-33. Should this statement be revised to reflect the fact that most of the oiling that occurred as a result of the DWH event was light, *i.e.*, very little heavy oiling occurred?

API 2-113

10. In a paragraph discussing the oiling of estuaries from the DWH event, the DSEIS states that, "Oiling of these areas, depending on the severity, can destroy nutrient-rich marshes and erode coastlines that have been significantly damaged by recent hurricanes." Should this statement be rephrased to clarify that this is a general statement, not a conclusion about actual impacts from the DWH spill?

API 2-114

11. The DSEIS cites a Wang and Roberts article arguing that "a fair amount of the oil from the DWH event may be buried below the beach surfaces in some areas, which can cause problems to the long-term recreational and ecological uses of these areas." DSEIS 4-297. Should this discussion be revised to reflect a meaningful quantification of the amount of buried oil rather than the imprecise phrase, "a fair amount"? The OSAT-II describes localized deposits of buried oil. In addition, should risk conclusions be updated to reflect current information?

- The OSAT II report found no evidence of human health risks associated with buried oil and noted "that the environmental effects of the residual oil remaining after cleanup are relatively minor, especially when considered in the context of pre-spill background of shoreline oiling." (p. 33) (OSAT II 2011).

API 2-115

12. Should the government's November 2010 oil budget be qualified by noting that the success of particular response methods in collecting oil depends on the incident and situation-specific factors, such as sea state, weather, simultaneous operations, oil encounter rates, wave height, the nature of the oil, *inter alia*? Should the budget be revised to account for biodegradation? Is the budget's estimate of the volume of oil dispersed by the use of chemical dispersants accurate? Does the budget adequately estimate the level of uncertainty in its assumptions? Is its assumption regarding the amount of oil released (4.9 million barrels) accurate?

Water Quality/Water Column

Analysis:

API 2-116

1. Oil encountered in samples from the Gulf of Mexico is not strictly a result of the DWH event, as implied in section 4.1.1.3.2. Natural oil seeps are prevalent in the Gulf of Mexico, and account for the majority of oil released into the Gulf of Mexico. Relevant to sections 4.1.1.3.2 and 4.1.1.8.1, several sources have indicated that the water quality quickly returned to background levels after the well was capped, while analyses showed that in the majority of sediment samples where oil was present, the oil was not attributed to DWH Macondo. DWH-impacted deepwater sediments appear to be limited to the zone within 3 km of the wellhead (OSAT I) where it would not be encountered by dredging or vessel traffic. Additionally, past oil spill research indicates that rapid biodegradation of the residual oil would occur if any remnant oil in sediments was re-suspended (Atlas and Hazen, 2011).

- "…by the first week of August, no surface oil slick was observed and concentrations of detectable oil in the water column were greatly diminished." (Atlas and Hazen 2011)
- "…post-release concentrations quickly return to low (background) levels." (Boehm et al. 2011, Presentation)
- "Sediment collected from more than 120 sites showed qualitative evidence for oil in up to 29% of the cores. However, detailed chemical analyses indicate that only 6% of these cores were contaminated with Macondo oil, all of which were within 2.7 km of the wellhead. Thus, the evidence so far indicated that sediment contamination was limited primarily to near the wellhead." (Atlas and Hazen 2011)
- "The Gulf of Mexico has more natural seeps of oil than any marine area in North America, contributing more than 400,000 barrels of oil a year to the Gulf of Mexico." (Atlas and Hazen 2011)
- "The TPAH concentrations found in the water samples should be viewed in the context of the non-zero background of TPAH that is characteristic of this area of the Gulf of Mexico, which is populated by numerous oil seeps." (Boehm et al. 2011, Paper)
- "Samples that exceeded sediment benchmarks were all located within the range of 0.3 3-2.7 km of the wellhead and were all confirmed to be consistent with MC252 oil." (OSAT I)
- "…if sediments were displaced, so that the oil was no longer sequestered, rapid biodegradation of the residual oil would occur." (Atlas and Hazen 2011)
- References:

- Atlas, R., and Hazen, T. C., Oil biodegradation and bioremediation: A Tale of the Two Worst Spills in U. S. history, Environmental Science & Technology, (2011)
- Boehm, P. et al., Aromatic Hydrocarbon Concentrations in Seawater: Deepwater Horizon Oil Spill, Presentation, 2011 International Oil Spill Conference, (May 23-26, 2011)
- Boehm, P., et al., Aromatic Hydrocarbon Concentrations in Seawater: Deepwater Horizon Oil Spill, Paper, International Oil Spill Conference (Jan. 20, 2011)
- Operational Science Advisory Team, Summary Report for Sub-Sea and Sub-Surface Oil and Dispersant Detection: Sampling and Monitoring, (Dec. 17, 2010) ("OSAT I")

API 2-117

2. The long-term impacts of the spill on coastal and offshore water quality are not entirely unknown, as implied in Sections 4.1.1.2.2.1 of the DSEIS. The DSEIS was apparently prepared before the Operational Science Advisory Team (OSAT) prepared its report on water column, sediment, and beach conditions. The DSEIS also cites only one of the reports prepared by the Joint Analysis Group (JAG). The JAG and OSAT reports are major sources of data on water column conditions during and after the spill. Section 4.1.1.16.3 (page 4-267) notes that, "the application of the dispersant (Corexit 9500) at the seafloor and the surface was alleged to have had the potential to produce larger areas of subsurface anoxic water because of the degradation of oil by bacteria." However, as noted elsewhere in the DSEIS (e.g., 4.1.1.22.1.1, page 4-361) and in the JAG DO report, anoxic conditions were not produced after the DWH release. This section should be updated to be consistent with the remainder of the DSEIS. Major water column findings from these reports include:

- JAG DO Report
  - "The dissolved oxygen measurements showing anomalies around 1000 m and extending to 1300-1400 m (identified in previous JAG reports) are interpreted as actual low values consistent with the depths of occurrence of the MC252 hydrocarbons. These depressions range from approximately 0.1 mL/L to 2.6 mL/L." (p. 7)
  - "The DO2 depression has been found more than 80 km from the wellhead based on CTD DO2 measurements." (p. 7)
  - "Measurements of the DO2 depression have not approached hypoxic levels. Hypoxic conditions are not expected to occur in the deep-water layer where MC252 #1 oil has been observed." (p. 7)
  - "DO2 depressions do not appear to be increasing over time, suggesting that the rate of hydrocarbon BOD is compensated by mixing with higher DO2 waters surrounding the DO2 depleted water layer." (p. 8)
- OSAT Report

- "No exceedances of EPA's Human Health benchmarks in water."
- "No exceedances of EPA's dispersant benchmarks."
- "Since 3 August, no exceedances of the aquatic life benchmark for PAHs in water that were consistent with MC252 oil"
- OSAT I, p. 48, referring to nearshore, offshore, and deepwater sampling. Note: Subsurface water sampling was conducted as far as 500 km to the southwest and 200 km to the northeast (OSAT I, p. 34).

- References
  - Joint Analysis Group (JAG), Review of Preliminary Data to Examine Oxygen Levels In the Vicinity of MC252#1, May 8 to August 9, 2010, (August 16, 2010), *available* http://ecowatch.ncddc.noaa.gov/JAG/files/JAG_Oxygen_Report%20FINAL%20090410.pdf
  - Operational Science Advisory Team, Summary Report for Sub-Sea and Sub-Surface Oil and Dispersant Detection: Sampling and Monitoring, (Dec. 17, 2010) ("OSAT I")
  - EPA, Human Health Benchmarks for Chemicals in Water, http://www.epa.gov/bpspill/health-benchmarks.html

API 2-118

3. Recent publications suggest "cloud" to be the most accurate terminology for references to the measureable amounts of hydrocarbons detected in the subsurface, rather than "plume" as used in sections 3.2.1 and 4.1.1.9.1. The terminology "plume" suggests a higher density of oil over a continuous volume of space in the subsea, whereas the oil released from the DWH spill was in discontinuous clouds of droplets present at low concentrations.

- "The deepwater dispersed oil droplets that had a concentration of less than 10 ppm total petroleum hydrocarbons has been likened to a 'cloud'." (Atlas and Hazen 2011).
- References:
  - Atlas, R., and Hazen, T. C., Oil Biodegradation and Bioremediation: A Tale of the Two Worst Spills in U. S. History, Environmental Science & Technology, (2011)

API 2-119

4. The DSEIS states that water column analyses are in their "preliminary stages" (Section 3.2.1) (pages 3-32, 3-34, 4-39) and mentions that hydrocarbon concentrations were in the parts per million range or less (Section 4.1.1.9.1) (page 4-176), without noting that concentrations in the ppm range were restricted to the area immediately surrounding the well or noting that concentrations fell rapidly after the well was capped. Review of data indicates that concentrations were on the order of parts per billion or less at greater distances from the well even while the well was leaking, and rapidly fell to the ppb range even near the wellhead once the well was capped. While NRD analyses in the water column may be in

their preliminary stages, extensive chemical analyses have been conducted and reported in the water column.

- Based on sampling conducted on the R/V Brooks McCall, May 8-August 24, up to 185 km from the wellhead: "While the concentration of BTEX solvent compounds (benzene, toluene, ethylbenzene, and xylene) was detected at concentrations up to a maximum level of ~500 ppb, in the water, the majority of samples were below 10 ppb." (Lee et al. 2011, poster #2011-381).

- Based on sampling conducted on the R/V Brooks McCall, May 8-August 24: "Despite a sustained period of oil release (thought to be 8,400 m^3/day) with concurrent additions of dispersant over a prolonged period of time, the field data showed a rapid decrease in the concentration of the plume with distance (ppb levels within 50 km, Figure 4) due to physical dilution processes and the biodegradation of oil." (Lee et al. 2011, paper #2011-245).

- "And so what we're seeing are in our water sampling of concentrations of oil that's right now what we're seeing at the higher end is about 0.5, one half part per billion hydrocarbon, which is again, it's clearly not a recoverable amount of oil. And even in the sediments, we're seeing similar very low concentrations of oil as well. And we've – this grid that we've done the sampling extends roughly 300 miles in radius around the well site itself." (Zunkunft 2010).

- Water column monitoring conducted onboard the Brooks McCall (May 7-26, 2010) estimated that maximum hydrocarbon concentrations (based on fluorometry) were on the order of 10s ppb (R/V Brooks McCall Cruises #1-4) in May. Laboratory analyses by Diercks (Diercks 2010) indicate that PAH concentrations in the subsurface in early May were somewhat higher than shown by the Brooks McCall fluorometry, ranging up to the low hundreds of ppb - "Profiles of *in situ* fluorescence and beam attenuation conducted during 9-16 May 2010 were characterized by distinct peaks at depths greater than 1,000 m, with highest intensities close to the wellhead and decreasing intensities with increasing distance from the wellhead. Gas chromatography/mass spectrometry (GC/MS) analyses of water samples coinciding with the deep fluorescence and beam attenuation anomalies confirmed the presence of polycyclic aromatic hydrocarbons (PAH) at concentrations reaching 189 ug L^{-1} (ppb)." (Diercks 2010).

- Based on the analysis of approximately 6,000 offshore water samples (more than 3 miles from shore): "TPH concentrations varied greatly as did the TPAH values summarized above, with values ranging from ND to 6130 mg/L (parts per million), with a geometric mean = 1.09 ppb. BTEX was measured for the most part at values <0.1ppb though higher values >100ppb were encountered in each quadrant other than the southeast (BTEX maximum of 94 ppb) and at the surface and deep water layers. Preliminary review of similar datasets (Camilli et al., 2010) indicates maximum results the same order of magnitude. Camilli et al., 2010 measured volatile mono-aromatics in excess of 50 ppb in the hydrocarbon plumes investigated." (Boehm et al. 2011).

- "During the release (April—July), concentrations of polynuclear aromatic hydrocarbons also decreased rapidly with distance from the release point (the wellhead) and were seen to reach <1.0 ppb within 15—20 mi (24—32 km) in all directions other than to the southwest, where a small number of samples exceeded 1 ppb out to 40 mi (64 km)." (Atlas and Hazen 2011).

- References

    - Diercks, A. et al., Characterization of Subsurface Polycyclic Aromatic Hydrocarbons at the Deepwater Horizon site, Geophysical Research Letters, (Oct. 2010)
    - Lee, K. et al., Time-series Monitoring the Subsurface Oil Plume released from Deepwater Horizon MC252 in the Gulf of Mexico, International Oil Spill Conference, (May 23-26, 2011)
    - Lee, K. et al., Lab Tests on the Biodegradation Rates of Chemically Dispersed Oil Must Consider Natural Dilution, International Oil Spill Conference, (May 23-26, 2011)
    - Rear Adm. Paul Zunkunft, Operational Update with Federal On-Scene Commander, Transcript, (October 19, 2010), *available at* http://www.restorethegulf.gov/release/2010/10/19/transcript-operational-update-fosc-rear-adm-paul-zukunft
    - NOAA, Vessel Data, http://www.noaa.gov/sciencemissions/bpoilspill.html
    - BP, Brooks McCall Cruises #1-4, May 7th -26th 2010, Monitoring Water Quality and Chemistry in the Vicinity of the MC252 Oil Spill Location, *available at* http://usresponse.bp.com/external/content/document/2911/962707/1/Summary_of_Water_Column_and_Dispersed_Oil_Plume_data_5-30-2010.pdf
    - Boehm, P. et al., Aromatic Hydrocarbon Concentrations in Seawater: Deepwater Horizon Oil Spill, 2011 International Oil Spill Conference, (May 23-26, 2011).
    - Atlas, R., and Hazen, T. C., Oil Biodegradation and Bioremediation: A Tale of the Two Worst Spills in U. S. History, Environmental Science & Technology, (2011)

API 2-120

5. Research has confirmed that biodegradation of both the oil and methane occurred rapidly due to the population of microbiota that is adapted to the natural presence of oil in the Gulf of Mexico.

API 2-121

6. Section 4.1.1.2.1.1 (page 4-23), Section 4.1.1.2.2.1 (page 4-33), and Appendix B Section 2.2.1.2 (page B-7 & 8) rely on pre-DWH studies of methane in the deepwater environment for a discussion about the potential concerns arising from elevated methane concentrations in the subsurface. Kessler et al. 2011 noted that methane released by DWH was effectively completely respired by fall 2010, and there is no evidence that methane remains in the environment. This is noted in other sections of the SEIS (4.1.1.16.1, page 4-261 and

4.1.1.16.3, page 4-267). This section of the SEIS should be updated to be consistent with other sections of the SEIS and to reference the Kessler et al research.

- "Average half-life of alkanes from two different cloud analyses and two different lab microcosm assays ranged from 1.2 to 6.1 days… Much of the decline in PAHs is attributable to microbial degradation." (Atlas and Hazen 2011).
- "When oil is highly dispersed in the water column and where microbial populations are well adapted to hydrocarbon exposure, such as in the Gulf of Mexico waters, biodegradation of oil proceeds very rapidly." (Atlas and Hazen 2011).
- "Extensive biodegradation of alkane and aromatic fractions in water likely accounts for rapidly decreasing (distance and time) PAH concentrations." (Boehm et al. 2011).
- "These results indicated that a variety of hydrocarbon-degrading populations exist in the deep-sea plume and that the microbial communities appear to be undergoing rapid dynamic adaptation in response to oil contamination." (Hazen et al. 2010).
- "Methane was the most abundant hydrocarbon released during the 2010 Deepwater Horizon oil spill in the Gulf of Mexico… a vigorous deepwater bacterial bloom respired nearly all the released methane within this time [~120 days]." (Kessler et al. 2011).
- Reddy et al. report that "the observed near-complete dissolution of methane in deep waters is consistent with previous field and modeling studies in systems of similar water column depth." They find that most of the ethane and propane was retained in the deep water "plumes," but that "a sizeable portion of ethane (9%) and propane (22%) was retained in the buoyant liquid oil phase that continued ascent to the sea surface."
- "Looking beyond hydrocarbon gases, we investigated the fractionation of higher molecular weight petroleum components into the deep water column by comparing their abundances to benzene. Benzene is highly water-soluble, suggesting that it too may have dissolved rapidly in the deep sea. Indeed, benzene concentrations were systematically elevated (0.4–21.7 μgL−1) in the 1,100-m-depth plume and nearly absent at depths shallower than 1,000 m (1) (Fig. 3, and Table S4). A comprehensive survey of hydrocarbons in air above the Macondo well site revealed that very little benzene reached the sea surface (24). Taken together, water column and surface measurements suggest that benzene was predominantly retained in the deep water column." *Id.*
- References:

  - Atlas, R., and Hazen, T. C., Oil Biodegradation and Bioremediation: A Tale of the Two Worst Spills in U. S. History, Environmental Science & Technology, (2011)

- Boehm, P. et al., Aromatic Hydrocarbon Concentrations in Seawater: Deepwater Horizon Oil Spill, 2011 International Oil Spill Conference, (May 23-26, 2011)
- Hazen, T.C. et al., Deep-Sea Oil Plume Enriches Indigenous Oil-Degrading Bacteria, Science, (Aug. 26, 2010)
- Kessler, J. et al., A Persistent Oxygen Anomaly Reveals the Fate of Spilled Methane in the Deep Gulf of Mexico, Sciencexpress (Jan. 6, 2011)
- Reddy C. et al., Composition and fate of gas and oil released to the water column during the Deepwater Horizon oil spill, Proceedings of the National Academy of Science, (July 18, 2011)

API 2-122

7. The nature of the deepwater blowout, not the subsea injection of chemical dispersants (as implied by Section 4.1.1.16.3 and at B-18), was responsible for the subsurface clouds of dispersed oil and gas. Based on pre-spill research into deepwater blowouts, persistent underwater clouds were expected. However, the use of subsea dispersants, which was not included in prior experiments or models, decreased droplet sizes and contributed to greater dispersion at depth. Additionally, recent research has indicated that methantropic bacteria have already respired nearly all the released methane.

- "Kessler et al. reported that within ~120 days from the onset of release, a vigorous deepwater bacterial bloom of methanotrophs had respired nearly all the released methane." Kessler et al. 2011.
- DeepSpill model simulations and field experiments conducted by SINTEF before the DWH spill indicated that not all oil droplets rise to the surface. Instead, a portion of the oil droplets (varying by droplet size) are carried by cross-currents laterally. SINTEF also found that the gas underwent dissolution before reaching the surface. (Johansen et al. 2001, Johansen et al. 2003, Reed et al.).
- "Together, these factors will cause a significant reduction in buoyancy flux, and as a consequence, the plume may become more sensitive to cross currents and the presence of density stratification in the water masses. In such cases, even small stable density gradients in the ambient water may be expected to cause trapping of the plume. However, the oil may finally arrive at the sea surface due to the buoyancy of individual oil droplets. The resulting surface spreading of the oil will then depend on the size distribution of the oil droplets and the strength and variability of the ambient current." (p. 123 of Johansen et al.)
- References
  - Atlas, R., and Hazen, T. C., Oil Biodegradation and Bioremediation: A Tale of the Two Worst Spills in U. S. History, Environmental Science & Technology, (2011)
  - Kessler, J. et al. A Persistent Oxygen Anomaly Reveals the Fate of Spilled Methane in the Deep Gulf of Mexico, Sciencexpress, (Jan. 6, 2011)

- Johansen, O., et al., DeepSpill - Field Study of a Simulated Oil and Gas Blowout in Deep Water, Spill Science & Technology Bulletin, (2003)
- Reed, M. et al., Deepwater Blowouts: Modeling for Oil Spill Contingency Planning, Monitoring, and Response, International Oil Spill Conference, (1999), *available at* http://www.iosc.org/papers/00429.pdf
- Johansen, O. et al., DeepSpill JIP - Experimental Discharges of Gas and Oil at Helland Hansen - June 2000, Technical Report, (June 5, 2001)

API 2-123

8. Section 4.1.1.13.1 notes that "[n]o oil has yet been reported as entering the Loop Current." DSEIS at 4-216. Should this section be updated to include NOAA's comment from July 30, 2010 that no significant oil was expected to enter the Loop Current (http://response.restoration.noaa.gov/dwh.php?entry_id=815)?

API 2-124

9. Section 4.1.1.6.2.3 (page 4-128) indicates that, "The report of damage to deepwater corals on the continental slope (USDOI, BOEMRE, 2010i) as a result of exposure to oil from the DWH probably resulted from the use of dispersant at the source of the blowout." *See also* 4-103. There is no evidence that coral damage occurred as the result of the use of dispersants, particularly since oil would have been present in the subsea regardless of whether chemical dispersants were used. Should the reference to dispersants in this statement therefore be removed?

API 2-125

10. Section 4.1.1.9.1 (page 4-176) references visual observations by Joye of material on the sea floor and suggests that these observations indicate the presence of "extensive oil deposition." Based on sampling data provided in the OSAT I report, there is no evidence of extensive oil deposition on the deep seafloor. The OSAT I report includes re-sampling of the area noted by Joye. Therefore, should this paragraph be revised accordingly to reflect the available data demonstrating that the Joye visual observations are not confirmed by laboratory analysis?

API 2-126

11. The DSEIS states, "Depending on how long it remained in the water column, oil may have been well-dispersed and thoroughly degraded by biological action before contact with the seafloor." DSEIS at 4-187. Does this statement incorrectly imply that oil would naturally sink unless it is well dispersed and biodegraded? Sinking would not occur unless the oil becomes entrained in heavier material or sand. Otherwise it rises to the surface or stratifies and dilutes until it is eventually biodegraded. *See* NOAA's Near Shore Submerged Oil Assessment. Moreover, successful dispersion of DWH oil resulted in the formation of very small particles (<50um), which are unlikely to re-coalesce and deposit on the seafloor. *See* public LISST data from Brooks McCall and other vessels. *See also* OSAT data (indicating limited sedimentation of oil, even near wellhead).

- References
  - Near Shore Submerged Oil Assessment, September 2010 http://www.noaa.gov/pdf/NearShoreSubmergedOil%20FINAL.pdf)

API 2-127

12. Sections 4.1.1.15.3 (page 4-253) and 4.1.1.15.4 (4-255 & 256) note that "[i]t can be assumed that since the oil was treated with dispersant that it may sink, and depending on the condition (toxicity) of the oil, it may potentially affect the benthic forage in the areas where it blankets the bottom." Data from the OSAT report provides no evidence that oil has blanketed the bottom. In addition, as noted elsewhere in the DSEIS, there is no basis for the conclusion that dispersed oil will sink. Instead, small dispersed droplets of oil will not fall to the seafloor unless they first interact with other heavier particles.

API 2-128

13. Should the citations to the Brooks McCall final data at p. 4-22, 4-33 be updated?

API 2-129

14. The DSEIS states that "significant amounts of oil remain" in the Gulf of Mexico as a result of the DWH event. DSEIS at 4-22, 4-33. The term "significant" may be confusing to some readers. For instance, a reader might conclude that this oil poses a human health risk, when OSAT II found that there are no human health risks from remnant oil on the shoreline. Would it be useful to instead describe the extent of remaining oil in terms of the specific findings contained in OSAT I, OSAT II and OSAT's Summary Report for Sub-Sea and Sub-Surface Oil and Dispersant Detection: Ecotoxicity Addendum (July 8, 2011)?

- References
  - Operational Science Advisory Team, Summary Report for Sub-Sea and Sub-Surface Oil and Dispersant Detection: Sampling and Monitoring, (Dec. 17, 2010) ("OSAT I")
  - Operational Science Advisory Team Gulf Coast Incident Management Team, Effects of Remnant Oil in the Beach Environment, (Feb. 10, 2011) ("OSAT II")
  - Operational Science Advisory Team Gulf Coast Incident Management Team, Summary Report for Sub-Sea and Sub-Surface Oil and Dispersant Detection: Ecotoxicity Addendum, (July 8, 2011) ("OSAT Exotoxicity Addendum")

API 2-130

15. The DSEIS states "[i]nitially released studies indicate that bacteria are degrading hydrocarbons from both gas and oil, but the degradation rates reported in the studies varied considerably." DSEIS at 4-24. Should this statement also cite to Kessler et al. Sciencexpress Jan. 6, 2011?

- References
  - Kessler, J. et al. A Persistent Oxygen Anomaly Reveals the Fate of Spilled Methane in the Deep Gulf of Mexico, Sciencexpress, (Jan. 6, 2011)

API 2-131

16. The DSEIS states, "As a result of the use of subsea dispersants, clouds or plumes of dispersed oil may occur near the blowout site far from coastal waters. Reports thus far from researchers deployed after the DWH event and resulting spill have found such plumes and have shown that the concentrations of these clouds drop to undetectable levels within a few miles (USDOC, NOAA, 2010c)." DSEIS at 4-24. *See also* 4-34. Are these statements accurate in light of the following?

- Natural turbulence during any deep spill will cause significant dispersion of oil into the water column, although subsea dispersants can further break up the oil and decrease droplet size.
- Hazen et al., Valentine et al. have found that the cloud of dispersed oil was virtually undetectable by mid-August, and have suggested that methane concentrations decreased to ambient levels within months of the well capping. Additionally, in November 2010, FOSC Rear Admiral Paul Zukunft said that the highest concentrations of oil being detected in the water column were "about 0.5 parts per billion." (Zukunft Operational Update).
- References
  - Rear Adm. Paul Zunkunft, Operational Update with Federal On-Scene Commander, Transcript, (October 19, 2010), available at http://www.restorethegulf.gov/release/2010/10/19/transcript-operational-update-fosc-rear-adm-paul-zukunft

API 2-132

17. The DSEIS states, "The BOEMRE research has shown that drilling mud discharges do not move very far, even when discharged at the surface (CSA, 2006a)." DSEIS at 4-24, 4-35. Does the reference cited support this statement? Can a specific page number be provided?

API 2-133

18. The DSEIS states, "Since the muds were discharged in deep water, it is not expected that coastal waters and sediments will suffer significant adverse effects." DSEIS at 4-24. Should OSAT I be cited to support this statement?

API 2-134

19. The DSEIS states that the "greatest concentrations [of oil] are expected to be near the wellhead and to decrease with distance from the source." DSEIS at 4-360, 4-381. This statement might be taken to mean that oil from the Deepwater Horizon spill is still being detected in the water column near the wellhead. Should it be revised either to clarify that it refers to soft bottoms rather than to the water column?

API 2-135

20. The DSEIS states, "Despite more limited information on the water quality of deep water, it is clear that the condition of the offshore waters of the Gulf of Mexico was altered by the DWH event and resulting oil spill." DSEIS at 4-32. Does this statement acknowledge the temporal nature of the effects of an oil spill on water quality? The condition of offshore waters in the Gulf of Mexico after the DWH event has improved since the first review of water quality data occurred.

API 2-136

21. The DSEIS states, "The negative effect is that the oil, once dispersed, is more available to microorganisms, which temporarily increase the toxicity (Bartha and Atlas, 1983)." DSEIS at 4-23, 4-34. Does dispersed oil that is more available to degradation by microorganisms in fact *decrease* toxic effects overall?

API 2-137 22. The DSEIS describes a variety of mechanisms by which oil could have come into contact with the sea floor. DSEIS at 4-175 - 4-176. *See also* DSEIS at 4-182. Is there any evidence or data that indicates that this occurred during the DWH event?

API 2-138 23. The DSEIS states, "As of this w*riting,* there are no data on the concentrations of hydrocarbons in sediments or on benthic community structure on the seafloor of the Gulf of Mexico after this event." DSEIS at 4-176, 4-361. Should this statement be revised because there are now numerous sources (e.g., OSAT I, JAG) that provide analysis of sediments samples as well as a substantial amount of data for hydrocarbon and dissolved oxygen levels in the water column?

API 2-139 24. The DSEIS states that "it has been suggested that the addition of dispersants at the seafloor has resulted in large subsurface clouds of elevated methane concentrations." DSEIS at 4-266. Is this claim supported by published evidence? There is no documentation to suggest that dispersant application results in increased methane dissolution into the water column. As reported by Kessler et al 2011, Ryerson et al 2011, etc., methane is expected to dissolve in the water column.

API 2-140 25. The DSEIS states, "The speed of degradation of the oil by bacteria is also related to the water temperature." DSEIS at 4-267. Should this statement be revised because deepsea cold waters contain microbial populations evolved to consume oil at ambient, low temperatures? Hazen has identified species responsible for rapid biodegradation observed after DWH. Laboratory studies by Ken Lee reported at IOSC confirmed that biodegradation may be rapid and efficient at temperatures as low as 0.5 C.

- References
    - Lee, K. et al., Lab Tests on the Biodegradation Rates of Chemically Dispersed Oil Must Consider Natural Dilution, International Oil Spill Conference, (May 23-26, 2011)

API 2-141 26. The DSEIS states that "hypoxic levels" may have been reached in the DWH subsea cloud. DSEIS at 4-361. Should the subsequent text be revised to reflect data showing that there was a temporary decrease in dissolve oxygen in certain areas, but no hypoxic levels were detected?

- The Join Analysis Group report states that, "Measurements of the DO_2 depression have not approached hypoxic levels. Hypoxic conditions are not expected to occur in the deep-water layer where MC252 #1 oil has been observed." (JAG 2010). This finding is confirmed in OSAT I.

- The Joint Analysis Group report also concluded that oxygen depletion has stabilized. There is no data to suggest that anoxic conditions will develop in the future as the result of the DWH spill.

- As BOEMRE notes in its final SEIS for the Western Planning Area, "Data from David Valentine… contradict the assertion of long-term impacts to dissolved oxygen.

His data indicate the methane was gone in 3 months after the Macondo well was capped, without appreciable impact to dissolved oxygen." 5-169.

Additional Comments Incorporated by Reference

API 2-142

In addition to the aforementioned comments, API incorporates, by reference, the following comments submitted in Enclosure 2 to API's comments in response to the Western Planning Area Lease Sale 218 Draft Supplemental Environmental Impact Statement. In many cases, BOEMRE made changes to the DSEIS for the Western Planning area in response to these comments. Where these changes are equally applicable to the CPA DSEIS, API requests that they be carried over. The table below is provided in part to facilitate this process.

API's prior comments to be incorporated herein are identified by the numbers assigned to them by BOEMRE in the Western Planning Area Lease Sale 218 Final Supplemental Environmental Impact Statement. The pages in the CPA DSEIS to which these numbers apply are also identified.

Comment	Changes Made by BOEMRE in Final WPA SEIS	CPA DSEIS Page Number(s)
API-1	x	Generally applicable
API-2	x	4-48
API-5	x	4-381
API-13		4-16, 4-18, B-17, B-31
API-14	x	B-17, B-31
API-15	x	4-266, 4-278
API-17		2-25, 4-16, 4-18, 4-347, 4-348, 4-349, B-17, B-48, B-50
API-18		4-15
API-19		4-127, 4-175, 4-360
API-21		4-176, 4-360
API-22	x	4-176, 4-361
API-23		4-361
API-24	x	E.g., 4-360
API-25		3-41, 3-42
API-27	x	Generally applicable
API-28	x	4-220
API-30	x	Table 4-6, A-54 - A-58
API-31	x	4-195, 4-202, 4-205, 4-211, 4-233, 4-242
API-33	x	E.g., 4-382
API-35	x	4-185, 4-193
API-36	x	4-176
API-39		4-298, 2-21, 4-297, 4-299
API-41		4-270, 4-281
API-42		4-287
API-43	x	B-19

API-44		
API-47	x	4-195, 4-202, 4-205, 4-211, 4-233, 4-242, D-22, D-24, D-29
API-48	x	B-21
API-49		4-199
API-53	x	E.g., 4-165, 4-168
API-54	x	4-81
API-56	x	4-275, 4-354
API-57	x	4-195, 4-202, 4-205, 4-211, 4-233, 4-242, D-22, D-24, D-29
API-58	x	4-211, A-23
API-59	x	B-21, D-22, D-33
API-60	x	4-176
API-63	x	B-30
API-67		4-382
API-68	x	4-145
API-73	x	4-155
API-74		4-155, B-18

API 2-1 Since publication of the Draft Supplemental EIS on July 1, 2011, BOEM subject-matter experts incorporated newly available relevant information and updated this Supplemental EIS accordingly.

API 2-2 Since publication of the Draft Supplemental EIS on July 1, 2011, BOEM subject-matter experts incorporated newly available relevant information and updated this Supplemental EIS accordingly.

API 2-3 References to websites internally in the document have been deleted and moved to the bibliography. Those websites referenced have been verified and are accurate as of the date that this Supplemental EIS is published.

API 2-4 If appropriate, those references were included when the document was prepared or updated since publication of the Draft Supplemental EIS on July 1, 2011.

API 2-5 The OSAT reports (OSAT and OSAT-2) were not accessible by BOEMRE at the time the Draft Supplemental EIS was prepared. The BOEM subject-matter experts have reviewed the reports and have revised the Supplemental EIS as necessary to include these reports and other newly available relevant information.

API 2-6 The references to the daily maps of spilled oil were removed as outdated from **Chapters 4.1.1.11 and 4.1.1.12**. Where appropriate, references to the OSAT report were added to this Supplemental EIS.

API 2-7 This Supplemental EIS has been updated to reflect the OSAT report results where appropriate.

API 2-8 Comment noted. The BOEM subject-matter experts have included what information they deem relevant, including anecdotal information where appropriate. Clarifying language has been added, noting that additional information on anecdotal data during the DWH event are addressed in **Chapter 4.1.1.21.4** (Environmental Justice).

API 2-9 The BOEM reviewed summary statements available at the time, which included USEPA and State of Louisiana air monitoring data. Where relevant, additional information was included by BOEM subject-matter experts.

API 2-10 The baseline years were established in 1977 for SO_2 and in 1987 for NO_2. However, the BOEM deleted the paragraphs referring to **Tables 4-26 and 4-27** from this Supplemental EIS because the information was previously discussed in detail in the Multisale EIS, and this Supplemental EIS tiers from that document.

API 2-11 The BOEM subject-matter expert believes no additional clarification on the referenced language is required. However, BOEM added comparative language to this Supplemental EIS regarding shoreline dioxin concentrations at the time of the in-situ burns to background concentrations in the rural U.S.

API 2-12 Clarifying language was added to this Supplemental EIS.

API 2-13 See the response to Comment API 2-12.

API 2-14 The short-term effects reportedly caused by the DWH event are anecdotal. The BOEM has revised this sentence to reflect “any long-term health effects.”

API 2-15 The sentence was in error and was deleted. The BOEM subject-matter experts have incorporated newly available relevant information, where appropriate, since publication of the Draft Supplemental EIS.

API 2-16 The statement was revised to focus on aerial dispersant application. The BOEM subject-matter experts have included what information they deem relevant, including anecdotal information on health complaints where appropriate.

API 2-17 Comment noted. The sentence referenced by API has been deleted from this Supplemental EIS, as the impacts and causation have not been established.

API 2-18 Comment noted. See the response to Comment API 2-17.

API 2-19 Comment noted. The text has been revised to address USEPA's health-based standards and public health concerns.

API 2-20 The BOEM subject-matter experts included available information they deemed relevant in their resource analyses, including in this instance, research related to the Kuwait oil-field fires. The Kuwaiti oil-field fires are a primary instance where ambient air quality effects from oil burning have been further researched. Nevertheless, BOEM has revised language relating to the Kuwaiti oil-field fires within this Supplemental EIS to avoid potential confusion.

API 2-21 The erroneous reference to Trapido (2010) has been deleted, and the correct references have been supplied. **Chapter 4.1.1.21.4.3** was updated to incorporate supporting references and an explanation of how USEPA defined human health benchmarks.

API 2-22 Comment noted. The subject-matter expert has updated this Supplemental EIS since publication of the Draft Supplemental EIS on July 1, 2011, and has added clarifying language and additional supporting material related to health effects from exposure to dispersants.

API 2-23 Since publication of the Draft Supplemental EIS on July 1, 2011, the subject-matter experts have incorporated newly available relevant information and have updated this Supplemental EIS accordingly. The incorporation of newly available relevant information is time consuming, as it must be obtained and reviewed by subject-matter experts in the context of the source of the data, research methodology, and data quality.

API 2-24 Updated information on the status of this study was included in **Chapter 4.1.1.13.1**.

API 2-25 Information from the OSAT-2 report has been added to this Supplemental EIS.

API 2-26 Clarifying language was added to **Chapter 4.1.1.13.1**.

API 2-27 Citations have been provided in **Chapter 4.1.1.14.1**.

API 2-28 The term was changed to "important" to avoid any confusion.

API 2-29 Clarifying language and additional studies are included in **Chapter 4.1.1.14.1**.

API 2-30 Additional language has been added to **Chapter 4.1.1.14.1**.

API 2-31 The citation for BOEM's original statement quoted in Comment API 2-31 is provided in this Supplemental EIS; however, BOEM has added clarifying language that it may be premature to report on certain specific populations.

API 2-32 The BOEM subject-matter experts determined the information that was relevant for the individual resource analyses. New information that was available and deemed relevant has been used to finalize this Supplemental EIS. Where relevant, additional language has been added to **Chapter 4.1.1.14.1** in response to this comment.

API 2-33 **Chapter 4.1.1.6.1.1**, subsection titled "Baseline Conditions following the *Deepwater Horizon* Event," has been updated to reflect new information available since publication of the Draft Supplemental EIS. The conclusions drawn in the paragraphs were deduced from the direction of currents and the physical properties of seawater paired with visual observations. Samples of the coral and oil were collected and fingerprinted; however, the results have not been released to the public yet.

API 2-34 The sentence referring to Haddad and Murawski (2010) has been removed from this Supplemental EIS and has been replaced with newly available data.

API 2-35 This paragraph was removed from this Supplemental EIS since the cruise was not directly pertinent to topographic features; it was focused on the West Florida Shelf.

API 2-36 Information was added to this Supplemental EIS to include the suggested revisions.

API 2-37 The pages that describe the nepheloid layer at banks include the following: Bright et al., 1976, pp. 50, 94, and 306; and Bright and Rezak, 1978, pp. III-31, III-47, and VI-33 (figure). The BOEM subject-matter expert's statement is based on the descriptions of the nepheloid layer in relation to the crests of banks.

API 2-38 No; although oil degrades over time, water currents would carry an underwater plume for many miles before it was degraded. If the sensitive habitats were continuous and if the oil plume traveled along the seafloor, the impacts would not be localized; rather, they would be widespread. It is a question of a matter of scale.

API 2-39 The wording refers to "potential hard-bottom habitats." The intended use of the word "potential" was meant to indicate that there remains some uncertainty as to the actual nature of the habitat in question.

API 2-40 The BOEM subject-matter expert believes that this Supplemental EIS is accurate as written. The mucus helps prevent the oil from penetrating to the tissues beneath, so it restricts penetration. Penetration is also restricted because mucus contains wax esters and lipids (Shigenaka, 2001).

API 2-41 No connection between the character of shallow gorgonians and *Lophelia* is intended. The statement was addressing another common deepwater coral, gorgonians. Resistance of shallow tropical corals (meaning scleractinians) suggests possible similar resistance in deepwater scleractinians. Then, resistance in shallow tropical gorgonians was cited, suggesting possible similar character of deepwater gorgonians. The paragraph was edited to clarify this data.

API 2-42 The verbiage in this Supplemental EIS was adjusted accordingly.

API 2-43 This is not a conclusion; rather, it is an illustration of the possible response to oil. The statement has been clarified in this Supplemental EIS.

API 2-44 The BOEM subject-matter experts believe that this statement remains accurate. Although some corals are encrusting, with very low profile, those corals typically encrust on structure that has relief, i.e., protrudes up into the water column. Even encrusting corals can form structure, i.e., they build a reef. Only a few solitary corals actually live on soft sediment.

Other corals, by nature, must stick up into waters above the sediment boundary layer to successfully live by suspension feeding. Their very purpose is to glean particles from the water column. All these corals would be more susceptible to oil impacts from a subsea oil plume than would the adjacent sediment.

API 2-45 Citations are given in this Supplemental EIS. As discussed, experiments with deepwater corals are not available at this time, and the results of studies following the DWH event are pending or not yet publicly available. The discussion is based on known reactions of shallow-water coral to oil exposure. Note that the discussion also suggests mechanisms by which impacts to corals may be negligible.

API 2-46 See the response to Comment API 2-33. Also note that a clarifying sentence was added to **Chapter 4.1.1.6.1.1**, indicating that samples of coral and oil were collected and fingerprinted but that the data have not been released yet.

API 2-47 The text has been edited in multiple locations to include information from the OSAT I report. As noted in the Supplemental EIS, subsea oil plumes travel with water currents and may be expected to lose oil via sedimentation in small quantities over a very wide area. Therefore, the sediment beneath a plume may show only very low levels of oiling. If such a plume were entrained in a bottom current, it would travel over sediment without mixing with sediment. However, when the plume encounters an obstruction, such as coral structure protruding above the seafloor, the turbulence induced would allow some contact of the oil with the obstruction.

API 2-48 Clarifying revisions were made to the text.

API 2-49 Comment noted. The text has been revised to address the USEPA's health-based standards and the public health concerns.

API 2-50 Comment noted. **Chapter 4.1.1.21.4.3** was supplemented with information from the OSAT report related to benchmark information.

API 2-51 The subject information has been reviewed by BOEM subject-matter experts, and it has been determined that these reports do not provide relevant information on toxicity to fish resources.

API 2-52 The references have been updated where appropriate.

API 2-53 The BOEM subject-matter experts have updated this section with information available since publication of the Draft Supplemental EIS.

API 2-54 The language has been changed to indicate that the dispersant actually breaks down the oil fractions into smaller droplets that remain in the water column and that are more susceptible to biodegradation, thus reducing toxicity. However, depending on the type of oil and how thoroughly it is weathered prior to encountering sediment plumes, there still may a slight potential for sinking to the mid-water column or to the bottom.

API 2-55 Newly available information regarding freshwater diversions and the potential for impacts from the DWH event has been included in **Chapter 4.1.1.17.1**.

API 2-56 The reference to the Knowland Group study has been removed from this Supplemental EIS. A reference from the U.S. House of Representatives (2010) has been added; this reference provides a more comprehensive examination of the role of perceptions and media coverage on tourism activity. In addition, data on the actual levels of hotel occupancy that were observed following the DWH event were also added to this Supplemental EIS.

API 2-57 Misperceptions can cause real effects in consumer activity and related economic responses. However, the role of misperceptions, particularly when considering the potential impacts of future spills, is difficult to predict. A study by Market Dynamics Research Group has been added to this Supplemental EIS; this study analyzes the role of perceptions following the DWH event.

API 2-58 Updated language regarding the pace of permitting and drilling during and after the suspension has been added to this Supplemental EIS.

API 2-59 Information related to the recovery of the recreational and commercial fisheries has been revised in **Chapter 4.1.1.21.3**. For additional information related to impacts to commercial and recreational fishing, refer to **Chapters 4.1.1.17 and 4.1.1.18**, respectively. Even though all Federal commercial fishing grounds have been reopened, there may still be effects to the extent that seafood demand was affected and to the extent that the fish populations in the Gulf of Mexico evolve following the spill and intervening factors.

API 2-60 The subject-matter expert has updated this Supplemental EIS since the publication of the Draft Supplemental EIS and has added clarifying language and additional supporting material. Case studies included in this Supplemental EIS regarding past oil-spill events have demonstrated that, because of a lack of available financial substitutes, the various effects of an oil spill may be felt more acutely by lower income groups. The BOEM subject-matter expert believes that the information and evidence provided in this Supplemental EIS remains relevant to a discussion of potential impacts and has clarified language in this Supplemental EIS to indicate that available data may not be sufficient to form final conclusions at this time.

API 2-61 The survey was conducted between July 19 and 25, 2010. There are no more recent surveys publicly available at the time of the preparation of this Final Supplemental EIS.

API 2-62 The BOEM subject-matter expert believes that the language in this Supplemental EIS remains accurate. Eligible GCCF grounds for a claim are listed in this Supplemental EIS. These claims include claims for removal and cleanup costs, real or personal property, lost earnings or profits, loss of subsistence use of natural resources, and physical injury/death directly or indirectly because of the DWH event (see **Table 4-42** for a state-by-state break down). See Section 7, #74 from the GCCF Frequently Asked Questions (Gulf Coast Claims Facility, 2010b).

API 2-63 The BOEM subject-matter expert believes the statement is accurate. Potential lingering impacts could be positive (such as improved oil-spill-response capacity) or negative (such as potential emotional distress in the areas with the greatest response efforts). As is the case with any large event, impacts may last beyond the spill or active cleanup efforts.

API 2-64 There are no published studies at this time, although there have been statements in the press. The BOEM subject-matter expert has clarified language in this Supplemental EIS on waste locations and that "waste disposal locations were determined by the specializations of existing facilities and by contractual relationships between them and the cleanup and containment firms."

API 2-65 The survey was conducted during July 2010. There are no more recent surveys.

API 2-66 The BOEM's reliance on this report has been supplemented with more recent information. A number of new data sources regarding the observed impacts of the DWH event have been added. Since publication of the Draft Supplemental EIS on July 1, 2011, the subject-matter experts have incorporated newly available relevant information and have updated this Supplemental EIS accordingly.

API 2-67 The study by CoreLogic presented a forecast of the impacts of the DWH event on property values rather than an analysis of observed data. This Final Supplemental EIS clarifies this issue. The study did control for other variables since CoreLogic's forecast analysis was based on losses relative to baseline expected property values.

API 2-68 The pages cited by API relate solely to Gulf sturgeon. **Chapter 4.1.1.16** addresses fish resources and EFH more generally and also the potential impacts to reproductive effects.

API 2-69 Comment noted. Information from Fodrie and Heck (2011) is included in **Chapter 4.1.1.17.1**. The BOEM notes that Fodrie and Heck also conclude, "The long-term impacts facing fishes as a result of chronic exposure and delayed, indirect effects now require attention." The Supplemental EIS language quoted by the commenter remains valid. Water quality data, including data from the OSAT report, are discussed in **Chapter 4.1.1.2**.

API 2-70 Updated information on fish kills in the CPA has been included in **Chapter 4.1.1.16.1**. As noted in this chapter, the cause of the fish kills has been listed as either unknown or due to low dissolved oxygen. No cause has been given for the low dissolved oxygen attributed to these fish kills.

API 2-71 The BOEM has modified the quoted language to indicate that there may be other factors that affect physical toxicity, including the toxicity of the dispersant used.

API 2-72 Newly available information regarding freshwater diversions and the potential for impacts from the DWH event has been included in **Chapter 4.1.1.17.1**.

API 2-73 Clarifying language can be found in **Chapter 4.1.1.16.1**.

API 2-74 Updated information on fish catches, where relevant, has been included in **Chapter 4.1.1.17.1**. The BOEM notes, however, that it is difficult to predict trends from a single year of data.

API 2-75 A change was made to **Chapter 4.1.1.21.4.3** to provide additional information related to the exposure of dispersed oil.

API 2-76 Although some raw data from NMFS (primarily strandings and carcasses recovered) have been released to the public, the bulk of NRDA studies are ongoing for marine mammals, with no conclusions to date.

API 2-77 A discussion of the UME is included in **Chapter 4.1.1.11.1**.

API 2-78 Since publication of the Draft Supplemental EIS, the subject-matter experts have incorporated relevant information and have updated this Supplemental EIS accordingly. This Final Supplemental EIS has been updated to reflect the results of the OSAT reports where appropriate.

API 2-79 This statement was based upon the referenced data included in **Chapter 3.2.1**: "Of the oil reservoirs sampled in the Gulf of Mexico OCS, the majority fall within the light-weight category, while less than one-quarter are considered medium-weight and a small portion are considered heavy-weight. Oil with an API gravity of 10.0 or less would sink and has not been encountered in the Gulf of Mexico OCS (USDOI, BOEMRE, 2010c)."

API 2-80 The requested language occurs in several places in this Supplemental EIS. For example, the Coastal Response Research Center's 2007 study's conclusion that "mechanical methods for recovering submerged oil have limited effectiveness" is included in **Chapter 3.2.1.5.2**.

API 2-81 The section referenced by API is a general description of offshore response and cleanup technology; it is not intended to address the fate of spilled oil. The fate of spilled oil is addressed in **Chapter 4.1.1.2** (Water Quality).

API 2-82 These statements, taken from Lubchenco et al. (2010), describe the oil as dispersed or weathered, which is why this report was quoted to support the statement on page 3-42 of the Draft Supplemental EIS, that dispersion increases the likelihood that the oil will be biodegraded both in the water column and at the surface. While noted, BOEM subject-matter experts believe that the additional references proffered by API are not appropriate for inclusion in a discussion that is focused on dispersant capability.

API 2-83 This statement has been clarified in this Supplemental EIS, as has the reference.

API 2-84 The BOEM subject-matter expert maintains that the statement related to the Johansen et al. (2001) study is a fair summary. The statement in this Supplemental EIS is further supported by *Oil in the Sea* (NRC, 2003, p. 108).

API 2-85 The API comment was noted, and clarifying revisions were made to the text.

API 2-86 The text was edited to include updated information based on the Federal Interagency Solutions Group (2010) analysis. This statement refers to oil not specifically collected at the time the well was capped.

API 2-87 The text was edited to include the possibility of dissolution or biodegradation.

API 2-88 Water currents and biodegradation regulate the lateral movement of subsea oil plumes (direction and distance). The API is correct that density controls its vertical movement and, thus, clarifying language was added in the text.

API 2-89 The comment was noted and this text has been deleted.

API 2-90 The reference has been added as appropriate.

API 2-91 Updated information, including both Mr. Allen's March 2011 presentation and the U.S. Coast Guard's BP *Deepwater Horizon* Oil Spill Incident Specific Preparedness Review, have been added to this Supplemental EIS.

API 2-92 The U.S. Coast Guard's BP *Deepwater Horizon* Oil Spill Incident Specific Preparedness Review (January 2011) does include recommendations for ACP upgrades that would better identify and prioritize environmentally sensitive areas and provide protection strategies for these areas; however, the specifics mentioned in this Supplemental EIS are not included within the January 2011 document. A reference to Admiral Thad Allen's press conference transcript (July 30, 2010) has been added to support the statement concerning damage to the marsh environment by hard boom during the DWH response.

API 2-93 The volumes and distances for the artificial sand berms described in **Chapter 3** are accurate as per COE-hosted weekly interagency coordination meetings during berm construction. The lengths of the approved plans are based on the actual COE permits, applications, and associated drawings. Appendix D will not be carried forward into the Final Supplemental EIS.

API 2-94 There are no publicly available documents to cite. The request for concurrence was denied via an email from USCG to the State of Louisiana. The referenced sentence has been revised.

API 2-95 Many of these statements related to the artificial berms were based on the berms' potential impacts as they were originally proposed prior to interagency coordination and not how they were ultimately constructed. Appropriate changes have been made to the description of the artificial berms in **Chapter 4.1.1.3.4**. The State did shift the berm project's objectives from an oil barrier to barrier island restoration, as evidenced by the reallocation of funds. The berms that were under construction were built, but the remaining planned berms were not. The leftover funds from the $360 million were reallocated to fund barrier island restoration projects that have not yet been identified or constructed.

API 2-96 This language has been clarified in this Supplemental EIS.

API 2-97 **Chapter 4.1.1.19.1** of this Supplemental EIS has been updated to clarify this language.

API 2-98 Updated information on beach status, including if they are in active cleanup, is now referenced in **Chapter 4.1.1.19.1**.

API 2-99 These additional factors are discussed in the cumulative impacts analysis of **Chapter 4.1.1.5.4 (**Seagrass Communities).

API 2-100 The document has been revised to remove the erroneous reference.

API 2-101 The BOEM acknowledges in this Supplemental EIS that seagrass communities were contacted by oil and could be affected. Ongoing research and the monitoring of seagrass communities will determine long-term impacts of contact by oil, as well as impacts resulting from cleanup and recovery operations.

API 2-102 Newly available information has been added to this Supplemental EIS, including relevant information from the OSAT reports.

API 2-103 The BOEM subject-matter expert on this issue believes the statement is accurate as written. Lack of evidence, especially early in the investigations and NRDA process, does not preclude possible later discoveries of impacts. The statements here discuss possible impacts.

API 2-104 The BOEM subject-matter experts have included newly available information since publication of the Draft Supplemental EIS and have updated this Supplemental EIS, as deemed appropriate. Where appropriate, the National Oceanic and Atmospheric Administration's ERMA data have been included in this Supplemental EIS. As noted in this Final Supplemental EIS, the NRDA process is ongoing and few data have been released to the public at this time.

API 2-105 The BOEM subject-matter experts have reviewed the information provided to determine the information that was relevant for the individual resource analyses. New information that was available and deemed relevant has been used to finalize this Supplemental EIS. The BOEM now has access to some of the USCG and OSAT data, and these data have been included in this Supplemental EIS, where appropriate.

API 2-106 The BOEM subject-matter experts have reviewed the information provided to determine the information that was relevant for the individual resource analyses. New information that was available and deemed relevant has been used to finalize this Supplemental EIS. For example, BOEM has included the OSAT reports, where appropriate, in this Supplemental EIS. The acronym SCAT (Shoreline Cleanup Assessment Team) implies that the area mapped has been or will be cleaned, and language in this Supplemental EIS has been clarified.

API 2-107 The statement, based on SCAT data available at the time, was accurate as of publication of the Draft Supplemental EIS. The BOEM subject-matter experts have reviewed the information provided to determine the information that was relevant for the individual resource analyses. New information that was available and deemed relevant has been used to finalize this Supplemental EIS; this information includes the OSAT report.

API 2-108 The BOEM subject-matter experts have reviewed the information provided to determine the information that was relevant for the individual resource analyses. New information that was available and deemed relevant has been used to finalize this Supplemental EIS. For example, BOEM has included the OSAT reports, where appropriate, in this Supplemental EIS.

API 2-109 The BOEM subject-matter experts have reviewed the information provided to determine the information that was relevant for the individual resource analyses. New information that was available and deemed relevant has been used to finalize this Supplemental EIS. For example, BOEM has included the 2011 report cited by API, where appropriate, in this Supplemental EIS. Researchers from both Louisiana State University (Dr. Irv Mendelssohn) and Loyola University (Dr. David White) were also contacted concerning their past and current work in those areas, and the same information was provided.

API 2-110 Comment noted. The information has been revised to reflect that the length of oiled shoreline increased not exponentially but by orders of magnitude, and a citation to the OSAT-2 report is provided in the table corresponding to the referenced statement.

API 2-111 Comment noted. This Supplemental EIS has been revised to read “Bay Jimmy.” The appropriate changes have been made to this Supplemental EIS.

API 2-112 As noted in **Chapter 4.1.1.5.1,** some heavy oiling did occur along the Gulf Coast. The BOEM subject-matter experts believe the quoted language remains accurate.

API 2-113 See the response to Comment API 2-112.

API 2-114 The subject-matter expert has elaborated on the methods and findings of Wang and Roberts (2010) and has also included the findings of OSAT-2. Since publication of the Draft Supplemental EIS, the subject-matter experts have incorporated newly available relevant information and have updated this Supplemental EIS accordingly.

API 2-115 Comment noted. The BOEM is not a party to the Federal interagency group that issued the oil budget on the fate of oil from the DWH event. As new information becomes available, BOEM subject-matter experts have reviewed the information in the context of the source of the data, research methodology, and data quality, and the information will applied to subsequent NEPA documents. In addition to updated information on the oil budget, BOEM included credible scientific information that is available, where relevant, and has applied it using accepted methodologies to supplement the oil budget.

API 2-116 The BOEM subject-matter experts have reviewed the information provided to determine the information that was relevant for the individual resource analyses. New information that was available and deemed relevant has been used to finalize this Supplemental EIS. The BOEM has reviewed this Supplemental EIS in light of the OSAT report and has included information from the OSAT report in this Supplemental EIS, as deemed necessary.

API 2-117 Comment noted. This Supplemental EIS has been updated to reflect the OSAT report results and information that became available after publication of the Draft Supplemental EIS. In addition, information was added to refer the reader to **Chapters 4.1.1.2.1.1 and 4.1.1.2.2.1** for a detailed description of the water quality in the GOM following the DWH event.

API 2-118 Comment noted. We have not defined the terms cloud or plume, nor was BOEM attributing a specific definition from previous documents or other Federal agencies’ usage of these terms.

Therefore, BOEM believes the terms continue to be descriptive and is keeping the terminology as it currently is used in this Supplemental EIS.

API 2-119 Comment noted. This topic has been thoroughly addressed and updated in **Chapter 4.1.1.2.2.1** since the publication of the Draft Supplemental EIS. For more information, please refer to **Chapter 4.1.1.2.1.1**.

API 2-120 Comment noted. These subjects are addressed in **Chapters 4.1.1.2.1.1 and 4.1.1.2.2.1**, and BOEM subject-matter experts have included newly available information, where appropriate.

API 2-121 Since publication of the Draft Supplemental EIS, the subject-matter experts have incorporated relevant information and have updated this Supplemental EIS accordingly. Kessler et al. (2011) and other relevant sources are cited in **Chapters 4.1.1.2.1.1 and 4.1.1.2.2.1**.

API 2-122 As noted in this Supplemental EIS (e.g., **Chapter 4.1.1.2.2.1**), both the nature of a blowout (including droplet size and ejection under pressure) and the use of subsea dispersants may allow oil and gas to become entrained in the water column or may allow the development of a subsurface cloud.

API 2-123 See the response to Comment API 2-26.

API 2-124 The BOEM subject-matter expert believes the statement remains accurate. It is known that the subsea oil was dispersed and that the presence of dispersants was measured in the subsea plume (OSAT, 2010). It is also known that the dispersed subsea plume traveled in the direction of the deepwater corals identified (OSAT, 2010). As noted in this Supplemental EIS, samples of the corals have been collected; however, the results of the analyses have yet to be released at the time of publication of this Supplemental EIS.

API 2-125 The text has been edited to include relevant information from the OSAT report.

API 2-126 The BOEM subject-matter expert believes the statement remains accurate. This Supplemental EIS makes it clear that typical GOM crude is lighter than water and is expected to rise rapidly to the sea surface unless it is broken into micro-droplets by dispersant or-atomized by high-pressure discharge. As an oil plume travels laterally with water currents, however, several processes operate on it, including dispersion, dissolution, and biodegradation. Sedimentation is a fourth process that could occur. The text was edited to clarify that the sentence refers to subsea oil plumes (which, by definition, are composed of micro-droplets that are suspended in a neutral density layer of the water column).

API 2-127 The BOEM subject-matter experts have reviewed the information provided to determine the information that was relevant for the individual resource analyses. New information that was available and deemed relevant has been used to finalize this Supplemental EIS. Where appropriate, BOEM subject-matter experts have included relevant data from the OSAT report.

API 2-128 Since publication of the Draft Supplemental EIS, the subject-matter experts have incorporated relevant information and have updated this Supplemental EIS accordingly. The BR/B *Brooks McCall* data have been updated accordingly in this Supplemental EIS.

API 2-129 Comment noted. Since publication of the Draft Supplemental EIS, the subject-matter experts have incorporated relevant information and have updated this Supplemental EIS accordingly. This Supplemental EIS has been updated to reflect the results of the OSAT reports, where appropriate.

API 2-130 Since publication of the Draft Supplemental EIS on July 1, 2011, the subject-matter experts have incorporated relevant information and have updated this Supplemental EIS accordingly. This Supplemental EIS has been updated to reference Kessler et al. (2011) and other newly available information where relevant.

API 2-131 Since publication of the Draft Supplemental EIS, the subject-matter experts have incorporated relevant information and have updated this Supplemental EIS accordingly. The incorporation of relevant information is time consuming, as it must be obtained and reviewed by subject-matter experts in the context of the source of the data, research methodology, and data quality. As is necessary under every NEPA analysis, at some point the subject-matter experts had to finalize their analyses to allow time for the Final Supplemental EIS to be prepared and presented to the decisionmaker. Relevant information from Hazen, Valentine, and other reports have been included in this Supplemental EIS.

API 2-132 Several sections of this study are relevant to this statement. For a summary, see page 55 of the report cited by API.

API 2-133 As the OSAT study did not specifically test for drilling muds in coastal waters or sediments, BOEM subject-matter experts believe this reference is not appropriate.

API 2-134 Comment noted. The statement was revised to clarify that the greatest concentrations of oil on the seabed are expected to be near the wellhead and to decrease with distance from the source.

API 2-135 Since publication of the Draft Supplemental EIS, the subject-matter experts have incorporated relevant information and have updated this Supplemental EIS accordingly. The incorporation of relevant information is time consuming, as it must be obtained and reviewed by subject-matter experts in the context of the source of the data, research methodology, and data quality. As is necessary under every NEPA analysis, at some point the subject-matter experts had to finalize their analyses to allow time for the Final Supplemental EIS to be prepared and presented to the decisionmaker. **Chapter 4.1.1.2** has been updated to include information on water quality sampling after the DWH event.

API 2-136 Since publication of the Draft Supplemental EIS, the subject-matter experts have incorporated relevant information and have updated this Supplemental EIS accordingly. The subject-matter expert feels that this discussion remains accurate. However, the discussion of dispersion and dispersants has been updated, where appropriate, in **Chapter 4.1.1.2**.

API 2-137 As noted in this Supplemental EIS, information regarding possible impacts from the DWH event is continuing to be developed through the NRDA process and other avenues, and much of this data remain unavailable to the public at this time. Nevertheless, this Supplemental EIS discusses possible avenues of seafloor impacts and mechanisms that could disperse and degrade subsea oil plumes to reduce seafloor impacts to negligible effects. The BOEM subject-matter experts have also included discussions where potential impacts have been observed, but no definitive link to the DWH event has been confirmed. For example, the deepwater coral community that appeared visibly oiled 11 km (7 mi) from the Macondo well has been referenced in this Supplemental EIS, including in **Chapters 4.1.1.9 and 4.1.1.10.**

API 2-138 The statement has been deleted and updated information on sediment sampling has been included, where deemed appropriate, by BOEM subject-matter experts.

API 2-139 Comment noted. The language has been revised to remove the suggestion that the addition of dispersants at the seafloor has resulted in large subsurface clouds of elevated methane concentrations.

API 2-140 This language has been clarified in this Supplemental EIS to state that the speed of degradation of the oil by bacteria is also related to the water temperature and type of bacteria involved.

API 2-141 The information cited by API is contained in this Supplemental EIS, just following the quoted text. The BOEM believes the information remains appropriate, and no revisions are necessary.

API 2-142 Please see Chapter 5.11 of the WPA Lease Sale 218's Final Supplemental EIS for the letters of comment on the Draft Supplemental EIS and BOEMRE's responses (USDOI, BOEMRE, 2011b). For any revisions to the WPA Lease Sale 218's Final Supplemental EIS in response to public comments that were also appropriate to a CPA lease sale Supplemental EIS, BOEM attempted to carry forward these revisions to this CPA Lease Sale 216/222 Final Supplemental EIS. In addition to these document revisions, the subject-matter experts updated this Supplemental EIS with newly available and relevant information since publication of the Draft Supplemental EIS on July 1, 2011.

ConocoPhillips

ConocoPhillips Company
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VIA E-MAIL: CPA Supplemental EIS@boemre.gov

August 15, 2011

Attention: Regional Supervisor
Leasing and Environment (MS 5410)
Bureau of Ocean Energy Management, Regulation and Enforcement
Gulf of Mexico OCS Region
1201 Elmwood Park Boulevard
New Orleans, Louisiana 70123-2394.

Subject: Comments on the CPA Lease Sale 216/222 Draft SEIS

ConocoPhillips Company (ConocoPhillips) is pleased to provide comments on the Central Planning Area (CPA) Lease Sale 216/222 Draft Supplemental Environmental Impact Statement (DSEIS) published June 2011 by the Bureau of Ocean Energy Management, Regulation and Enforcement's (BOEMRE), Gulf of Mexico OCS Region.

ConocoPhillips is one of North America's leading energy producers, and one of our primary strategic objectives is to produce more oil and natural gas in the United States. We are a leading producer of natural gas in the United States, the largest producer of oil in Alaska, and among Canada's largest producers of natural gas (much of which flows to the U.S.). We are also the second largest refiner in the United States. We have major positions in most of the nation's leading producing basins with active exploration and development drilling programs. ConocoPhillips is known worldwide for its technological expertise in deepwater exploration and production, reservoir management and exploitation and 3-D seismic technology. Therefore, ConocoPhillips has a direct and strong interest in the BOEMRE's offshore leasing program.

Relative to the BOEMRE Regional Director's Note: ConocoPhillips believes that the DSEIS addresses the potential changes to the baseline conditions of the environmental and socioeconomic resources that took place in 2010 as a result of the Deepwater Horizon event. ConocoPhillips agrees that the DSEIS was prepared using the best information that was publicly available at the time the document was prepared.

CONOC-1

ConocoPhillips supports Alternative A set forth in the DSEIS. Alternative A would offer for lease all unleased blocks within the CPA for oil and gas operations, except blocks directly south of Florida and within 100 miles of the Florida coast; and blocks that are beyond the U.S. Exclusive Economic Zone in the area known as the northern portion of the Eastern Gap. ConocoPhillips does not support Alternatives B, C and D set forth in the DSEIS.

As stated in the DSEIS: The CPA sale area encompasses about 63.3 million acres and the estimated amount of resources to be developed as result of the CPA Lease Sale 216/222 (Sale 216/222) is up to approximately 1.6 billion barrels of oil and up to 6.5 Tcf of gas. Oil from the CPA would help reduce the Nation's need for oil imports and lessen a growing dependence on foreign oil, and oil produced from the CPA would reduce the environmental risks associated with transoceanic oil tankering from sources overseas.

Also as stated in the DSEIS: The cancellation of the proposed lease sale would not significantly change the environmental impacts of overall Outer Continental Shelf (OCS) activity. Direct economic impacts have undoubtedly already occurred from the cancellation of WPA Lease Sale 215 (Sale 215). The DOE's Energy Information Administration (EIA) reported that domestic crude production in the GOM would decline 190,000 bbl/day in 2011 and 2012. In addition, Casselman and Gilbert reported in 2011 that some operators have reported to be shifting investment out of the Gulf. One condition to which operators pay close attention is uncertainty in access to new land offerings on the OCS or access to their current leases in the face of large capital costs under existing contracts that assumed work would proceed expeditiously. The cancellation of Sale 216/222 on top of already canceled Sale 215, would manifest further impacts. The U.S. has been long regarded as a favorable operating environment because of strong tradition for the rule of law, a stable political system, a tested leasing program with regular opportunities to secure access to land in lease sales, and a mature regulatory system for OCS operations. Cancellation of Sale 216/222, in combination with canceled Sale 215, could cause a company to reevaluate operator risk in rebalancing a worldwide portfolio of operating opportunities. If a company begins to view lease sale predictability as being in question or at least counter to longstanding experience in the GOM, it may decide to shift attention and assets to other places in the world. Cancellation of Sale 216/222 would also negatively affect revenues collected by the Federal Government and the revenue distributions to the States that are based on total revenue.

ConocoPhillips agrees with the comments stated in the DSEIS as set forth above. Clearly, the CPA contains potentially significant resources and conducting Sale 216/222 is vitally important to America's energy security. In addition, the OCS contains potentially significant, untapped resources of oil and natural gas that are critically important to sustaining our national economic growth and maintaining much-needed jobs in virtually every sector of the economy. ConocoPhillips' continued commitment to the OCS will largely depend on the extent to which the BOEMRE's Oil and Gas Leasing Program makes high potential areas available for leasing.

ConocoPhillips supports Alternative A set forth in the CPA Lease Sale 216/222 Draft SEIS and appreciates the opportunity to comment on the Draft SEIS. Should you have any questions, please contact Jim Higgins at (281) 293-3139.

Sincerely,

Richard Lunam

Richard Lunam
Vice President, North America Exploration

CONOCO-1 Comment noted. The decision on which alternative will be selected will be made after this Supplemental EIS is finalized and, if the decision is to hold a lease sale under either Alternative A, B or C, it will be announced in the Final Notice of Sale.

Via Electronic Mail

August 15, 2011

Mr. Joseph A. Christopher
Regional Supervisor – Leasing and Environment
Bureau of Ocean Energy Management,
Regulation and Enforcement (MS 5410)
Gulf of Mexico OCS Region
1201 Elmwood Park Boulevard
New Orleans, LA 70123-2394
Email: CPASupplementalEIS@boemre.gov

Subject: Draft Supplemental Environmental Impact Statement for the Gulf of Mexico OCS, Central Planning Area, Oil and Gas Lease Sale for the 2007-2012 5-Year OCS Program

Dear Mr. Christopher,

The International Association of Geophysical Contractors (IAGC) is pleased to provide the following comments to the Bureau of Ocean Energy Management, Regulation and Enforcement (BOEMRE) in response to its 1 July 2011 Federal Register Notice of Availability (NOA) of a Draft Supplemental Environmental Impact Statement (SEIS) for the Gulf of Mexico (GOM) Central Planning Area (CPA), Oil and Gas Lease Sale for the 2007–2012 5–Year Outer Continental Shelf (OCS) Program.

IAGC is the international trade association representing the industry that provides geophysical services (geophysical data acquisition, processing and interpretation, geophysical information ownership and licensing, associated services and product providers) to the oil and natural gas industry. In the last ten years IAGC member companies have invested over $3 billion in acquiring and processing multi-client geophysical data in the GOM OCS. Geophysical data plays an integral role in the successful exploration and development of offshore hydrocarbon resources.

Comments

The Gulf of Mexico is one of the most productive oil and gas provinces in the world. Its prospectivity attracts investments from around the world. One of the more attractive aspects of the GOM OCS has always been the consistency that acreage has been made available for leasing through regularly scheduled lease sales. IAGC and the geophysical

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15 August 2011
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industry are supportive of the actions of BOEMRE to move forward with the completion of the SEIS for the Central Planning Area that will allow for a lease sale to be held in that Planning Area early in 2012. Furthermore, IAGC supports BOEMRE's conclusion that their analysis of information made available since the completion of the Multisale EIS and the 2009-2012 Supplemental EIS and the consideration of the Deep Water Horizon event has not resulted in any substantial differences that would alter the impact conclusions as presented in the Multisale EIS and the 2009-2012 Supplemental EIS for a Central Planning Area lease sale.

IAGC-1

IAGC supports proposed action Alternative A which would offer for lease all un-leased blocks within the Central Planning Area for oil and gas operations, except for the following:

1. Blocks directly south of Florida and within 100 miles of the Florida Coast; and
2. Blocks that are beyond the U.S. Exclusive Economic Zone in the area known as the northern portion of the Eastern Gap.

Summary

IAGC supports the conclusions presented in the Draft SEIS and urges BOEMRE to devote all of the necessary resources (time and personnel) to complete the SEIS for the Central Planning Area in the most expeditious time possible – without compromising the integrity of the process – and to hold Central Gulf of Mexico Lease Sales 216 and 222 early in 2012.

On behalf of IAGC and the geophysical industry, thank you for the opportunity to provide you with these comments.

Sincerely,

WRRosenbusch

Walt Rosenbusch, Vice President – Projects & Issues

cc: Chip Gill, IAGC President
Sarah Tsoflias, Vice President – Marine Environment
IAGC Americas Chapter Chairman
IAGC Americas Offshore Committee Chairman
IAGC Americas Offshore Committee Members

IAGC-1 Comments noted. The decision on which alternative will be selected will be made after this Supplemental EIS is finalized and, if the decision is to hold a lease sale under either Alternative A, B or C, it will be announced in the Final Notice of Sale.

**CENTER FOR BIOLOGICAL DIVERSITY, DEFENDERS OF WILDLIFE,
OCEANA, SOUTHERN ENVIRONMENTAL LAW CENTER**

August 16, 2011

Via Email

Regional Supervisor
Leasing and Environment (MS 5410)
Bureau of Ocean Energy Management, Regulation and Enforcement
Gulf of Mexico OCS Region
1201 Elmwood Park Boulevard
New Orleans, LA 70123-2394
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RE: Central Planning Area Lease Sale 216/222 Draft Supplemental Environmental Impact Statement

Dear Regional Supervisor:

Oceana, the Center for Biological Diversity, Defenders of Wildlife, and the Southern Environmental Law Center greatly appreciate the opportunity to comment on the Draft Supplemental Environmental Impact Statement (hereafter "DSEIS") for Lease Sale 216/222 in the Central Planning Area of the Gulf of Mexico. Lease Sale 216/222 marks the first lease sale in the Central Planning Area since the tragic Deepwater Horizon incident. It is incredibly important that the environmental impacts of this lease sale are fully accounted for so as to clearly and fully explain the potential environmental impacts of the lease sale to the public and stakeholders. The DSEIS is key to achieving this end. For this reason, the DSEIS should be prepared with the utmost scrutiny to potential environmental impacts from the Lease Sale, and so should take into account any and all information related to the impacts of the Deepwater Horizon spill. The DSEIS begins to describe the significant potential environmental impacts of Lease Sale 216/222. However, as explained below, the Bureau of Ocean Energy Management, Regulation, and Enforcement ("BOEMRE") must significantly strengthen its discussion of potential environmental impacts in the DSEIS for Lease Sale 216/222 before issuing a Final SEIS. Only by doing so can BOEMRE fully abide by the law while providing a complete and detailed description of the potential environmental impacts of the proposed action to the public and stakeholders.

SUMMARY OF PROBLEMS

1. Overarching problems in the DSEIS
    a. The DSEIS should not be tiered to prior NEPA documents that have been outdated by the Deepwater Horizon spill.
    b. The DSEIS does not analyze a reasonable range of alternatives. Additional alternatives that should be analyzed include:

    i. Adopting measures that could further mitigate the impacts of oil exploration and development and improve safety.
    ii. Adopting the draft staff finding of the National Commission on the BP Deepwater Horizon Spill and Offshore Drilling that recommends long-term monitoring and the establishment of Marine Protected Areas.
    iii. Delaying leasing until complete information regarding the damage caused by the Deepwater Horizon spill is available.
  c. Where incomplete or unavailable information regarding potential environmental impacts of the proposed action exist, the DSEIS fails to whether the missing information can be obtained without exorbitant cost.
  d. The DSEIS fails to provide a full and fair discussion of environmental impacts due to significant amounts of insufficient information, particularly with regard to previous and current baseline conditions and potential environmental impacts of a catastrophic oil spill like the Deepwater Horizon.
  e. The DSEIS fails to adequately consider issues related to climate change throughout the document. In particular, the SEIS fails to adequately addresss:
    i. greenhouse gas emissions resulting from the proposed action,
    ii. environmental impacts of the proposed action in light of ongoing climate change,
    iii. ocean acidification,
    iv. exacerbation of the Gulf hypoxic zone vis-à-vis climate change, and
    v. other environmental impacts of climate change.
  f. The DSEIS fails to take into account the significant impacts on endangered species from the Deepwater Horizon spill. Moreover, BOEMRE's decision to proceed with the National Environmental Protection Act evaluation of Lease Sale 216/222 is at odds with the hold placed on formal Endangered Species Act consultations pending an updated baseline and additional data. BOEMRE also fails to specify whether Lease Sale 216/222 will be held before formal consultations are complete, and if it is held, what the environmental impacts of that action will be.
  g. The DSEIS relies on an inadequate and flawed oil spill risk analysis, relying on outdated and unproven estimates of spill cleanup and response technologies and the risk and environmental impact of a catastrophic spill. The Bureau also arbitrarily and capriciously relies on an outdated oil spill risk analysis model, which is meant to serve as a proxy for trajectory analysis, and fails to use a catastrophic blowout for its oil spill risk analysis. Finally, the Bureau has failed to make its Oil Spill Response Plan certification process open to public scrunity.
2. Problems in the catastrophic spill impact analysis on biological resources (Appendix B of the DSEIS)
  a. The DSEIS's discussions (in Appendix B) of potential impacts that catastrophic oil spills would have on specific groups of species are insufficient in many ways. Broadly, the DSEIS:
    i. contains multiple knowledge gaps, some of which have already been filled by published research pertaining to the impacts of the Deepwater Horizon spill, that limit a complete analysis of environmental impacts from another catastrophic spill;

ii. fails to consider many potential effects of catastrophic oil spills, like those on behavior, reproduction, growth, and development, that are necessary for a comprehensive analysis of risk to biological systems;
iii. fails to consider all life stages of affected species;
iv. fails to consider population level effects of sublethal impacts such as malnourishment, particularly in the context of already-weakened populations from the Deepwater Horizon spill; and
v. fails to consider potential impacts of a catastrophic oil spill on critical habitats in the Central Gulf of Mexico.

The SEIS also contains multiple shortcomings in each of its impact analyses for groupings of species, e.g. sea turtles. All of these issues violate NEPA by preventing the DSEIS from providing a full and fair discussion of the proposed action's potential environmental impacts, and should be addressed.

I. BACKGROUND

On April 20, 2010, the *Deepwater Horizon* offshore drilling rig exploded and caught fire, killing 11 workers and resulting in an oil geyser that spilled millions of gallons of oil into the Gulf of Mexico. The *Deepwater Horizon* sank two days after the explosion, and the well it was drilling spewed oil without abatement for months. Approximately 25 percent of the oil was recovered, leaving the vast majority of oil in the marine environment. In addition to the oil, nearly 2 million gallons of toxic dispersants were discharged into the Gulf's waters.

While the analysis of the impacts of the spill still is not complete, most indicators are that the spill was large both in size and its impact on the environment. The spill resulted in roughly 580 miles of oiled shoreline.[1] Scientists also reported large plumes of oil below the sea's surface originating from the *Deepwater Horizon* well.[2] Researchers from the National Institute for Undersea Science and Technology discovered oil plumes as large as ten miles long, three miles wide, and 300 feet thick.[3] Scientists from Woods Hole Oceanographic Institution documented an undersea oil plume 22 miles long and 700 feet thick.[4] Scientists have confirmed that the undersea oil plumes originated from the *Deepwater Horizon* well.[5]

It has been over a year since the oil spill began, but still there is pervasive uncertainty concerning its root causes. As noted by BOEMRE Director Michael R. Bromwich in a report to the Secretary of Interior on October 1, 2010,

> Several environmental reviews and investigations seeking to identify the root causes of the Deepwater Horizon accident are ongoing and have not yet issued findings . . . . Substantial investigative work remains to be done and, therefore,

[1] Robertson, C., and J.C. Rudolf. "Spill Cleanup Proceeds Amid Mistrust." *N.Y. Times.* 3 Nov. 2010. Page A14.
[2] Reddy, C.M., et al. Composition and fate of gas and oil released to the water column during the *Deepwater Horizon* oil spill. *PNAS* Early Edition Online: 1-6.
[3] Gillis, Justin. "Giant Plumes of Oil Forming Under the Gulf." *N.Y. Times.* 16 May 2010. Page A1.
[4] WHOI Scientists Map and Confirm Origin of Large, Underwater Hydrocarbon Plume in Gulf. *Woods Hole Oceanographic Inst.* 19 Aug 2010. http://www.whoi.edu/dwhresponse/page.do?pid=43720&tid=282&cid=79926
[5] Id.

significant factual information and insights relating to the Macondo blowout and Deepwater Horizon explosion will be available in the future.[6]

On May 22, 2010, President Obama established the National Commission on the BP Deepwater Horizon Oil Spill and Offshore Drilling (hereafter "the Commission") as an independent, nonpartisan entity charged with providing a thorough analysis of the causes of the disaster, an assessment of the oil industry's ability to respond to spills, and recommended reforms for making offshore drilling safer.[7] The Commission issued its final report on January 11, 2011, in which it reached numerous conclusions and offered several recommendations regarding offshore oil activities in the Gulf of Mexico.[8]

In its final report, the Commission found that, in order to ensure the safety of offshore energy exploration and production, regulatory oversight of offshore drilling activities would require reforms beyond those already initiated since the *Deepwater Horizon* oil spill. The report noted that the breakdown of the government's environmental review process for OCS activities was "systemic," requiring significant revision.[9] The Commission made the following recommendations, among others:

- To assure human safety and environmental protection, regulatory oversight of leasing, energy exploration, and production requires reform in both the structure of regulatory oversight and related internal decisionmaking processes to ensure political autonomy, technical expertise, and full consideration of environmental protection concerns.
- Because regulatory oversight alone will not be sufficient to ensure adequate safety, the oil and gas industry will need to take its own, unilateral steps to increase safety throughout the industry, including self-policing mechanisms that support governmental enforcement.
- The technology, laws and regulations, and practices for containing, responding to, and cleaning up spills lag behind the real world risks associated with deepwater drilling into large, high-pressure reservoirs of oil and gas located far offshore and thousands of feet below the ocean's surface. Government must close the existing gap and industry must support rather than resist that effort.
- Scientific understanding of environmental conditions in sensitive environments in deep Gulf waters, along the region's coastal habitats, and in other areas proposed for drilling, such as the Arctic, is inadequate. The same is true of the human and natural impacts of oil spills.

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[6] Memorandum from Michael R. Bromwich to Secretary of the Interior Kenneth Salazar, Report regarding the current suspension of certain offshore permitting and drilling activities on the Outer Continental Shelf. 1 Oct 2010. Page 7. http://www.doi.gov/news/pressreleases/loader.cfm?csModule=security/getfile&PageID=64703.

[7] Weekly Address: President Obama Establishes Bipartisan National Commission on the BP Deepwater Horizon Oil Spill and Offshore Drilling. 22 May 2010. http://www.whitehouse.gov/the-press-office/weekly-address-president-obama-establishes-bipartisan-national-commission-bp-deepwa.

[8] National Commission on the BP Deepwater Horizon Oil Spill & Offshore Drilling. *Deepwater: The Gulf Oil Disaster and the Future of Offshore Drilling: Report to the President.* http://www.oilspillcommission.gov/sites/default/files/documents/DEEPWATER_ReporttothePresident_FINAL.pdf.

[9] Id. Page 260.

- The government must revise and strengthen NEPA policies to improve environmental analyses, transparency and consistency and create a new oil spill analysis and planning process.
- In addition, a fundamental reorganization of the former Minerals Management Service is needed. Congress should create an independent agency within the Department of Interior with enforcement authority to oversee offshore drilling safety.

Neither these recommendations, nor any of the Commission's other findings, have been implemented by BOEMRE or the Department of the Interior.

As BOEMRE recognizes, the *Deepwater Horizon* disaster represents new information making supplemental analysis necessary pursuant to the National Environmental Policy Act (NEPA).[10] A change that produces a seriously different picture of the environmental landscape requires BOEMRE to take another hard look at the environmental impacts. *See Louisiana Wildlife Federation, Inc. v. York*, 761 F.2d 1044, 1051-53 (5th Cir. 1985) (requiring supplemental environmental review where there are concerns of sufficient gravity presenting a seriously different picture of the environmental landscape such that another hard look is necessary). The present draft, however, does not represent a hard look at the impacts of the *Deepwater Horizon* disaster nor does it provide a realistic analysis of potential future spills sufficient to satisfy NEPA.

II. THE DRAFT SEIS DOES NOT MEET NEPA'S REQUIRMENTS.

A. BOEMRE Should Not Continue To Tier to Outdated NEPA Documents

CBD-1

In its DSEIS, BOEMRE continues to tier to prior EISs to find no new significant impact will occur as the result of the lease sale. *See* DSEIS at 2-3 ("This Supplemental EIS tiers from the Multisale EIS and the 2009-12 Supplemental EIS. Its purpose is to determine if new information is substantial enough to alter the conclusions state in [those EISs]."). However, tiering to prior EISs which have been rendered obsolete as a result of significant new circumstances or information relevant to environmental concerns and bearing on the proposed action or its impacts is improper. 40 C.F.R. § 1502.9(c)(1)(ii).

For example, in the 2007 Multi-Sale EIS upon which BOEMRE relies, MMS assumed the probable large spill would only be 4,600 barrels, would only last one day, would occur 200 miles from shore, would produce an oil slick with a maximum size of 350 acres, that the oil would weather (naturally disperse) long before reaching shore, and that only 19-31 miles of shoreline would be affected. Multisale EIS at IV-232 to 235. Within a week of the Deepwater Horizon disaster, these assumptions had been proven conclusively wrong. The spill amounted to roughly 60,000 barrels per day,[11] lasted at least 87 days (DSEIS 3-46), occurred only 52 miles from shore,[12] produced a slick that measured 3,850 square miles (or 2.4 million acres) at one

[10] 75 Fed. Reg. 69,122 (Nov. 10, 2010).
[11] Oil Budget Calculator: Deepwater Horizon. *The Federal Interagency Solutions Group*. Nov. 2010. Page 11.
[12] "Gulf of Mexico Region: Spills ≥ 50 Barrels (2,100) gallons – 2010." *BOEMRE*. Accessed 16 Aug 2011. http://www.boemre.gov/incidents/SigPoll2010.htm

point,[13] and did not naturally disperse but rather washed ashore, oiling more than 650 miles of shoreline.[14] In other words, the Multisale EIS's probable large spill underestimated the volume of oil spilled per day by 92%, the duration of the leak by 99%, the size of the slick by ~100%, and the amount of oiled shoreline by 95%.[15]

The full extent of currently-known impacts of the Deepwater Horizon spill is chronicled in the National Commission's Report (Ch. 6). Given what is now known, it is untenable for BOEMRE to continue, as it does in the DSEIS, to rely upon the Multisale EIS's analysis of the impacts of accidental events on the resources of the gulf. *See, e.g.,* DSEIS at 4-200 (stating for impacts of accidental events on marine mammals "a detailed impact analysis . . . can be found in the Mutisale EIS."), 4-210 (same for sea turtles), 4-229 (same for coastal and marine birds).

B. BOEMRE Failed To Analyze a Reasonable Range of Alternatives

One of NEPA's fundamental requirements is that the agency "study, develop, and describe appropriate alternatives to recommended courses of action in any proposal which involves unresolved conflicts concerning alternative uses of available resources." 42 U.S.C. § 4332(2)(E) (2000). NEPA does not require the agency to adopt any particular alternative, but it does require the agency fully to consider alternatives. The discussion of alternatives "is the heart of the [EIS]," 40 C.F.R. § 1502.14, and it "guarantee[s] that agency decisionmakers have before them and take into proper account all possible approaches to a particular project (including total abandonment of the project) which would alter the environmental impact and the cost-benefit balance." *Alaska Wilderness Recreation & Tourism Ass'n v. Morrison*, 67 F.3d 723, 729 (9th Cir. 1995) (quoting *Bob Marshall Alliance v. Hodel*, 852 F.2d 1223, 1228 (9th Cir. 1988)); *see also California v. Block*, 690 F.2d 753, 767 (9th Cir. 1982).

CBD-2

BOEMRE should analyze additional alternatives to consider measures that could further mitigate the impacts of oil exploration and development and improve safety. Instead, BOEMRE adopts the same alternative MMS analyzed in the previous Multisale EISs. DSEIS at 2-3 to 4. BOEMRE should analyze an alternative that incorporates stringent mitigation measures into any future leases as lease stipulations.

CBD-3

In addition BOEMRE should consider an alternative that implements the draft staff finding, announced on December 3, 2010 by the *National Commission on the BP Deepwater Horizon Oil Spill and Offshore Drilling* that recommends: "Long-term monitoring of potential harm to Gulf seafloor habitats, the water column, and valued species—bluefin tuna, shrimp, and many others—is critical to successful restoration. . . . . Marine Protected Areas should be considered as possible "mitigation banks" to help offset harm to the marine environment; should be aggressively vetted in public. Also: National Marine Sanctuaries pass through a rigorous public process and provide protection across a number of metrics." [16]

[13] "Gulf Oil Slick Triples in Size a Rough Seas Thwart Cleanup." *The Associated Press.* 1 May 2010. http://www.foxnews.com/us/2010/05/01/gulf-oil-slick-triples-size-rough-seas-thwart-cleanup/

[14] Final Report: National Commission on the BP Deepwater Horizon Oil Spill and Offshore Drilling. January 2011. Page 176.

[15] Transcript Press Briefing May 15, 2010. http://www.restorethegulf.gov/release/2010/05/19/transcript-press-briefing-may-15.

[16]

CBD-4

BOEMRE should also consider an alternative suspending leasing until complete information about the damage caused by the Deepwater Horizon spill is available. According to BOEMRE, the SEIS "is being prepared because of the potential changes to baseline conditions of the environmental, socioeconomic, and cultural resources that may have occurred as a result of (1) the *Deepwater Horizon* (DWH) event … [and] (2) the acute impacts that have been reported or surveyed since that time." DSEIS at 1-3. However, as stated multiple times throughout the DSEIS itself, insufficient information currently exists to determine the extent to which the Deepwater Horizon spill altered baseline conditions in the Gulf. *See e.g.*, DSEIS at 4-139 ("[t]he best available information does not provide a complete understanding of the effects of the spilled [Deepwater Horizon] oil and active response/cleanup activities on the affected marine mammal environment"), *id.* at 2-16 ("[t]he actual effects of the DWH event on fish populations are unknown at this time"), *id.* at B-40 ("[t]here is a great deal of uncertainty regarding the long-term impacts of a catastrophic spill [like the Deepwater Horizon] in the Gulf of Mexico.").

C. Incomplete Information

CBD-5

According to BOEMRE, the DSEIS "is being prepared because of the potential changes to baseline conditions of the environmental, socioeconomic, and cultural resources that may have occurred as a result of (1) the *Deepwater Horizon* (DWH) event … [and] (2) the acute impacts that have been reported or surveyed since that time." DSEIS at 1-3. However, as stated multiple times throughout the DSEIS, insufficient information exists to determine the extent to which the Deepwater Horizon spill affected Gulf resources. This lack of necessary information is a systemic problem in the DSEIS. The following list of direct quotes from the DSEIS highlights just some of the places in the DSEIS where it acknowledges insufficient information exists.

- Although many potential effects of the DWH event on the fish populations of the Gulf of Mexico have been alleged, the actual effects are at this time unknown, and the total impacts are likely to be unknown for several years (2-20).
- Many of the long-term impacts of the DWH event to low-income and minority communities are unknown (4-349).
- A survey of major oil-spill events in the past indicates that the long-term effects of an oil spill on human health and the environment, are still unknown (4-18).
- How assemblages of fish have changed or will change as a result of the DWH event is unknown at this time (4-261).
- The effects of the DWH event on the population levels of each of these species [of fish] are unknown at this time (4-274).
- Longitudinal epidemiological studies of possible long-term health effects from exposure to either the DWH event's oil or dispersants, such as the possible bioaccumulation of toxins in tissues and organs, are lacking and the potential for the long-term human health effects are largely unknown (although the National Institutes of Health has proposed such a study) (4-348).
- The best available information does not provide a complete understanding of the effects of the spilled oil and active response/cleanup activities on the affected marine mammal environment (4-202).

- The best available information does not provide a complete understanding of the effects of the spilled oil and active response/cleanup activities on the affected sea turtle environment (4-211).
- The best available information does not provide a complete understanding of the effects of the spilled oil and active response/cleanup activities on the affected coastal and marine bird environment (4-233).

1. BOEMRE Fails to Satisfy CEQ Regulation Demanding a Feasibility Analysis for Obtaining Incomplete Information

CEQ regulations set forth how agencies are to deal with incomplete and unavailable information:

> If the incomplete information relevant to reasonably foreseeable significant adverse impacts is essential to a reasoned choice among alternatives and the overall costs of obtaining it are not exorbitant, the agency shall include the information in the environmental impact statement.

40 C.F.R. § 1502.22(a).

CBD-6

Pursuant to this mandate, BOEMRE should have evaluated ongoing research related to the impacts of the spill, as well as research that has yet to be undertaken, to determine whether the information can be obtained without exorbitant cost. Even if the cost of obtaining the information is found to be exorbitant, BOEMRE still must disclose that the information is missing, include a "statement of the relevance of the incomplete or unavailable information to evaluating reasonably foreseeable significant adverse impacts on the human environment," summarize existing scientific evidence relevant to evaluating reasonably foreseeable significant adverse impacts, and evaluate such impacts based upon generally accepted scientific methods. 40 C.F.R. § 1502.22(b). Importantly for inherently risky activities such as offshore oil drilling, "'reasonably foreseeable' includes impacts which have catastrophic consequences, even if their probability of occurrence is low, provided that the analysis of the impacts is supported by credible scientific evidence, is not based on pure conjecture, and is within the rule of reason." *Id.* A federal district court in Alaska recently found BOEMRE to be in violation of this requirement regarding the sale of OCS leases in Alaska's Chukchi Sea. *Native Vill. of Point Hope v. Salazar*, 730 F. Supp. 2d 1009 (D. Alaska 2010).

2. The Systemic Nature of Incomplete Information in the SEIS Prohibits a Full and Fair Assessment and Demonstrates a Disregard for 40 C.F.R. § 1502.22

CBD-7

The systemic nature of incomplete information within the DSEIS prohibits the DSEIS from providing a "full and fair discussion of environmental impacts," 40 C.F.R. § 1502.1, and demonstrates BOEMRE's disregard for 40 C.F.R. § 1502.22, in violation of NEPA. Specifically, complete information pertaining to the impacts of the Deepwater Horizon spill is essential to adequately establish two crucial aspects of the DSEIS: baseline conditions of Gulf resources and potential environmental impacts of another catastrophic oil spill. Baseline conditions of Gulf resources must be established in order to assess what damage environmental impacts resulting from Lease Sale 216/222 will have. Similarly, understanding the environmental effects of the

Deepwater Horizon spill is requisite for a full impact assessment of another catastrophic spill, a discussion currently so riddled with knowledge gaps as to render it largely meaningless.

CBD-8

BOEMRE purports to go through the analysis required by 40 C.F.R. § 1502.22 concluding, "there is no incomplete or unavailable information that is deemed relevant to making a determination regarding reasonably foreseeable significant adverse impacts or that is essential to a reasoned choice among alternatives . . ." DSEIS at 4-5 to 4-6. At the same time, BOEMRE acknowledges multiple deficiencies in its understanding of the impacts of the Deepwater Horizon spill that prevent it from fully assessing said impacts (e.g., see above list and below discussions). BOEMRE does not explain how understanding the full effect of a spill, and particularly a first-of-its-kind deepwater catastrophic spill, on marine mammals, endangered sea turtles, other Gulf resources, and ecosystem-wide baseline conditions is not relevant to making a decision on further leasing. BOEMRE also does not include any discussion of how costly it would be collect said information for the DSEIS.

a. Baseline Conditions

CBD-9

Due to systemic deficiencies in information, the DSEIS fails to sufficiently assess past and previous baseline conditions. Numerous early reports from spill response efforts alerted that it would be difficult to judge the full impact of the spill because significant baseline information had not been gathered or regularly updated prior to the spill. This concern about missing information highlights both the importance of a robust baseline condition assessment as part of the NEPA process, as well as BOEMRE's previous failure to take seriously the requirements of 40 C.F.R. § 1502.22. Yet, BOEMRE continues to neglect baseline conditions; a significant degree of missing or incomplete information exists regarding the impact of the Deepwater Horizon spill on Gulf resources, prohibiting a thorough evaluation of current baseline conditions. Such a thorough evaluation cannot be completed using currently available scientific information, either, for in many ways the Deepwater Horizon spill is unique and presents first-of-their-kind potential impacts to Gulf resources (e.g., the impact of a deep-sea underwater plume on benthic resources). Thus, no information or data exists upon which to found, let alone validate, scientific methodologies to predict the impact of the spill, so BOEMRE must wait for sufficient data to be collected. Until such data is collected, the agency must not move forward with further leasing and related activities in the Gulf until has it fully complied with 40 C.F.R. § 1502.22, including reassessing previously analyzed baseline conditions, fully assessing conditions previously disregarded, and fully assessing current baseline conditions.

b. Catastrophic Oil Spill Impacts

CBD-10

The environmental impacts of a future catastrophic oil spill and, by extension, Lease Sale 216/222 have not been fully considered in the DSEIS. The Deepwater Horizon spill was the largest offshore oil spill in the United States, and was the first catastrophic spill in deepwater. As a result, it provided a unique, first-of-a-kind opportunity to collect data on the environmental impacts of deepwater catastrophic oil spills, but those data are still being collected and analyzed. Because data collection and analysis is ongoing, it is too soon to fully assess the impacts of a catastrophic spill. Therefore, any EIS purporting to do so is necessarily incomplete.

CBD-10 (CONTINUED)

BOEMRE attempts to assess the environmental impacts of catastrophic oil spills in Appendix B of the DSEIS. However, because of the significant shortcomings in the understanding of the environmental impacts of the Deepwater Horizon spill (as described above and acknowledged in the document itself), the analysis in Appendix B riddled with knowledge gaps and therefore inadequate. For instance, Appendix B states that "[t]he best available information does not provide a complete understanding of the effects of the spilled oil and active response/cleanup activities on marine mammals." DSEIS at B-19, and that "[l]ongitudinal epidemiological studies of possible long-term health effects from exposure to either the Deepwater Horizon event's oil or dispersants, such as the possible bioaccumulation of toxins in tissues and organs, are lacking and the potential for the long-term human health effects are largely unknown (although the National Institutes of Health has proposed such a study)." *Id.* at B-47.

Because Lease Sale 216/222 has the potential to cause catastrophic oil spills, any full and fair discussion of the environmental impacts of Lease Sale 216/222 must contain a full and fair discussion of the environmental impacts of catastrophic oil spills, including those that occur in deepwater. The Deepwater Horizon was the first catastrophic spill from a deepwater blowout, and so presents a new understanding of the broad suite of potential environmental impacts. Because these impacts have not been thoroughly examined before in a natural setting, the relevance of any pre-existing scientific information cannot be used to estimate impacts from similar spills in the future. Only by collecting and analyzing data from the Deepwater Horizon spill can a full assessment of the potential impacts of a catastrophic spill, and consequently a reasoned choice among alternatives, be made. Until such data are collected, Lease Sale 216/222 cannot take place.

D. Climate Change

CBD-11

Climate change is a global phenomenon that will have significant environmental and economic impacts around the world, including in the Gulf of Mexico.[17] Given the magnitude and diversity of impacts posed by climate change, the DSEIS's discussion of it falls woefully short. Specifically, the DSEIS's discussion of climate change violates NEPA because the DSEIS (and 2007-2012 5-Year Program EIS) fails to (1) inventory greenhouse gas ("GHG") emissions resulting from the proposed action, Lease Sale 216/222, (2) take a "hard look" at the environmental impacts of the proposed action in the context of ongoing climate change, (3) consider the potential contribution of Lease Sale 216/222 to and the environmental impacts of ocean acidification, (4) consider the exacerbation of the Gulf hypoxic zone vis-à-vis climate change by Lease Sale 216/222, and (5) adequately consider the remaining potential environmental impacts of climate change.

[17] E.g., (1) M.L. Parry, O.F. Canziani, J.P. Palutikof, P.J. van der Linden and C.E. Hanson (eds). *Contribution of Working Group II to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change, 2007.* Cambridge University Press, New York, NY, USA.
(2) "Building a Resilient Energy Gulf Coast." *Entergy Corporation.* 20 Oct 2010. http://www.swissre.com/rethinking/climate/Building_a_resilient_Energy_Gulf_Coast.html.

1. Inventory of Greenhouse Gas ("GHG") Emissions

The DSEIS violates NEPA by failing to quantify GHG emissions that would result from Lease Sale 216/222. Lease Sale 216/222 leads to the generation of GHG emissions directly, via activities related to exploration, development, transportation of product and product processing, as well as indirectly, via the combustion of the oil and gas extracted as a result of the lease sale. In neither case does the DSEIS quantify emitted GHGs, which contribute to climate change.[18] We realize that the 2007-2012 5-Year Program EIS quantifies GHG emissions from some sources; however, as discussed elsewhere, this DSEIS cannot be tiered to the previous 5-Year EIS, so a new GHG emissions inventory must be performed. Furthermore, no previous NEPA documents have inventoried GHG emissions generated from the combustion of oil and gas produced as a result of Lease Sale 216/222.

The omission of GHG accounting prohibits the DSEIS from "providing a full and fair discussion of environmental impacts," 40 C.F.R. § 1502.1, because climate change could have significant impacts on the Gulf of Mexico, and so affect the potential impacts of this proposed action. The DSEIS itself notes that "[g]lobal climate change can increase surface temperature, increase sea levels, and increase storm events," DSEIS at 4-87, all of which could have profound impacts on resources in the Gulf. For instance, the DSEIS states that "[s]everal studies highlight the potentially disastrous effects of future hurricane storm-surge enhanced by sea-level rise on coastal communities." *Id* at 4-353. It also finds that "a [0.8-2.0 m] rise in sea level [as expected to occur by 2100 by recent climate change projections, according to the DSEIS (4-353),] would cause unprotected shorelines to migrate inland." *Id.* According to the DSEIS, climate change would also affect deepwater benthic communities, *id.* at 4-183, foraging areas and nesting beaches of hawksbills, *id.* at 4-206, and Kemp's ridleys, *id.* at 4-207, and threaten sperm whale populations via loss of prey base, *id.* at 4-196.

The above list of environmental impacts from climate change is not intended to be exhaustive (and indeed is not nearly so), but to merely point out that BOEMRE itself recognizes climate change may significantly impact the Gulf. Yet, the DSEIS fails to connect these and other climate change-induced threats to GHGs, which have a cumulative impact on climate change. An EIS must "consider the cumulative impact of the proposed action." *Kern v. US Bureau of Land Mangmt.*, 284 F.3d 1062, 1076 (9th Cir. 2002). GHGs accumulate in the atmosphere and ultimately cause climate change. As "individually minor but collectively significant actions taking place over a period of time," 40 C.F.R. §1508.7, GHGs definitively qualify as cumulative impacts, and so "[t]he impact of greenhouse gas emissions on climate change is precisely the kind of cumulative impacts analysis that NEPA requires agencies to conduct." *Center for Biological Diversity v. NHTSA*, 538 F.3d 1172, 1217 (9th Cir. 2008)). Thus, the DSEIS's failure to account for and consider the cumulative impacts of GHGs is a violation of NEPA.

[18] Core Writing Team, Pauchauri, R.K., and A. Reisinger (eds.). *Contribution of Working Groups I, II, and III to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change, 2007.* IPCC, Geneva, Switzerland.

Furthermore, the calculation of GHG emissions as a result of the lease sale is not a difficult task. Emissions factors are readily available from the U.S. Environmental Protection Agency and Energy Information Administration for the combustion of crude oil and natural gas in various applications, including transportation and electricity generation. The ready availability of these emissions factors in conjunction with the DSEIS's estimates of oil and gas resources that would be developed as a result of Lease Sale 216/222 make the calculation of GHG emissions from combustion relatively straightforward. The following calculation done by Oceana is only meant to illustrate the ready availability of the necessary data, and by no means should be considered a sufficiently detailed analysis for inclusion in the DSEIS. A sufficiently detailed analysis would take into account all GHGs and black carbon, not just CO_2, and divide the developed resources by their intended use, e.g. for transportation versus electricity.

Table 1: Projected emissions of CO_2 from the combustion of oil and gas resources that would be developed as a result of Lease Sale 216/222.

Resource	**CO_2 Emissions Factor**[a]	**Reserves Estimate**[b]	**CO_2 Emissions Estimate (million metric tons CO_2)**
Crude Oil	0.43 metric tons CO_2 per barrel oil	0.801 billion barrels	344.43
		1.624 billion barrels	698.32
Natural Gas	120,000 lb CO_2 per 10^6 scf gas	3.332×10^{12} scf	181.42
		6.560×10^{12} scf	357.17
		Total CO_2 Emissions (Low):	**525.85**
		Total CO_2 Emissions (High):	**1,055.49**

[a] Emissions factors estimated by the EPA.[19]

[b] See DSEIS 1-4.

Routine activities would also emit significant amounts of GHGs that must be quantified. Some routine activities, e.g. service vessels trips and helicopter operations, have already been projected by BOEMRE in Table 3-2 of the DSEIS (A-25). However, when calculating emissions from routine activities, a "cradle-to-grave" approach must be taken in determining what qualifies as a routine activity. In other words, routine activities at all stages of oil and gas production, from exploration to development to transportation to refining to decommissioning, must be quantified and the resulting GHG emissions calculated because activities at all stages would be the result of Lease Sale 216/222 and have potentially significant environmental impacts. Only by summing these emissions with those resulting indirectly from Lease Sale 216/222 (i.e., from combustion of developed oil and gas) can the DSEIS fully account for the potential environmental impacts of Lease Sale 216/222 and therefore comply with NEPA.

[19] Crude oil emissions factor: "Green Power Equivalency Calculator Methodologies." *EPA*. Apr 2011. http://www.epa.gov/greenpower/pubs/calcmeth.htm.
Natural gas emissions factor: "AP-42, Vol. 1, CH1.4: Natural Gas Combustion." *EPA*. July 1998. Page 1.4-6, Table 1.4-2. http://www.epa.gov/ttn/chief/ap42/ch01/final/c01s04.pdf.

2. Environmental Impacts in the Context of Ongoing Climate Change

As previously documented, climate change is projected to have significant environmental impacts on the Gulf of Mexico. These impacts stem from a variety of consequences of climate change, including ocean acidification, rising sea levels, and increased water temperature. While the most severe impacts from climate change are projected to occur mid to late century, some impacts are already occurring today.[20] As they worsen, these impacts will increasingly alter the environment of the Gulf of Mexico, which could stress biological populations. Further stress, in turn, could weaken the resilience of populations, which would make them more susceptible to the environmental impacts from Lease Sale 216/222. The DSEIS, however, neglects to consider such likely changes to baseline conditions of biological resources. Consequently, it also fails to consider the impacts of Lease Sale 216/222 on biological populations in the context of altered (i.e. worsened) baseline conditions. Such an analysis must be conducted for the DSEIS to truly take a "hard look" at the environmental impacts of the proposed action and thereby comply with NEPA.

3. Environmental Impacts of Ocean Acidification

The DSEIS fails to mention or discuss ocean acidification despite the significant threat it poses to Gulf of Mexico resources. Ocean acidification is driven by the dissolution of atmospheric CO_2 into seawater; approximately one third of anthropogenic CO_2 emissions are projected to be stored in the oceans.[21] As atmospheric CO_2 concentrations increase, more CO_2 dissolves into the oceans, lowering its pH. Detrimental effects of decreased pH include lower fertilization rates, respiratory stress, behavioral shifts, and inhibited calcification.[22] Activities that generate carbon dioxide contribute to ocean acidification and so qualify as cumulative impacts, since they are "individually minor but collectively significant actions taking place over a period of time." 40 C.F.R. §1508.7. As previously discussed, NEPA demands cumulative impacts be analyzed. Since Lease Sale 216/222 would lead to the emission of CO_2 but the DSEIS does not analyze the cumulative impacts of these emissions via ocean acidification, the DSEIS violates NEPA and will continue to until such an analysis is conducted.

4. Exacerbation of Gulf of Mexico Dead Zone by Climate Change

The Gulf of Mexico dead zone, estimated to have been the size of New Jersey at 7,722 square miles in 2010,[23] is one of the largest in the world. Dead zones are areas of hypoxic water, where insufficient oxygen exists to sustain most life. Hypoxic conditions are caused by an influx of excess nutrients, which typically originate from runoff containing nitrogen and phosphorus from agricultural fertilizers. Excess nutrients lead to phytoplankton blooms that die and are decomposed by bacteria in a process that consumes oxygen. When blooms are especially large,

[20] M.L. Parry, O.F. Canziani, J.P. Palutikof, P.J. van der Linden and C.E. Hanson (eds). *Contribution of Working Group II to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change, 2007.* Cambridge University Press, New York, NY, USA.
[21] Sabine, C., *et al.* 2004. The oceanic sink for anthropogenic CO_2. *Science*, 305(5682):367-371.
[22] Harrould-Kolieb, E., and J. Savitz. "Acid Test." *Oceana*. June 2009.
[23] "NOAA-Supported Scientists Find Changes to Gulf of Mexico Dead Zone." *NOAA*. 9 Aug 2010. http://www.noaanews.noaa.gov/stories2010/20100809_deadzone.html.

as when in the presence of excess nutrients, oxygen becomes so depleted that its aqueous concentration decreases below life-sustaining levels, killing and altering the distribution of fish, benthic marine species, and other marine life.

Climate change is expected to exacerbate the dead zone in the Gulf of Mexico through various mechanisms. Increased precipitation due to climate change in the Mississippi River watershed is expected to increase the river's discharge to the Gulf of Mexico, which would increase nutrient influxes to the region and exacerbate the dead zone.[24] Increased surface water temperatures due to atmospheric warming are enhancing stratification of ocean layers, which decreases mixing between layers and could also strengthen and/or expand dead zones.[25] Finally, increased aqueous CO_2 concentrations due to fossil fuel related emissions are expected to increase acidity, which will in turn increase baseline respiratory stress on organisms, lowering their tolerance to depleted oxygen concentrations and increasing the threat such low-concentration regions like dead zones pose.[26]

5. Other Environmental Impacts of Climate Change

The DSEIS does not sufficiently consider environmental impacts of climate change beyond those listed above. These additional environmental impacts include, but are not limited to, sea level rise, more severe and frequent storms, and increased water and atmospheric temperatures. Because Lease Sale 216/222 would contribute to climate change via direct and indirect GHG emissions (see above), the DSEIS must consider the impacts climate change-related impacts would have at a global level, as well as specifically on Gulf resources, but it only minimally engages in this discussion. For instance, it states simply that global climate change threatens nesting beaches of Kemp's ridley sea turtles, DSEIS at 4-207; affects hawkbills in foraging areas and on nesting beaches, *id.* at 4-206; decreases the prey base of sperm whales, *id.* at 4-196; and affects seagrass beds by adding stress vis-à-vis increased surface temperature, sea levels, and storm events, *id.* at 4-87. These considerations are very simplistic and do not consider in sufficient detail (e.g., by implementing regional climate forecast models) or breadth (e.g., by accounting for climate impacts at all life stages of development) the diverse array of potential impacts from climate change at a global or regional level. In order to comply with NEPA by "provid[ing] full and fair discussion of significant environmental impacts," 40 C.F.R. §1502.1, the DSEIS must fully consider the potential breadth and severity of climate change-related impacts.

E. Endangered Species

CBD-12

The DSEIS fails to take into account the significant impact on endangered species from the Deepwater Horizon spill and response efforts. BOEMRE's conclusions are contradicted by the available evidence and represent the same unrealistic approach MMS followed before the Deepwater Horizon event. For example, BOEMRE finds "no substantial new information that

[24] Justic, D., Rabalais, R. Turner, R.E. 1997. Impacts of climate change in net productivity of coastal waters: implications for carbon budgets and hypoxia. *Climate Research*, 8:225-237.

[25] Diaz, R. J. and Rosenberg, R. 2008. Spreading dead zones and consequences for marine ecosystems. *Science*, **321**: 926-929.

[26] Brewer, P.G., and Peltzer, E.T. 2009. Limits to marine life. *Science,* **324**: 347-348.

CBD-12 (CONTINUED)

would alter the impact conclusion for sea turtles presented in the Multisale EIS and the 2009-2012 Supplemental EIS." DSEIS at 4-204. This conclusion is impossible to reconcile with the fact that dozens of endangered turtles were killed by the Deepwater Horizon spill.[27] The take of turtles from the spill almost certainly exceeds the incidental take authorized by NMFS for the entire 40-year lifetime of the 2007 to 2012 lease sales. *See* DSEIS at 4-210 (quoting NMFS incidental take authorizations). Because this additional mortality likely does change the baseline, BOEMRE has reinitiated ESA consultation with NMFS and USFW.[28] In this context, contrary to what BOEMRE is now concluding in its DSEIS, BOEMRE explicitly stated that

> … the DWH incident and the resulting oil spill necessitate this reinitiation action. . . . [W]e acknowledge that the spill volumes and scenarios used in the analysis for the existing NMFS BO need to be readdressed given the "rare event" of a spill exceeding 420,000 gallons as referenced in the current NMFS BO has occurred and that affects [sic] to and the status of some listed species or designated critical habitats may have been altered as a result of the DWH incident and therefore require further consideration.

Id. NMFS responded to this letter on September 24, 2010, agreeing that reinitiation was warranted. In this response, NMFS explicitly noted that:

> As our response and impact analysis . . . [regarding the spill] continues, it is a good time for [BOEMRE] to evaluate the impacts to endangered and threatened species, and designated critical habitat from the oil, as well as for any potential future spills. We have begun synthesizing data from the spill, and it is clear that we have underestimated the size, frequency, and impacts associated with a catastrophic spill under the 2007-2012 lease sale program.
>
> The previous environmental impact statement did not estimate the size of a catastrophic spill and NMFS relied on historical data and other assumptions to estimate the potential size and impacts of such a spill on listed species. In light of the ongoing investigations surrounding the MC 252, we believe these assumptions did not sufficiently address the potential risks of a spill of this magnitude occurring and the risks posed to listed species and their habitats.
>
> The risk of oil spills, oil and gas industry response activities, and the potential impacts on protected resources should be comprehensively analyzed and the potential effects to listed species and critical habitat re-evaluated.

NMFS, Response to Reinitiation Letter, at 2.

FWS sent a similar response to BOEMRE on September 27, 2010, in which it concurred with BOEMRE's assessment that "the Deepwater Horizon incident and the resulting oil spill necessitate reconsideration of the existing consultation dated September 14, 2007 and concluded informally." In particular, FWS stated that

> The incident and resulting oil spill represent new information regarding potential adverse [e]ffects to endangered and threatened species that has not previously

[27] Deepwater Horizon Response Consolidated Fish and Wildlife Collection Report. 2 Nov. 2010.
[28] Reinitiation Letters of July 30, 2010

> been assessed. Furthermore, the status of some listed species or designated critical habitats may have been altered as a result of the Deepwater Horizon incident and therefore require further consideration.

FWS, Response to Reinitiation Letter, at 1. It agreed with BOEMRE that "the potential spill volumes and scenarios used in the analysis for the existing consultation . . . need to be re-addressed given the 'rare event' of a spill exceeding 420,000 gallons." *Id.* at 2. As part of this new analysis, FWS "encourage[d] the Bureau to conduct additional modeling to address this scenario and its potential effects on listed species and their designated critical habitats." *Id.*

CBD-13

It appears, however, that both NMFS and FWS have placed these reinitiated consultations on hold until they receive data from studies conducted as part of the National Resource Damage Assessment ("NRDA") process – data that the agencies believe will allow them to more accurately assess the environmental baseline in the Gulf. *See* DSEIS at 5-9. At present, it is unknown when the NRDA studies will be completed, though the draft programmatic EIS for NRDA is scheduled for release later this year, with the final EIS currently expected to be published next year. As a result, it is distinctly possible that the reinitiated consultations will not commence, let alone be completed, prior to the end of the current Five-Year Plan. Such a delay would effectively mean that the consultations were reinitiated in name only and that there would be no real analysis of whether any actions approved by BOEMRE in the interim, including this SEIS, complied with the mandates of the ESA. We believe that such an approval will violate the ESA, particularly its requirements to insure against jeopardy to listed species, described below.

Furthermore, assuming that the ESA consultations are on hold pending an updated baseline, that decision is at odds with BOEMRE's apparent decision to proceed with the lease sales, and to perform its NEPA evaluation of them, without waiting for these new results. As described above, such a reliance on an outdated baseline is at odds with the requirements of NEPA and its implementing regulations.

Additionally, the DSEIS fails to specify whether it will hold a lease sale before formal consultations are complete and a new Biological Opinion is obtained. If BOEMRE were to hold a lease sale under a Biological Opinion that has been rendered invalid by new understandings obtained during the Deepwater Horizon spill, it must explicitly assess the potential environmental impacts of this action, i.e. holding a lease sale not authorized by the Endangered Species Act.

F. Oil Spill Risk Analysis

CBD-14

The DSEIS fails to remedy BOEMRE's previously inadequate analysis of the likely impact of oil spills. In the initial Multisale EIS, MMS downplayed all of the impacts from offshore drilling. Among the Multisale EIS's conclusions are the following:

- An oil spill would only "result in sublethal impacts (e.g., decreased health, reproductive fitness, and longevity; and increased vulnerability to disease) to marine mammals" (2007 Multisale EIS 2-37 to 2-38).

- "In most foreseeable cases, exposure to hydrocarbons persisting in the sea following the dispersal of an oil slick will result in sublethal impacts (e.g., decreased health, reproductive fitness, and longevity; and increased vulnerability to disease) to sea turtles" (Id. 2-38).
- "The majority of effects … on endangered/threatened and nonendangered/nonthreatened coastal and marine birds are expected to be sublethal" (Id. 2-39).
- "The likelihood of spill occurrence and subsequent contact with, or impact to, Gulf sturgeon and/or designated critical habitat is extremely low" (Id. 2-40).
- The effects of an oil spill on fish populations and the commercial fishing industry would be "negligible and indistinguishable from variations due to natural causes" and "any affected commercial fishing activity would recover within 6 months" (Id).

MMS estimated that over the 40-year life span of the eleven proposed lease sales, the total amount of oil spilled in the offshore waters of the Central Planning Area, which includes the Deepwater Horizon site, would be 5,500 to 26,500 barrels of oil. *Id.* at 4-241. The maximum amount estimated – 26,500 barrels – is slightly over 1 million gallons, about 0.5% of the current estimate of oil spilled at the Deepwater Horizon site.

CBD-15

The Deepwater Horizon incident has illustrated, among other problems with current OCS operations, how difficult it is to control a blowout in very deep water and how difficult it is to marshal and put to use cleanup equipment. Alarmingly, cleanup techniques used in the Deepwater Horizon incident are the same as those that would be used in any future spills, yet all of these techniques were demonstrated to have significant shortcomings, particularly booms, *in situ* burning, chemical dispersants, and skimming, and all of which date back decades.[29] For example, *in situ* burning must be done within the first couple of days after the oil reaches the surface or else too much of the oil's complement of volatile components, which are necessary for ignition of the oil, will be lost.[30] *In situ* burning and skimming require corralling oil within booms, which is only possible in mild weather conditions.[31] Additionally, the rapid expansion of oil slicks from large spills quickly surpasses available corralling capacity for skimming and burning, leading to very low rates of oil recovery from these two methods.[32] Dispersants also have significant limitations; they are typically ineffective in calm sea conditions and are difficult to apply in seas of greater than a few feet. These and other problems resulted in an anemic oil recovery rate; the federal oil budget calculator estimates only 24% of the spilled oil, or 1.2 million barrels, was either chemically dispersed, burned, or skimmed, while 23% of the oil was unaccounted for and between 52% and 75% of the oil remained in Gulf waters.[33]

CBD-16

Deficiencies in spill cleanup technologies added to the overall impact of the spill once it occurred and must be fully analyzed in the DSEIS. BOEMRE also must include in its assessment of future oil spill impacts both the impacts of the release of crude oil and the impacts of cleanup

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[29] Miller, George. "Stop Offshore Drilling Until New Technology Is In Place." *Congressman George Miller*. 11 May 2010. http://georgemiller.house.gov/blogs/blog/2010/05/stop-offshore-drilling-until-n.shtml.

[30] Short, Jeffrey. "Deluge of Oil Highlights Research and Technology Needs for Oil Recovery and Effective Cleanup of Oil Spills." Written testimony to the U.S. House of Representatives Committee on Science and Technology, Subcommittee on Energy and Environment. Delivered 9 June 2010.

[31] Id.

[32] Id.

[33] "Oil Budget Calculator: Deepwater Horizon." *The Federal Interagency Solution Group*. Nov 2010. Pages 39-40.

CBD-16 (CONTINUED)

technologies such as in situ burning and application of dispersants. For instance, when dispersants are effective in creating microdroplets, these microdroplets become entrained in the water column, where they are more susceptible to microbial degradation.[34] Significant rates of degradation can deplete oxygen from the water column, creating hypoxic conditions that threaten fish and other marine life.[35] Preliminary research by Florida Institute of Oceanography scientists also suggests that oil mixed with Corexit is more toxic to phytoplankton than oil alone, raising broader biological impact concerns.[36] Similarly, scientists continue to debate the impact of the application of unprecedented amounts of dispersants near the seafloor, particularly with regard to how it altered or interacted with the fate of the oil released from the Macondo well. Again, this analysis requires a clear-eyed assessment regarding the capacity of both the government and the industry to control and mitigate the impacts of any future oil spills.

CBD-17

In the DSEIS, it is clear that BOEMRE continues to underestimate the impacts of oil spills on the environment and overestimate the ability of industry to prevent and respond to spills. Particularly troubling is the agency's use of recovered animals as an approximation of the number taken by the spill. Given the difficulty of recovering the corpses of marine animals, these numbers dramatically underestimate the actual impact. Williams et al.[37] report that under normal circumstances, "the overall pooled rate of carcass recovery for cetaceans in the Gulf of Mexico is approximately 0.4% of the total estimated mortality" (230). Based on known recovery rates, Williams et al. found that it is possible up to 5,050 cetaceans were killed by the Deepwater Horizon spill (231).

The Center for Biological Diversity reviewed scientific articles and government figures to assess the likely impacts of the spill. This review underscores how BOEMRE continues to underestimate the impacts of oil spills on the environment.

> In total, we found that the oil spill has likely harmed or killed approximately 82,000 birds of 102 species, approximately 6,165 sea turtles, and up to 25,900 marine mammals, including bottlenose dolphins, spinner dolphins, melon-headed whales and sperm whales. The spill also harmed an unknown number of fish — including bluefin tuna and substantial habitat for our nation's smallest seahorse — and an unknown but likely catastrophic number of crabs, oysters, corals and other sea life. The spill also oiled more than a thousand miles of shoreline, including beaches and marshes, which took a substantial toll on the animals and plants found at the shoreline, including seagrass, beach mice, shorebirds and others.[38]

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[34] Short, Jeffrey. "Deluge of Oil Highlights Research and Technology Needs for Oil Recovery and Effective Cleanup of Oil Spills." Written testimony to the U.S. House of Representatives Committee on Science and Technology, Subcommittee on Energy and Environment. Delivered 9 June 2010.

[35] Id.

[36] Spinner, Kate. "Did BP's Oil-Dissolving Chemical Make the Spill Worse?" *Herald-Tribune*. 30 May 2011. http://www.heraldtribune.com/article/20110530/ARTICLE/110539976/-1/news?p=1&tc=pg.

[37] Williams, R., et al. 2011. Understanding the Damage: Interpreting Cetacean Carcass Recoveries in the Context of the *Deepwater Horizon*/BP Incident. *Conservation Letters* **4**: 228-233.

[38] Center for Biological Diversity, *A Deadly Toll: The Gulf oil spill and the unfolding wildlife.*

1. The Bureau's Accidental Oil Spill Analysis is Fundamentally Flawed

CBD-18

The oil spill risk analysis of the DSEIS, summarized in Table 3-5, fails to take into account that spill rates differ across drilling depths and well types. Ultimately, this leads to an underestimation of the risk of large spills (i.e. greater than 1,000 barrels) and of the environmental impacts such spills would have.

The oil spill risk analysis used in the DSEIS hinges on spill rates classified by spill size. The spill rates "were calculated based on the assumption that spills occur in direct proportion to the volume of oil handled." DSEIS at 3-33. In other words, spill rates were calculated as the number of spills of a certain size that occur per billion barrels of oil handled/produced, pooling data across all other variables, e.g. drilling depth. For instance, Table 3-5 of the DSEIS shows that the estimated spill rate for spills of size less than one barrel is roughly 3,400 spills per billion barrels of oil handled. Setting aside the fact that these spill rates have not been updated since 2000, an egregious oversight in and of itself, the methodology for calculating these spill rates is fundamentally flawed. As a result of the flaw, the DSEIS underestimates the risk and corresponding environmental impacts of all spills, but particularly of large spills of greater than 1,000 barrels.

By categorizing spill rates by spill size only and not other variables, the DSEIS and its spill risk analysis implicitly assumes that oil produced across all depths and well types has an equal spill risk. However, this is not true. Deepwater and ultra-deepwater wells pose significantly greater risks than shallow wells due to increased complexity and harsher environments, making deepwater operations inherently riskier operations.[39] In the DSEIS, BOEMRE itself states: "Industry challenges remain as operators move into ultra-deepwater areas and seek deeper geologic prospects with little knowledge of its subsurface environment and with the use of new technologies in both familiar and unfamiliar environments." DSEIS at 3-46.

CBD-19

One reason deepwater drilling poses an exceptional oil spill risk is that deepwater wells in the Gulf of Mexico may be high pressure/high temperature ("HPT/HT") wells, which were not considered economically viable until the mid-1990s.[40] "HP/HT conditions are extremely dangerous and add exorbitant risk to drilling, completion and workover operations. The most extreme risk is that HP/HT conditions can cause blowouts."[41] A survey of HP/HT professionals taken post-Deepwater Horizon disaster describes the hazards and the major challenges facing operators drilling such wells such as the fact that "BOP control is not proven."[42] The risks peculiarly associated with ultra-deepwater drilling in the Gulf of Mexico are well known:

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[39] E.g., "Deep Water: The Gulf Oil Disaster and the Future of Offshore Drilling." *National Commission on the BP Deepwater Horizon Oil Spill and Offshore Drilling*. Jan 2011. Page vii.

[40] (1) How Are HP/HT Reservoirs Developed. *Rigzone*. http://www.rigzone.com/training/insight.asp?insight_id=328&c_id=1.;
(2) Kelessidis, V.C. "Challenges for very deep oil and gas drilling – will there ever be a depth limit?" *3rd AMIREG International Conference*. 2009. http://drillinglab.mred.tuc.gr/Publications/56.pdf.

[41] Id.

[42] "Major Challenges in HPHT Operations, Survey results of a survey sent to HPHT Professionals." *HPHT Wells Summit 2010.* 16 November 2010.

CBD-19 (CONTINUED)

Many of the prospects in the ultra deepwater GoM have what can only be described as having a unique combination of challenges. The combination of deepwater (Up to 10,000 ft [3048m] water depth), high-pressure (Over 10,000 psi [690 bar] shut in pressures), high temperatures (Over 350ºF [195ºC] bottom hole temperature), problematic formations (Salt zones, tar zones, etc.), deep reservoirs (Over 30,000 ft [9145m] true vertical depth), tight sandstone reservoirs (< 10mD) and fluids with extreme flow assurance issues separate many GoM deepwater and ultra deepwater wells from deepwater and ultra deepwater wells in other parts of the world.

Much of the prospective GoM deepwater exploration areas are in 4,000 ft [1220m] to 10,000 ft [3048m] of water. Most of this area is in a sub-salt environment; with salt canopies ranging from 7,000 ft [2134m] to 20,000 ft [6096m] thick, and have target depth ranges from 25,000 ft [7620m] to 35,000 ft [10668m] true vertical depth.[43]

For these reasons, one barrel of oil produced in deep water has a greater spill risk than one barrel of oil produced in shallow waters, in direct contradiction to the method employed by BOEMRE. The spill rate factors used in the DSEIS's spill risk analysis are taken from a paper written in 2000,[44] when most historic oil and gas production had occurred in relatively shallow water. In the years since, oil production has shifted to increasingly deeper water, as shown below in Table 2. Indeed, the DSEIS projects that the majority of wells drilled as a result of Lease Sale 216/222 will be in water deeper than 200 meters (DSEIS Table 3-2). Thus, it is likely that spill rates for spills of all sizes, and consequently overall spill risk, for Lease Sale 216/222 are higher than for the 2000 values. Given the significant environmental impacts spilled oil poses, a recalculation of spill risks must be done in order to fully comply with NEPA.

Table 2: Crude oil production categorized by drilling water depth from 1992 to 2007, the most recent year data for which data is available. Source: EIA.[45]

Years	Crude Oil Production from Less than 200 Meters Deep (million bbl)	Crude Oil Production from Greater than 200 Meters Deep (million bbl)	Ratio of Crude Oil Production from Less than 200 Meters Deep to Greater than 200 Meters Deep
1992-1999	1694	834	2.03
2000-2007	1119	2390	0.47

In addition to an erroneously low overall spill risk, the DSEIS significantly underestimates the risk of large oil spills (i.e. greater than 1,000 barrels). Given that Lease Sale 216/222 will lead to the drilling of many wells, *see* DSEIS Table 3-2, well blowouts are a particularly relevant potential cause of spills that should be considered in a spill risk analysis.

[43] Close, F., McCavitt, B., and B. Smith. "Deepwater Gulf of Mexico Development Challenges Overview." *Chevron North America E&P Co.*. 2008.

[44] Anderson, C.M., and R.P. LaBelle. 2000. "Update of Comparative Occurrence Rates for Offshore Oil Spills." *Spill Science and Technology Bulletin*, **6**: 303-321.

[45] "Gulf of Mexico Federal Offshore Production." *EIA*. 30 Dec 2010. http://tonto.eia.gov/dnav/pet/pet_crd_gom_s1_a.htm.

CBD-19 (CONTINUED)

When analyzing spills from well blowouts using the DSEIS's spill risk analysis methodology, though, two problems arise. First, because deepwater wells are located in harsher environments, controlling and stopping well blowouts can be more difficult. This fact was amply demonstrated during the Deepwater Horizon spill, when numerous techniques applicable in shallow water failed to stop the flow of oil from the Macondo well due to unique deepwater conditions. Because blowouts in deep water tend to be harder to control or stop, once a blowout occurs oil will likely flow for a longer period of time than in shallow water. Consequently, the risk of a catastrophic oil spill is greater with deepwater drilling. Second, more oil is being produced in deep versus shallow water (see above) and drilling is occurring in increasingly deeper environments (for instance, average crude oil exploratory well depth was 1,899 meters between 1964 and 1999, the timeframe examined by Anderson and LaBelle, and 2,276 meters between 2000 and 2008[46]). As a result, the total potential for well blowouts and other events that could lead to a spill is greater. These two issues (i.e. spills from deepwater operations have a greater chance of being catastrophic and deepwater production is increasing in volume and depth) combine to substantially increase the risk of a catastrophic oil spill. Yet the DSEIS's risk analysis methodology does not detect this rise in risk because it pools data across depths, obscuring the additional risks brought on by the increased prevalence of deepwater and ultra-deepwater, and consequently HP/HT condition, drilling. It is unreasonable for BOEMRE not to discuss areas where deepwater drilling could occur, the riskiness of those areas, and the unique risks associated with drilling in those areas in conducting its oil spill risk analysis for the DSEIS.[47]

2. *The Bureau's Reliance on Blowout Preventers to Minimize the Risk of an Accidental Spill and Consequential Environmental Harm is Unreasonable*

CBD-20

A recent investigation commissioned by the Department of the Interior and conducted by Det Norske Veritas ("DNV") suggests blowout prevention capabilities may be much more limited than previously thought.[48] DNV conducted a forensic examination of the Deepwater Horizon's blowout preventer ("BOP"), which infamously did not prevent the Macondo well from blowing out. DNV found that the BOP failed to seal the well because the blind shear rams ("BSRs") failed to fully close. The failure of the BSRs, in turn, was attributed by DNV in part to the drill pipe elastically buckling within the wellbore "due to forces induced on the drill pipe during loss of well control" ("Report No. EP030842" 5). In other words, as stated by DNV, "[t]he elastic buckling of the drill pipe was a direct factor that prevented the BSRs from closing and sealing the well" (Id.6).

The disturbing conclusions of DNV show that all BOPs, not just the Deepwater Horizon's, may be flawed by design and therefore cannot be relied upon as a viable last line of defense in blowout prevention. Indeed, the high-pressure surge of oil and gas that accompanies loss of well control - exactly the type of event BOPs are supposed to defend against – can render

[46] "Annual U.S. Average Depth of Crude Oil Exploratory Wells Drilled." *EIA*. 5 May 2011. http://www.eia.gov/dnav/pet/hist/LeafHandler.ashx?n=PET&s=E_ERTWO_XWDE_NUS_FW&f=A.

[47] "Over-Pressured Wells a Risk for E&P Operators in Deep-Water Gulf of Mexico, Says Joint HIS/GPT Report." *IHS*. 15 Feb 2011. http://press.ihs.com/press-release/energy-power/over-pressured-wells-risk-ep-operators-deep-water-gulf-mexico-says-joint-.

[48] "Report No. EP030842, Forensic Examination of Deepwater Horizon Blowout Preventer." *Det Norske Veritas*. 20 Mar 2011.

CBD-20 (CONTINUED)

BOPs ineffective. While DNV only investigated the BOP used by Deepwater Horizon, it is a standard design used widely in the deepwater drilling industry, and DNV concludes that the findings of its study should "be considered and addressed in the design of future Blowout Preventers and the need for modifying current Blowout Preventers" (Id. 177).

Similarly, in response to this study, the head of BOEMRE informed the House Committee on Natural Resources on March 30 that blowout preventers need further examination and should no longer be treated as certain to work.[49] He has also stated that additional rules need to be put in place to govern their use.[50] Industry experts, including those who have assisted BOEMRE and the oil spill commission have stated that "blowout preventers are not reliable enough" and that ultra deep water drilling shouldn't be conducted until the operators conduct validation projects to prove they can drill safely. It was well known in the industry that operation of subsea blowout preventers in the hostile deepwater environment presented risks not existing on surface mounted BOPs:

> From the 1st BOP design to the present designs, the basic mechanisms have remained constant: A BOP body is sandwiched between 2 operating systems. The rams are opened and closed mechanically either by manual intervention or by hydraulically operated pistons. What has changed, however, and is in a constant state of flux are the operating parameters and the manner in which BOPs are used in today's drilling activities. Today, a subsea BOP can be required to operate in water depths of greater than 10,000 f t, at pressures of up to 15,000 psi and even 5,000 psi, with internal wellbore fluid temperatures up to 400° F and external immersed temperatures coming close to freezing (34° F).[51]

CBD-21

Further, BOEMRE has acknowledged that new BOP rules are needed to reduce the risk of a major blowout:

> First, we will be launching in the very near future a major rulemaking designed to further enhance offshore drilling safety. This process will be broad, inclusive and ambitious. Our goal will be nothing less than a further set of enhancements that will increase drilling safety and diminish the risks of a major blowout. It will address weaknesses and necessary improvements to blowout preventers, as well as many other issues. We genuinely hope that the broad efforts undertaken by the industry in the wake of Deepwater Horizon, through its joint industry task forces, recently-announced Center for Offshore Safety, and other vehicles, will provide the basis for solid recommendations of

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[49] A webcast of Mr. Bromwich's testimony is available at http://naturalresources.house.gov/Calendar/EventSingle.aspx?EventID=227642 and incorporated by reference.

[50]

(1) Tilove, J. "Interior Department will seek continual improvements in blowout preventers." *NOLA*. 5 April 2011.
(2) Dlouhy, J.A. "Offshore safety updates in works." *Chron*. 29 April 2011.

[51] (1) Whitby, M.F. "Design evolution of a subsea BOP." *Drilling Contractor*. May/June 2007..
(2) National Commission on the BP Deepwater Horizon Oil Spill and Offshore Drilling. "The History of Offshore Oil and Gas in the United States, Staff Working Paper No. 22."

CBD-21 (CONT)

best practices, including those that should be included within prescriptive or performance-based regulations.[52]

It is unreasonable for BOEMRE to analyze environmental risk and anticipate mitigation of that risk through blowout preventers in the face of this newly acquired knowledge and its own acknowledgement that new BOP rules are needed to reduce the risk of a major blowout.[53]

3. *The Bureau's Reliance on the Marine Well Containment Company to Minimize the Risk of an Accidental Spill and Consequential Environmental Harm is Unreasonable*

Similarly, BOEMRE relies upon newly required "containment systems" which are being developed by the industry as a backup in the event the blowout preventer fails.

CBD-22

The Commission has strongly stated that oil spill response plans should not be approved unless there is proof the containment technology is "immediately deployable and effective" (Commission Report 33). The National Commission has also strongly recommended that source control and well-containment capabilities not be left in the hands of the industry which would appear to be the case here (Id. 32). The Bureau should not be assessing environmental risk based upon an assumption of mitigation when the system it is relying upon for mitigation has not been tested to the satisfaction of independent experts.

Additionally, a key component to the containment system devised by the Marine Well Containment Company, floating risers, recently failed for unknown reasons in connection with the Petrobras floating development and production system recently permitted by BOEMRE.[54] As stated by an oil industry expert: "The failure of a key component in freestanding riser technology raises the question about the reliability of the free standing risers in the well containment systems that are staged for rapid deployment in the event of another subsea well blowout."[55] Reliance on an unproven system of unknown reliability for the purpose of finding that an accidental spill will not occur is unreasonable.

4. *The Bureau's Reliance on the Oil Spill Risk Analysis Model Is Arbitrary and Capricious.*

CBD-23

The Bureau continues to rely upon its oil spill risk analysis model ("OSRA") which serves as a proxy for a trajectory analysis. The problems with the use of this model to accurately determine environmental risk are self-evident. The model does not predict the fate of a release greater than one day; it does not evaluate the fate of the single release for longer than 30 days; and it does not assume a particular spill size but only evaluates contact probabilities for spills

[52] BOEMRE Director Discusses Future of Offshore Oil and Gas Development in the U.S. at Gulf Oil Spill Series. 19 April 2011. http://csis.org/files/attachments/110419_EnergyBromwichRemarks.pdf.
[53] Rascoe, A. "Analysis: A year after BP spill, drilling risks linger." *Reuters.* 20 April 2011.
[54] See articles on Petrobras floating riser failure and MWCC description of expanded containment system (showing floating risers).
[55] Id.

CBD-23 (CONTINUED)

greater than 1000 barrels. The analysis also does not consider marine fishery resources and habitats; offshore marine mammal habitats and resources; or offshore sea turtle resources and habitats.[56] As Commission staff points out – overall, it fails to consider most of the offshore environmental resources that are located outside of the coastal zone and are managed by NOAA.[57] Use of this model by the Bureau during its NEPA analyses, "resulted in significant underestimations of oil-spill impacts compared to the actual BP oil spill."[58] Given these facts, BOEMRE's use of the OSRA to model environmental risk is arbitrary and capricious.

Instead, BOEMRE should be using the OSRA Catastrophic Run (Appendix C of the DSEIS) to analyze the environmental risk of deepwater drilling.

5. *The Bureau's Failure to Use the Catastrophic Blowout for its Oil Spill Risk Analysis Is Arbitrary and Capricious.*

The Commission found that the Deepwater Horizon disaster and its adverse impacts cannot be severed from other proposed Gulf drilling operations because the root causes of the blowout are endemic to the industry as a whole. If allowed to proceed apace without redress, these flaws might well result in another disaster:

> The blowout was not the product of a series of aberrational decisions made by rogue industry or government officials that could not have been anticipated or expected to occur again. Rather, the root causes are systemic and, absent significant reform in both industry practices and government policies, might well recur.[59]

CBD-24

The Commission has determined that a combination of missteps, poor training, lack of communication, and lack of regulatory oversight, all contributed to the blowout, but went unnoticed as common industry practices (Id. 125-126). The Commission further suggests that this haphazard decision-making is part of a corporate culture shared by other companies in the industry (Id.). In its Recommendations, the Commission suggested that what is needed is "fundamental reform" that goes beyond those reforms already initiated since the disaster (page vii).[60] Because BOEMRE has not carried out the Commission's recommendation, nor has Congress intervened, prior to moving forward with deepwater exploration in the Gulf of Mexico, the risk of another uncontrolled blowout and its associated environmental risk is a potential outcome. As the Commission explained:

[56] National Commission on the BP Deepwater Horizon Oil Spill and Offshore Drilling: Federal Environmental Review Of Oil And Gas Activities In The Gulf Of Mexico: Environmental Consultations, Permits, And Authorizations, Staff Working Paper No. 21, January 12, 2011. Page 26.
[57] Id.
[58] Id. Page 27.
[59] Final Report: National Commission on the BP Deepwater Horizon Oil Spill and Offshore Drilling. January 2011.
[60] "Deepwater: The Gulf Oil Disaster and the Future of Offshore Drilling: Recommendations." *National Commission.* http://www.oilspillcommission.gov/sites/default/files/documents/OSC_Deep_Water_Summary_Recommendations_FINAL.pdf.

CBD-24 (CONT)

> [I]in the aftermath of the BP Deepwater Horizon spill, it is difficult to argue that deepwater drilling is an activity that does not present at least some potentially significant risk of harm to the environment of the Gulf.

(Id. 18). It is arbitrary and capricious for BOEMRE to conduct its environmental analysis of anything other than the catastrophic blowout described in Appendix C. We now know that a catastrophic spill is not inconceivable, that blowout preventers are known to fail, and containment systems are unproven and indeed, BOEMRE concedes, may not work at all.

6. The Bureau Must Withdraw the DSEIS Until Its OSRP/Certification Process Has Been Made the Subject of Public Notice and Comment

CBD-25

At this time, operators in the Gulf do not have approved regional oil spill response plans ("OSRPs"). Instead, they are being allowed to go forward with drilling if they have "certified" they can respond to the maximum extent possible to a worst case discharge in the region. Despite the National Commission's strong recommendation that oil spill response plans should be the subject of extensive interagency consultation and a transparent process including notice and comment ("Recommendations" 26)[61] OSRPs and certifications and the process by which those certifications have been approved have never been disclosed to the public.

OSRPs provide the "mitigation" BOEMRE uses to claim that the environmental risk of a blowout resulting in a large oil spill has been reduced to an insignificant level. The public cannot meaningfully participate in an environmental review of a lease sale where the basis for the minimization of risk associated with the activities to be conducted pursuant to that plan has not been exposed to public scrutiny and comment.

III. PROBLEMS IN THE CATASTROPHIC SPILL IMPACT ANALYSIS ON BIOLOGICAL RESOURCES (APPENDIX B)

A. Relevance of Deepwater Horizon Spill to DSEIS

CBD-26

The Catastrophic Spill Event Analysis of the DSEIS, located at Appendix B, excludes credible scientific analysis on the impacts to marine life that occurred from the recent Deepwater Horizon spill. The DSEIS ignores scientific studies produced after the Deepwater Horizon spill and, by not taking their findings into account, does not incorporate many foreseeable impacts of another catastrophic oil spill. This is particularly egregious given that the Deepwater Horizon spill occurred in the Central Planning Area of the Gulf of Mexico, where the proposed action would occur. Given the relevance of the Deepwater Horizon disaster to this leasing process, it is necessary to consider all evidence pertaining to catastrophic oil spills to adequately understand the potential environmental impacts associated with offshore oil drilling in the Gulf of Mexico. Such evidence includes, but is not limited to, comprehensive ecosystem perspectives of spill impacts, current and ongoing research on the Deepwater Horizon spill, and longitudinal studies of previous catastrophic spills like the Exxon Valdez, much of which the DSEIS ignores. The

[61] "Specifically, oil spill response plans, including source-control measures, should be subject to interagency review. … Plans should also be made available for a public comment period prior to final approval…"

CBD-26 failure of the DSEIS to consider the issues described below makes it highly deficient in "providing a full and fair discussion of environmental impacts," 40 C.F.R. § 1502.1, violating NEPA. In order to comply with NEPA, the Final SEIS must therefore include the considerations detailed below.

B. Section-Specific Problems of Appendix B, Section 3 ("Offshore Spill (Phase 2)")

The following comments detail the numerous shortcomings contained in Appendix B of the DSEIS section-by-section, with particular emphasis placed on Section 3 of Appendix B, "Offshore Spill (Phase 2)" (DSEIS B-11). Section headings below (e.g. "3.2.2.1 Marine and Migratory Birds") mirror those employed within Appendix B for ease of reference and comparison.

3.2.2.1 Marine and Migratory Birds

CBD-27

i) As of November 2010, there have been over 8,000 birds collected in the CPA due to the Deepwater Horizon spill, many of which were oiled.[62] There was an exponential increase in bird deaths after the Deepwater Horizon spill[63] and long term population level impacts need serious consideration since the collected animals are a small subset of the total number of birds that were actually killed. Any analysis of the impacts of a catastrophic spill in the CPA needs to include modeling efforts to estimate more accurately the number of bird deaths and injuries to date. BOEMRE needs to update this DSEIS and better analyze the baseline impacts to populations of birds from direct mortality after the spill.

CBD-28

ii) The number of birds found dead near a catastrophic spill is likely a small subset of the total number killed by direct contact with oil. Although the Exxon Valdez was in different conditions, 30,000 dead oiled seabirds were found on the beaches, while aerial surveys and population assessments estimated that 250,000 seabirds were killed by the oil - nearly ten times more.[64] Due to direct losses and changes in the habitat, several populations of seabirds have not recovered, even though it has been more than 20 years since that catastrophic spill event.[65]

CBD-29

iii) Some larger birds, such as pelicans, can leave the affected area while partially covered in oil, leading to the underestimation of total bird fatalities due to a disaster. After the Exxon Valdez spill, about 88% of the total birds found dead were found outside of Prince William Sound, where the spill was located.[66] The impacts to populations of migratory birds that were affected by the Deepwater Horizon or

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[62] NOAA. (2011). Deepwater horizon response consolidated fish and wildlife reports, As of November 2nd, 2010.

[63] Antonio, F.J., Mendes, R.S., and Thomaz, S.M. (2011) Identifying and modeling patterns of tetropod vertebrate mortality rates in the Gulf of Mexico oil spill. Aquatic Toxicology, 105: 177-179.

[64] Piatt, J and P. Anderson. 1996. Response of Common Murres to the Exxon Valdez oil spill and long-term changes in the Gulf of Alaska marine ecosystem. *American Fisheries Society Symposium*, **18**: 720-737.

[65] Id.

[66] Piatt, J. Lnesink, L., Butler, W., Kendziorek, M., and D. Nysewander. 1996. Immediate impact of the Exxon Valdez oil spill on marine birds. *The Auk*, **107**: 387-397.

another catastrophic spill are difficult to estimate, but endangered species of migratory birds are of great concern.

CBD-30

iv) While the short term impacts to bird deaths from direct contact with oil is easier to evaluate and explain, the long-term impacts to bird populations can take years to decades to fully evaluate. Birds are top predators in the Gulf of Mexico and require a healthy supply of prey species to sustain their populations. The long term impacts of potential food stress for bird species throughout the Gulf of Mexico from an altered ecosystem are yet to be seen, but they are not acknowledged in Appendix B of the DSEIS as threats from a catastrophic oil spill. This is a major oversight. Disturbances to the ecosystem can cause long-term sublethal impacts in birds such as malnourishment and decreased reproductive success, which can have severe impacts to bird populations as seen after the Exxon Valdez.[67]

3.2.2.2 Fish, Fisheries, and Essential Fish Habitat

CBD-31

i) Fish species are most vulnerable to an oil spill early in their life history at the egg and larval stages. The onset of the Deepwater Horizon disaster coincided with the spawning period (April and May) of one of the world's most valuable commercial fish species, which is also already threatened, the North Atlantic bluefin tuna. Some of the most important and highest quality habitat of North Atlantic bluefin tuna larvae was in the vicinity of the Deepwater Horizon oil spill and at least part of the 2010 year class was immediately lost by contacting the oil.[68] NOAA is continuing with research surveys of the area to determine the extent to which larvae were affected by the oil and the dispersant used in response, and how this may affect recruitment for the already threatened North Atlantic bluefin tuna. This information should be considered in the DSEIS prior to the proposed action.

CBD-32

ii) At the height of the Deepwater Horizon spill, 36% of federal waters in the Gulf of Mexico were closed to fishing, an area of 86,985 square miles (225,290 km²).[69] Figure 2 shows the area that was closed to fishing. The closure affected 22% of the annual U.S. commercial catch in the Gulf and 24% of the corresponding annual landed value was in prior years derived from the area closed to fishing, representing a potential minimum annual loss of $247 million.[70] Another catastrophic oil spill in the CPA represents similar threats that need to be addressed in the DSEIS.

iii) The DSEIS inappropriately summarizes the threats to commercial fisheries as follows:

[67] Piatt, J and P. Anderson. 1996. Response of Common Murres to the Exxon Valdez oil spill and long-term changes in the Gulf of Alaska marine ecosystem. *American Fisheries Society Symposium*, **18**: 720-737.
[68] "Bluefin Tuna Hit Hard by 'Deepwater Horizon' Disaster." *European Space Agency*. 26 Oct 2010. http://due.esrin.esa.int/news/news210.php.
[69] "FB10-055. BP Oil Spill: NOAA Modifies Commercial and Recreational Fishing Closure in the Oil-Affected Portions of the Gulf of Mexico." *NOAA*. 21 June 2010. http://sero.nmfs.noaa.gov/bulletins/pdfs/2010/FB10-055_BP_Oil_Spill_Closure_062110.pdf.
[70] Mcrea-Strub, A. et al. (2011) Potential impact of the Deepwater Horizon oil spill on commercial fisheries in the Gulf of Mexico. *Fisheries*, 36(7), 334.

CBD-33

> The potential impacts from accidental events, a well blowout or an oil spill, associated with the CPA proposed action are anticipated to be minimal. Commercial fishermen are anticipated to avoid the area of a well blowout or an oil spill. Any impact on catch or value of catch would be insignificant compared with natural variability. (DSEIS Summary, xiii)

This statement should be revised to more accurately depict the threats of a catastrophic oil spill to widespread fisheries closures, impacts to Gulf seafood image and branding, and economic losses to fisheries, all of which have been observed for fisheries in the CPA since the Deepwater Horizon spill.

3.2.2.3 Marine Mammals

CBD-34

i) The mortality rate of marine mammals increased exponentially after the Deepwater Horizon spill, and would be expected to follow similar patterns in another catastrophic oil spill in the CPA.[71] NOAA is currently investigating the cause of an Unusual Mortality Event (UME) for dolphins and whales in the northern Gulf of Mexico. While the UME for cetaceans began just before the Deepwater Horizon spill in February 2010, the number spiked post-spill, especially since November 2010.[72]

A UME is defined under the Marine Mammal Protection Act as "a stranding that is unexpected; involves a significant die-off of any marine mammal population; and demands immediate response" (16 U.S.C. § 1421(h)(6)).

According to NOAA's data on the UME in the Northern Gulf of Mexico from 2010 to 2011, there were 350 cetacean strandings (96 percent of which were dead upon stranding) from the beginning of the Deepwater Horizon spill on April 30, 2010, to May 15, 2011. Furthermore, a recent increase in strandings has occurred that has been particularly alarming due to the abnormally high number of premature, stillborn or neonatal dolphin carcasses (74 such carcasses were found between January and April 17, 2011).[73] These young dolphins were developing in their mother's wombs as the oil spill spread, and the timing of their appearance coincides with the expected time of birth of individuals conceived around the time of the spill. Whether the high number of dead young dolphins can be tied to the Deepwater Horizon spill and/or the dispersants used during spill response is still being investigated.

CBD -35

ii) The number of carcasses found is likely only a small fraction of the actual number of cetaceans killed from the Deepwater Horizon spill. Based on historical carcass detection rates in the northern Gulf of Mexico for 14 cetacean species, the number of marine mammal deaths from the Deepwater Horizon spill may be 50 times higher

[71] Antonio, F.J., Mendes, R.S., and Thomaz, S.M. (2011) Identifying and modeling patterns of tetropod vertebrate mortality rates in the Gulf of Mexico oil spill. Aquatic Toxicology, 105: 177-179.
[72] "2010-2011 Cetacean Unusual Mortality Event in the Northern Gulf of Mexico." *NOAA Fisheries Office of Protected Resources*. 2011. http://www.nmfs.noaa.gov/pr/health/mmume/cetacean_gulfofmexico2010.htm.
[73] Id.

CBD-35 (CONTINUED)

than the number of located carcasses.[74] This DSEIS fails to extrapolate data on carcass detection rates since the Deepwater Horizon in conjunction with historical carcass detection rates to model how the baseline of marine mammals have been affected since the Deepwater Horizon spill. Similar numbers of marine mammal mortalities would be expected in another catastrophic spill in the CPA. BOEMRE should incorporate the concerns of the Marine Mammal Commission, and delay the lease sale activity until marine mammal population assessments have been completed.

> The BOEMRE should develop a set of standards for baseline information needed to assess the effects of oil and gas operations on marine mammals and their environment, initiate research on these topics prior to the resumption of lease sales in the Gulf of Mexico, and consider ways to improve oil-spill prevention and response capabilities. (DSEIS Marine Mammal Scoping Comments, A-110)

3.2.2.4 Sea Turtles

CBD-36

i) The mortality rate for sea turtles increased exponentially during and after the Deepwater Horizon spill.[75] As of April 30th, 2011 there have been 1,146 sea turtles collected either live or dead in the CPA.[76] BOEMRE should incorporate the most up to date data to more accurately detail how the baseline of turtles in the CPA has been affected. Many of these deaths have been attributed to fisheries interactions with trawling nets and the lack of appropriate use of Turtle Excluder Devices on shrimp trawlers.[77] However, these deaths were an indirect result of the Deepwater Horizon spill, which shifted enforcement resources away from shrimp fisheries and also economically incentivized shrimp fishermen to not abide by regulations aimed at protecting sea turtles. The exponential increase in turtle deaths during and after the spill compared to pre-spill data has affected the baseline of these endangered species and must be more thoroughly reviewed. Based on carcass detection rates after the Deepwater Horizon spill and appropriate multipliers involving historical carcass detection rates, BOEMRE can more accurately model what the impacts have been to populations of sea turtles since the Deepwater Horizon. This is essential to determining a baseline for endangered sea turtles in the CPA, and should be included for any analysis of the potential impacts of a catastrophic spill.

ii) The DSEIS does not consider the full life history, habitats, range or sublethal impacts to which sea turtles are susceptible in a catastrophic spill. Sea turtles require sandy

[74] Williams, R., Gero, S., Bejder, L., Calambokidis, J., Kraus, S., Lusseau, D., Read, A., and J. Robbins. 2011. Underestimating the damage: interpreting cetacean carcass recoveries in the context of the Deepwater Horizon/BP incident. *Conservation Letters*, DOI:10.1111/j.1755-263x2011.00168x.

[75] Antonio, F.J., Mendes, R.S., and Thomaz, S.M. (2011) Identifying and modeling patterns of tetropod vertebrate mortality rates in the Gulf of Mexico oil spill. Aquatic Toxicology, 105: 177-179.

[76] NOAA Office of Protected Resources (2011) Sea turtles and the Gulf of Mexico Oil Spill, As of February 15th, 2011.

[77] "RE: Notice of Intent to Sue for Violations of the Endangered Species Act Related to the Management of the Gulf of Mexico Shrimp Trawl Fishery." *Oceana.* 19 July 2011. http://na.oceana.org/sites/default/files/Gulf_Notice_of_Intent_7.19.11.pdf

CBD-37

beaches as nesting spots, and a catastrophic oil spill in the Central Gulf of Mexico could threaten at least 17 known sea turtle nesting beaches and hundreds of clutches along the Texas coastline including important nesting sites at Padre Island National Seashore which is the longest stretch of undeveloped barrier island in the world.[78,79] This includes important nesting sites for three of the six species of sea turtles in U.S. waters, the endangered Kemp's ridley and loggerhead turtles, as well as a threatened population of green sea turtles.[80]

CBD-38

iii) Along with nesting beaches, oil spills can be harmful to sea turtles by destroying important sea turtle habitat areas and reducing available prey.[81] Some important sea turtle habitats that can be affected by oil include sargassum seaweed mats, sea grass beds and coral reefs. Declines in sea grass, as well as invertebrates and sponge populations, as a result of oil exposure reduce the available food supply to sea turtles.[82]

CBD-39

iv) An independent review by retired Coast Guard flag officers and government officials noted that the Coast Guard was unprepared to protect Environmentally Sensitive Areas ("ESAs") along the coasts from another spill of a similar magnitude as the Deepwater Horizon.[83] No laws have been passed to improve the response of the Coast Guard to protect ESAs in the CPA and other parts of the Gulf of Mexico, such as sea turtle nesting sites, in the case of another catastrophic oil spill. After the Deepwater Horizon spill, NOAA had to transfer 274 sea turtle nests to the eastern side of Florida to prevent the hatchlings from encountering oil.[84] Whether this was successful remains to be seen.

CBD-40

v) The DSEIS inaccurately depicts the range of sea turtles and claims the impacts to turtles would occur mostly in shallow water, minimizing the threats in the open ocean. Adult females will migrate from foraging areas to mainland or island nesting beaches and may travel hundreds or thousands of kilometers each way through the open ocean.[85] After emerging from the nest, hatchlings swim to offshore areas, where they are believed to live for several years, feeding close to the surface on a variety of

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[78] "Sea Turtle Nesting Sites: OBIS-SEAMAP." *State of World's Sea Turtles (SWOT)*. 2009. http://seamap.env.duke.edu/swot.

[79] "Padre Island National Seashore." *National Park Service, U.S. Department of Interior.* 31 Mar 2011. http://www.nps.gov/pais/index.htm.

[80] "Sea Turtle Nesting Sites: OBIS-SEAMAP." *State of World's Sea Turtles (SWOT)*. 2009. http://seamap.env.duke.edu/swot.

[81] Shigenaka, G. et al. "Oil and Sea Turtles, Biology, Planning and Response." *NOAA*. 2003. http://response.restoration.noaa.gov/book_shelf/35_turtle_complete.pdf.

[82] Id.

[83] "Final Action Memorandum: Incident Specific Preparedness Review (ISPR) of Deepwater Horizon Spill." *U.S. Department of Homeland Security, U.S. Coast Guard.* 18 Mar 2011. Page 20.

[84] "Number of Turtle Nests Translocated and Hatchlings Released in the Atlantic Ocean." *NOAA Fisheries Office of Protected Resources*. 19 Apr 2010. http://www.nmfs.noaa.gov/pr/health/oilspill/turtles.htm.

[85] "NOAA's Oil Spill Response: Effects of Oil on Marine Mammals and Sea Turtles." *NOAA*. 12 May 2010. http://response.restoration.noaa.gov/book_shelf/1887_Marine-Mammals-Sea-Turtles-fact-sheet.pdf.

CBD-41

pelagic plants and animals.[86] The DSEIS downplays the impacts of an offshore catastrophic spill on essential habitat for turtles in the open ocean convergence zones.

vi) The DSEIS also excludes many internal and external injuries that can occur when sea turtles contact oil or chemical dispersants. Sea turtles are vulnerable to the direct effects of oil at all life stages—eggs, post-hatchlings, juveniles, and adults.[87] They are especially at risk because they do not avoid oiled waters.[88] Depending on the circumstances of the oil spill, sea turtles could become coated in oil or inhale volatile chemicals when they surface to breathe, swallow oil or contaminated prey, swim through oil, or come in contact with it on their nesting beaches. A catastrophic oil spill is dangerous to sea turtles in a variety of ways that are not covered by the DSEIS:

1) Oil or dispersants on the sea turtle's skin and body can cause skin irritation, chemical burns, and infections.[89] Oil exposure for just 4 days can cause sea turtles' skin to continually fall off in sheets. This condition persists even after they are removed and treated from the exposure.[90]
2) Inhalation of volatile petroleum compounds or dispersants can damage the respiratory tract and lead to diseases such as pneumonia.[91]
3) Ingesting oil or dispersants may cause injury to the gastrointestinal tract, which may affect the animals' ability to absorb or digest foods.[92] Turtles of all life stages exposed to tar balls have been found with tar blocking their digestive systems leading to toxic exposure and "floating syndrome" where gas prevents the turtle from diving and therefore feeding. This can lead to starvation.[93]
4) Chemicals that are inhaled or ingested may damage liver, kidney, and brain function, cause anemia and immune suppression, or lead to reproductive failure or death.[94]

CBD-42

vii) The DSEIS fails to detail the threats of a catastrophic oil spill to important nesting sites, the full life history of sea turtles, crucial foraging and offshore habitats, and sublethal long-term impacts to prey species for sea turtles in the CPA. The failure of the DSEIS to present the full range of threats to these already endangered species and to even attempt to model any population level impacts from the Deepwater Horizon event shows the documents glaring insufficiencies.

3.2.2.5 Offshore Habitats

[86] Id.
[87] Shigenaka, G. et al. "Oil and Sea Turtles, Biology, Planning and Response." *NOAA*. 2003. http://response.restoration.noaa.gov/book_shelf/35_turtle_complete.pdf.
[88] Id.
[89] "NOAA's Oil Spill Response: Effects of Oil on Marine Mammals and Sea Turtles." *NOAA*. 12 May 2010. http://response.restoration.noaa.gov/book_shelf/1887_Marine-Mammals-Sea-Turtles-fact-sheet.pdf.
[90] Shigenaka, G. et al. "Oil and Sea Turtles, Biology, Planning and Response." *NOAA*. 2003. http://response.restoration.noaa.gov/book_shelf/35_turtle_complete.pdf.
[91] "NOAA's Oil Spill Response: Effects of Oil on Marine Mammals and Sea Turtles." *NOAA*. 12 May 2010. http://response.restoration.noaa.gov/book_shelf/1887_Marine-Mammals-Sea-Turtles-fact-sheet.pdf.
[92] Id.
[93] Id.
[94] Id.

CBD -43

i) Offshore habitat impacts are some of the most overlooked when it comes to the impacts of an oil spill. The open waters of the Gulf of Mexico are not devoid of life, but home to many forms of plankton and zooplankton that are essential producers. Not only is plankton important in regulating climate, but it also contributes to marine snow, which serves as an important source of nutrients for mesopelagic and benthic habitats.[95] Plankton also includes the larval forms of many ecologically and commercially important fish and shellfish, including blue crabs, oysters, and shrimp. A spill in offshore waters would not just impact free-floating sargassum mats and the hundreds of species that depend on these mats as spawning sites, but it could also damage many offshore plankton populations and the species that depend on them as well as fishery-dependent economies.

3.2.2.6 Continental Shelf Benthic Resources

CBD -44

i) Seafloor communities along the continental shelf that are directly covered with oil will be adversely affected, and additional secondary effects could occur related to a large oil spill like the buildup of microbial mats on the seafloor and the potential toxicity of dispersants like COREXIT® EC9500A. The consumption of oil by microbes can be a good thing, but when excessive, the enhanced bacterial respiration can impact oxygen levels and contribute to hypoxic conditions that already harm Gulf of Mexico ecosystems. Large amounts of microbes can sink to the seafloor and form a thick microbial mat that snuffs out other forms of life.[96] The long term biological impacts of the large quantities (over 1 million gallons) of COREXIT® EC9500A used during the Deepwater Horizonspill needs better understanding. There is little information in the DSEIS about how dispersant has been biodegraded after the Deepwater Horizon spill and whether it or any of its breakdown products are bioaccumulating in the food chain or remaining in coastal sediments.[97]

3.2.2.7 Deepwater Benthic Communities

CBD -45

i) Soft Bottom: Based on the susceptibility of foraminifera to chemical pollution,[98] their populations were likely adversely affected by the Deepwater Horizon spill. Oil-affected foraminifera exhibit deformed shells, but the shells do not totally dissolve in the presence of oil. Their malformed shells are useful in assessing the status of recovery after oil spills.[99] NOAA scientists and researchers at Auburn University and the University of South Florida have taken samples of benthic foraminifera from the

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[95] Green, E., and M. Dagg. 1996. Mesozooplankton associations with medium to large marine snow aggregates in the northern Gulf of Mexico. *Journal of Plankton Research*, **19**(4): 435-447.

[96] Duran, R., and M. Goni-Urriza. (2010) Impact of pollution on microbial mats. *Handbook of Hydrocarbon and Lipid Microbiology*, **22**:2339-2348.

[97] Place, B., et al. (2010) A role for analytical chemistry in advancing our understanding of the occurrence, fate, and effects of Corexit oil dispersants. *Environ. Sc. Technol.*, **44**(16):6016-6018.

[98] Ernst, S.R. et al. 2006. Benthic foraminiferal response to experimentally induced Erika oil pollution. Marine Micropaleontology, **61**: 76-93.

[99] Sabean, J., Scott, D., Lee, K., and A. Venosa. (2009) Monitoring oil spill bioremediation using marsh foraminifera as indicators. *Mar Pollut Bull*, **59**(8-12): 352-61.

CBD-45

Deepwater Horizon spill area, and they will be conducting further analysis and sampling in 2011.[100] Understanding the status of benthic foraminifera will be a significant and important indicator of the health of the Gulf of Mexico after the Deepwater Horizon spill and will help to determine how much the deepwater communities have been affected.

CBD-46

ii) BTEX at Depth: Much of the dissolved petroleum stayed in the deep waters of the Gulf, and some of the most toxic forms remain in the deep sea (but at low levels).[101] The plume is mostly comprised of benzene, toluene, ethybenzene, and total xylenes, or BTEX. BTEX compounds only represented about 2 percent of the oil that came out of the well, but almost 100 percent of the deep-sea plume. They remain at below 3,000 feet depth, whereas the other hydrocarbons - like methane - degraded, washed on shore, were eaten by bacteria, or were burned at the surface. In the case of the Deepwater Horizon much of the gas and oil experienced a significant residence time in the water column with no opportunity for the release of volatile species to the atmosphere. This indicates that much of the oil became soluble and stayed in the deep sea which absorbed much of the impacts. The levels of BTEX that they found may not be acutely toxic to marine life, but could cause other less well-understood impacts like neurological effects for mesopelagic and benthic animals. More study is needed to determine any adverse impacts of these BTEX levels for marine life. Further assessing how deep sea environments have been adversely affected due to decaying material drifting to the ocean bottom and the persistent deep-sea oil plume is necessary for the DSEIS's catastrophic spill analysis.

CBD-47

iii) Deep Sea Impacts from Methane Release: Along with the 200 million gallons of oil that were spilled during the Deepwater Horizon blowout, another 500,000 tons of gaseous hydrocarbons were released into the deep-sea, accounting for 40% of the total amount of hydrocarbons discharged.[102] This large and sudden flux of hydrocarbons (more than natural seeps) caused a massive increase in microbial consumption. The DSEIS lacks appropriate discussion of how microbial processes and biogeochemical changes were affected by methane releases during the Deepwater Horizon, and how this has altered the baseline conditions of the CPA.

CBD-48

iv) Deepwater Coral Benthic Communities: The DSEIS makes faulty claims about the resilience of corals to oil pollution, e.g. "[e]xperiments with shallow tropical corals indicate that corals have a high tolerance to oil exposure. The mucus layers on coral resist penetration of oil and slough off the contaminant" (DSEIS B-24). Real-world examples of coral responses to oil spills have demonstrated the opposite.[103] Increased

[100] Preliminary Research: Lewis, R. Using mid-outer shelf foraminifera to assess benthic community damage and recovery following the deepwater horizon oil spill, Gulf of Mexico. *Dept. of Geology and Geography Auburn University.*

[101] Reddy, C.M. et al (2011) Composition and fate of gas and oil released to the water column during the Deepwater Horizon oil spill. PNAS, doi:10.1073/pnas.1101242108/-/DCSupplemental.

[102] Joye, S. B., MacDonald, I.R., Leifer, I., and V. Asper. 2011. Magnitude and oxidation potential of hydrocarbon gases released from the BP oil well blowout. *Nature Geoscience*, **4**, 160-164.

[103] Loya, Y., and B. Rinkevich. 1980. Effects of oil pollution on coral reef communities. *Mar. Ecol. Prog. Ser.*, **3**: 167-180.

CBD-48 (CONTINUED)

levels of oil significantly decreased the number of corals, total coral cover, and species diversity on a coral reef after a major spill in Bahia Las Minas, Panama.[104] Deepwater corals may experience similar responses as shallow water corals to oil pollution. Such responses could include reductions in colony viability, decreases in the number of ovaria per polyp, lower life expectancy of gametes and abnormal behavioral responses of gametes, direct damage to tissues, thinning of cell layers, disruption of cell structure and damage to normal feeding mechanisms, as well as excessive mucus secretion leading to enhanced bacterial growth and eventual coral destruction.[105] The DSEIS also makes an unreasonable claim that it is not likely that a sensitive deepwater coral habitat would be affected by a deepwater plume of oil from a catastrophic spill, which defies recent observations in the post-Deepwater Horizon spill Gulf and detections of toxic levels of hydrocarbons taken near the Macondo well that extended at least 13km away from the site of the spill at depths of 1000 to 1,400 meters.[106] In line with this paper, a community of deepwater corals (gorgonian and *Madrepora*) located seven miles from the Deepwater Horizon spill has shown decreased coral health such as decaying tissue or no tissue visible.[107] The team that discovered the unhealthy corals will be returning to the Gulf of Mexico at least four times in 2011 to search for more coral communities and assess the extent and persistence of damage caused by the oil spill on the marine ecosystem near these deep sea coral sites.[108] Clearly, the likelihood of a coral habitat being affected by an oil plume depends primarily on the presence of such a habitat within a reasonable distance from a spill site, which is not the least bit unlikely in the Gulf of Mexico.

C. Missing Species and Additional Considerations

CBD-49

i) Census of Marine Life Data: Scientists have collected spill impact data on very few species that live in the vicinity of the Deepwater Horizon spill, and are just beginning to assess the broader impacts to the health of the CPA and Gulf of Mexico system. The Census of Marine Life states that there is a baseline of 8,332 species in the area affected by the Deepwater Horizon spill.[109] The following are some examples of the number of species that are located near the Deepwater Horizon spill area: 1,461 mollusk species, 604 polychaete species,1,503 crustacean species,1,270 fish species, 4 sea turtle species, 218 bird species, and 29 marine mammal species.[110] In fact,

Guzman, H., Jackson, J., and E. Weil. 1991. Short-term ecological consequences of a major oil spill on Panamanian subtidal reef corals. *Coral Reefs*, **10**: 1-12.

[104] Guzman, H., Jackson, J., and E. Weil. 1991. Short-term ecological consequences of a major oil spill on Panamanian subtidal reef corals. *Coral Reefs*, **10**: 1-12.

[105] Loya, Y., and B. Rinkevich. 1980. Effects of oil pollution on coral reef communities. *Mar. Ecol. Prog. Ser.*, **3**: 167-180.

[106] Diercks, A.R. et al (2010) Characterization of subsurface polycyclic aromatic hydrocarbons at the Deepwater Horizon site. *Geo. Res. Lett.*, 37, L20602.

[107] "Life and Death in the Deep Sea: Does the Gulf Oil Spill Threaten Vital Seafloor Communities." *Oceanus Magazine*. 5 May 2011.

[108] Id.

[109] Ausube, J.H., Crist, D.T., and Waggoner, P.E., eds. *First Census of Marine Life: Highlights of a Decade of Discovery*. New York: Census of Marine Life, 2010. Page 20.

[110] Id.

CBD-49

according to the Census of Marine Life, the entire Gulf of Mexico ecosystem is ranked as the fifth most biologically diverse region of the world in terms of sea life.[111] The DSEIS's catastrophic spill analysis does not refer to the significant threats to the overall biodiversity of the CPA and the Gulf of Mexico.

CBD-50

ii) Marine Protected Areas: Although BOEMRE has jurisdiction over several of the marine protected areas (MPAs) located in the CPA, it does not incorporate a risk analysis for these MPAs from a catastrophic oil spill. The DSEIS does not list the impacts that may have occurred to the 53 state and federal MPAs that were in proximity to the Deepwater Horizon spill, and how their environmental baselines were altered. BOEMRE should adhere to NOAA's scoping comments suggesting that "…BOEMRE [should] review the designation of all No-Activity Zones associated with all of the topographic features in the Central and Western Planning Area, and re-establish these areas based on current bathymetric and biological data" (DSEIS NOAA Scoping Comments, A-113). At the bare minimum BOEMRE should list these sites' locations within the CPA (found at http://www.mpa.gov/dataanalysis/maps/) and acknowledge the threats that another catastrophic oil spill would pose for these protected areas.

CBD-51

iii) Impacts to Microbes and Phytoplankton: Oil has a strong influence on microbial population dynamics that is now becoming evident on beaches near the Deepwater Horizon spill. There have been sharp spikes in the frequency of human pathogens such as Vibrio cholera and an increase in Rickettsiales sp.[112] These changes in microbial and phytoplankton communities have significant impacts on marine ecosystems and threaten human health. Vibrio cholera causes the illness called cholera in humans, and exposure to Rickettsiales sp. can also lead to a variety of harmful infections. Changes to microbial communities can also transform the functionality of marine ecosystems, and the DSEIS lacks appropriate acknowledgment of these important changes that have occurred after the Deepwater Horizon spill.

CBD-52

iv) Lack of Visual Maps for Oil Slick Trajectory Analysis and Deep-Sea Plumes: The DSEIS includes estimates of the size of the area that could be affected by a catastrophic spill, but excludes good spatial depictions of what is truly at risk from a catastrophic oil spill in the CPA of a similar magnitude to the Deepwater Horizon event. It is necessary to consider how all resources in the CPA could be further affected by another catastrophic oil spill. In particular, Appendix B should include visual depictions of hypothetical worst case scenario spill trajectories based on what was learned about spill trajectories in the Gulf from the Deepwater Horizon event. The Gulf of Mexico is a hydrographically dynamic system and the persistence of large subsurface oil plumes without significant biodegradation provides evidence that

[111] Id.

[112] Widger, W., et al. (2011) Longitudinal metagenomic analysis of the water and soil from Gulf of Mexico beaches affected by the Deep Water Horizon oil spill. *Nature Precedings*, hdl:10101/npre.2011.5733.1.

CBD-52

the impacts extend beyond the visible surface boundaries.[113,114] Attempts should be made in the Final SEIS at not only mapping the visible oil slick trajectories, but also subsurface oil plumes where many of the impacts are likely to occur from a catastrophic spill like the Deepwater Horizon event.

CBD-53

v) Lack of Acknowledgment of the Natural Resources Damage Assessment (NRDA) from the Deepwater Horizon spill: The DSEIS's claim that there is incomplete or unavailable information about the impacts of the Deepwater Horizon spill ignores the massive amount of information collected during and after the spill. NOAA's "Natural Resources Damage Assessment (NRDA) by the Numbers" report stated that by December 1, 2010, the following actions had been taken: 29,599 environmental samples collected; 37,183 NRDA laboratory analyses conducted; almost 30,000 other samples collected by 83 offshore research cruises, including 17,026 water samples, 3,806 sediment samples, 5,007 tissue samples, and 1,917 tarball samples; 34,768 images taken; and over 4,000 linear miles of shoreline surveyed.[115] Reviewing this information from the Deepwater Horizon spill is imperative for any EIS about offshore drilling in the Gulf of Mexico, and BOEMRE should therefore make every effort to obtain access to this information prior to its public release.

CBD-54

vi) While BOEMRE pays particular attention to federally-protected wildlife, such as those listed under the Endangered Species Act, Marine Mammal Protection Act, or Migratory Bird Treaty Act, many more additional species have no federal protection yet are classified at a global level. A recent paper by Campagna et al.[116] estimates that in the Gulf of Mexico, 14 marine species are federally protected, whereas 40 species are not despite being listed as threatened on the International Union for Conservation of Nature's ("IUCN") Red List. The IUCN's Red List is a widely-recognized indicator of species health that is based on a broad range of scientific data, and should therefore not be taken lightly. Indeed, these 40 threatened but federally-unprotected species are not specifically considered in the DSEIS despite their globally-threatened status, which makes them particularly susceptible to local disruptions to crucial habitat as occurred during the Deepwater Horizon spill.

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[113] Camili, R., *et al.* (2010) Tracking hydrocarbon plume transport and biodegradation at Deepwater Horizon. *Science*, 330: 201-204.

[114] Reddy, C.M. *et al.* (2011) Composition and fate of gas and oil released to the water column during the Deepwater Horizon oil spill. PNAS, doi:10.1073/pnas.1101242108/-/DCSupplemental.

[115] "Gulf Spill Restoration." *NOAA*. 23 Dec 2010. http://www.gulfspillrestoration.noaa.gov/.

[116] Campagna, C., Short, F.T., Polidoro, B.A., McManus, R., Collette, B.B., Pilcher, N.J., de Mitcheson, Y.S., Stuart, S.N., and K.E. Carpenter. 2011. Gulf of Mexico oil blowout increases risks to globally threatened species. *Bioscience* **61**: 393.

CBD-55

For the above reasons, BOEMRE must significantly strengthen its DSEIS for Lease Sale 216/222 before completing the document. Only by doing so can BOEMRE fully comply with existing regulations while putting forth a full and fair discussion of environmental impacts of Lease Sale 216/222. We would emphasize the incredible importance of this DSEIS, the first NEPA document for a lease sale in the Central Gulf since the Deepwater Horizon, and strongly encourage BOEMRE to fully and in good faith examine all potential environmental impacts of the proposed action. We thank you for the opportunity to comment on this document.

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CBD-1 The BOEM disagrees that the analyses and conclusions in the Multisale EIS and the 2009-2012 Supplemental EIS are rendered obsolete due to the DWH event. The proposed action (i.e., the lease sale) remains the same, and much of the analysis in the Multisale EIS and the 2009-2012 Supplemental EIS on the affected environment, impacts from routine events, accidental events that do not rise to the level of a catastrophic event similar to the DWH event, and cumulative impacts remain just as relevant today. The oil spill resulting from the DWH event was a catastrophic accidental event, not part of the proposed action. Nonetheless, significant new information available since the Multisale EIS and the 2009-2012 Supplemental EIS, as well as the changes in baseline conditions as a result of the DWH oil spill, are adequately considered in this Supplemental EIS. In addition, BOEM has included a catastrophic spill analysis in **Appendix B**, in light of the DWH event.

CBD-2 The BOEM's consideration of appropriate mitigations and stipulations are already included for each action alternative as part of the OCSLA lease sale process. An EIS is a disclosure document and, based upon its findings, is often used in the development of mitigations and stipulations to reduce or eliminate impacts of the chosen action alternative. Consistent with this principle, BOEM considers mitigations and stipulations to minimize the impacts of oil and gas exploration and development and to improve safety throughout the leasing process. The ASLM, through authority delegated by the Secretary of the Interior, may apply a number of lease sale mitigations and stipulations. **Chapter 2.2.2.1** discusses these mitigations and stipulations, including the Topographic Features Stipulation, Military Areas Stipulation, Protected Species Stipulation, and Law of the Sea Convention Royalty Payment Stipulation. Additionally, a number of site-specific mitigations for environmental protection and safety are routinely applied at the postlease stage. All exploration plans, development plans, and pipeline applications are thoroughly reviewed to determine what additional protective measure(s) should to be included as a condition of plan or permit approval. Mitigations and stipulations are developed as conditions warrant and are subject to a review and approval process.

CBD-3 Long-term monitoring is not an alternative to the proposed action, nor is it, on its own, a method for mitigating impacts of the proposed action or alternatives. Monitoring requirements are a result of consultations conducted with other Federal agencies, as well as BOEM's long-term monitoring of OCS-related activities. The analyses in the Multisale EIS, the 2009-2012 Supplemental EIS, and this Supplemental EIS are based upon the best available scientifically credible information known to date. Where relevant information on reasonably foreseeable significant adverse impacts is incomplete or unavailable, the need for the information was evaluated to determine if it was essential to a reasoned choice among the alternatives and, if so, was either acquired or in the event it was impossible or exorbitant to acquire the information, accepted scientific methodologies were applied in its place. The BOEM has done so here, and, in light of the above, long-term monitoring is not an appropriate alternative for this Supplemental EIS.

This Supplemental EIS meets the requirements of NEPA in the development and consideration of alternatives.

CBD-4 The Center for Biological Diversity commented that BOEM should consider an alternative suspending leasing until complete information about the damage caused by the DWH spill is available. This is essentially the same as the No Action Alternative (Alternative D), where a lease sale would not be held at this time; thus, the Center's requested course of action has been analyzed in this Supplemental EIS.

The analyses in this Supplemental EIS considered changes to baseline conditions that may have occurred since the Multisale EIS and the 2009-2012 Supplemental EIS, including the DWH event. As acknowledged in this Supplemental EIS, credible scientific data regarding the potential short-term and long-term impacts of the DWH event is incomplete. In light of the absence of this information, BOEM considered what incomplete or unavailable information was relevant and essential to its analysis of alternatives based upon the resource analyzed. If essential to a reasoned choice among the alternatives, BOEM considered whether it was possible to obtain the information, if the cost of obtaining it is exorbitant, and if it cannot be obtained, applied acceptable scientific methodologies to inform the analysis in light of this incomplete or unavailable information. Information on many impacts of the DWH event and oil spill, particularly as part of the NRDA process, may not be available for years, and certainly not within the contemplated timeframe of this NEPA process. In its place, subject-matter experts have used the scientifically credible information available and scientific methodologies to evaluate impacts to the resources while this information is unavailable.

CBD-5 See the response to Comment CBD-4. In accordance with Section 1502.22 of the CEQ regulations implementing NEPA, when an agency is evaluating reasonably foreseeable significant adverse effects on the human environment in an EIS and when there is incomplete or unavailable information, the agency shall always make clear that such information is lacking. However, NEPA does not require that all informational gaps be addressed before an EIS is completed and a decision is made. In accordance with 40 CFR 1502.22, where relevant information on reasonably foreseeable significant adverse impacts is incomplete or unavailable, the need for the information was evaluated to determine if it was essential to a reasoned choice among the alternatives, and if so, was either acquired or in the event it was impossible or exorbitant in cost to acquire the information, what scientifically credible information was available was applied using accepted scientific methodologies in its place. Language in **Chapter 4.1**, "Incomplete or Unavailable Information," was clarified to prevent any misperceptions on this issue and the BOEM subject-matter experts in the individual resource analyses have identified where there is incomplete or unavailable information and explain whether it was relevant, could be obtained, and whether it was essential to a reasoned choice among alternatives, where appropriate.

CBD-6 See the responses to Comments CBD-4 and 5.

CBD-7 See the responses to Comments CBD-4 and 5. In addition, **Appendix B** was added to this Supplemental EIS to provide more information about general impacts of a catastrophic spill (**Appendix B**, "Catastrophic Spill Event Analysis"). However, it should be noted that the analysis in **Appendix B** was intended to be a general overview of potential effects of a catastrophic spill and to complement the substantive analyses in the main body of the Supplemental EIS itself. It was never envisioned to replace such analyses for individual resources in the main Supplemental EIS. As such, the "Catastrophic Spill Event Analysis" should be read with the understanding that further detail about oil impacts on a particular resource can be found in the main Supplemental EIS or previous relevant NEPA documents.

CBD-8 See the responses to Comments CBD-4 through 7. The BOEM subject-matter experts, however, have clarified in this Supplemental EIS where incomplete or unavailable information may be essential to a reasoned choice among alternatives, if the information could be obtained or if the costs of obtaining it are exorbitant, and that what scientifically credible information is available was applied using accepted scientific methodologies.

CBD-9 The Gulf of Mexico, including the CPA, is a dynamic environment that will be studied far into the future. There will never be a "final" assessment of baseline conditions in such an environment; any baseline would be constantly evolving. Nevertheless, BOEM has extensive experience in this environment, having held over 90 lease sales in the Gulf of Mexico, preparing over 50 lease sale EIS's, and continuing to study this ever-changing environment. The types of basic information included in the "Description of the Affected Environment" for each resource has been developed over many years, and new information is added on a regular basis. In this Supplemental EIS, the subject-matter experts described new scientifically credible information on changes in baseline conditions as a result of the DWH spill, and this information was taken into account in analyzing the impacts of the proposed action on the various resources. In addition, three new resources were added to this Supplemental EIS in consideration of the DWH spill. These included soft bottoms, *Sargassum*, and diamondback terrapins. It is BOEM's opinion that the discussion of baseline conditions in this Supplemental EIS is robust and is, in fact, much more lengthy than recommended by NEPA guidelines.

CBD-10 While the probability of a high-volume oil spill is still very low, particularly in light of improved safety requirements for OCS activities, BOEM has nonetheless conducted an analysis of the effects of accidental oil spills on environmental and socioeconomic resources. This analysis is included in **Appendix B**. The BOEM subject-matter experts, however, have clarified in this Supplemental EIS where incomplete or unavailable information may be essential to a reasoned choice among alternatives, if the information could be obtained or if the costs of obtaining it are exorbitant, and that what scientifically credible information is available was applied using accepted scientific methodologies.

CBD-11 Climate change is a global phenomenon influenced by many activities worldwide. The BOEM's policy is to address programmatic issues such as global warming at the 5-Year Program level rather than at the individual lease sale level. It is not possible to tease out the impacts of an individual lease sale on climate change. Global warming is addressed in the 2007-2012 Five-Year Program EIS (USDOI, MMS, 2007a).

CBD-12 This Supplemental EIS identifies new information on endangered species available since prior NEPA documents, including but not limited to, the numbers of strandings related to Unusual Mortality Events and increased strandings before and since the DWH event. For most of these strandings, NMFS has not identified or released the suspected causes of death or stranding. Where there remains incomplete or unavailable information on a resource, BOEM has identified it as such in **Chapter 4**, in compliance with NEPA. The status of the reinitiated consultation is addressed in this Supplemental EIS as well. Nevertheless, this lease sale does not in and of itself make an irreversible or irretrievable commitment of resources that would foreclose the development or implementation of any reasonable and prudent measures to comply with the Endangered Species Act. The BOEM will continue to comply with reasonable and prudent measures and the terms and conditions of the existing Biological Opinion, and BOEM is working with both NMFS and FWS to develop an interim coordination program while consultation is ongoing (see NMFS comments included above).

CBD-13 See the response to Comment CBD-12. A lease sale does not in and of itself make an irreversible or irretrievable commitment of resources that would foreclose the development or implementation of any reasonable and prudent measures to comply with the Endangered Species Act. For example, additional mitigations and requirements to comply with the Endangered Species Act (including a Biological Opinion resulting from consultation) may be imposed for postlease activities.

CBD-14 This Supplemental EIS supplements and updates information made available since the Multisale EIS and the 2009-2012 Supplemental EIS. At the time of these prior NEPA documents, a spill of the magnitude of the DWH event was not a reasonably foreseeable occurrence. Indeed, the likelihood of another event on this scale is exceedingly low, made even more so by BSEE's promulgation of new drilling and safety regulations and the ongoing endeavors to advance containment technologies. Information that is currently available indicates that the resources in the CPA were not significantly impacted. One new appendix, however, was added to this Supplemental EIS to provide more information about general impacts of a catastrophic spill, similar to a spill of the size of the DWH event—**Appendix B**, "Catastrophic Spill Event Analysis."

CBD-15 The capacity of both government and industry to respond to oil spills, both from a regulatory and technological perspective, is continually being updated and improved. Many of these issues are outside of BOEM's authority (e.g., USCG is responsible for response to and clean up of spills on the OCS). The BSEE believes that this Supplemental EIS has accurately depicted the containment capabilities and challenges identified during the DWH event and in developments made since that event. The BSEE has also been careful to point out that no one response technique is likely to be wholly effective and that a suite of response capabilities are likely to be deployed in the event of a future spill. Although the DWH event did highlight that certain containment capabilities were not as efficient in deep water or offshore as expected, e.g., the skimmers, significant strides have been made and continue to be made, in both regulatory and technical approaches. For the purposes of this NEPA analysis, BOEM has taken a conservative approach, has assumed for purposes of impact analysis that a catastrophic spill may occur, and has not relied on untested technological advances in oil-spill response in our analysis of impacts. This Supplemental EIS presents impact analyses that presume contact with oil and, where known, the effect of cleanup operations.

CBD-16 Comment noted. See response to Comment CBD-15. Where information is available on the impacts of deploying oil-spill-response technologies (including in-situ burning and the application of dispersants), the subject-matter experts included this information in their analyses of the resources (**Chapter 4.1.1**). Where information is incomplete or unavailable, BOEM evaluated whether the information was relevant to reasonably foreseeable significant impacts, and if so, was it essential to a reasoned choice among alternatives (**Chapter 4.1**, "Incomplete or Unavailable Information").

CBD-17 The most recent data on strandings and recovered carcasses available during the preparation of this Supplemental EIS are included in this document. The BOEM has clarified in this Supplemental EIS that these numbers may underestimate the total number of individuals affected. It is also important to note that evaluations have not yet confirmed the cause of death, and it is possible that not all carcasses were related to the DWH oil spill. As noted in this Supplemental EIS, extrapolation from this raw data is not reliable at this point in time. In this case, BOEM has identified where relevant information on reasonably foreseeable significant adverse impacts is incomplete or unavailable and has evaluated the need for the information to determine if it was essential to a reasoned choice among the alternatives, and if it was, either acquired the information or, in the event it was impossible or exorbitant to acquire the information, what scientifically credible information is available and what accepted scientific methodologies were applied in its place.

CBD-18 The BOEM uses data on past OCS production and spills, along with estimates of future production, to evaluate the risk of future spills (Chapter 4.3.1.2 of the Multisale EIS). Data on the numbers, types, sizes, and other information on past spills, including those that are relevant to ultra-deepwater wells, were reviewed to develop the spill scenario for analysis in this Supplemental EIS. Past spill data used in the model indicate that there is no trend of increased number of spills based on exploration in deeper water prior to Macondo. The spill scenario provides the set of reasonable assumptions and estimates of future spills; the type, frequency, quantity, and fate of the spilled oil for specific scenarios; and the rationale for the scenario assumptions or estimates. Neither high-temperature/high-pressure conditions nor water depth are used to calculate the risk of future spills because these are postlease operational issues that cannot be reasonably predicted at the lease stage without site-specific information. In the postlease stage, applicants submit site-specific data on conditions, and BOEM technical staff reviews this data to determine whether conditions on approval, based on well data, are appropriate. The BOEM believes that the NEPA analysis in this Supplemental EIS is conservative, in that even with the oil-spill risk analysis showing that the risk of a spill remains low (whether in deep water or shallow water), for the purposes of impacts analysis, a potential spill was assumed and evaluated.

Also, Anderson and LaBelle (2000) have recently been updated. Though it is still in draft form, the new information has been incorporated into **Table 3-5** of this Supplemental EIS. Future OSRA runs will also use this updated historical spill rate information.

CBD-19 See the response to Comment CBD-18. The OSRA model is a trajectory analysis, combined with the probability of spill occurrence. Past spill data used in the OSRA models, both for accidental spills and catastrophic runs, indicate that there is no trend of an increased number of spills based on exploration in deeper water prior to Macondo. For purposes of this Supplemental EIS, BOEM believes that it is appropriate to run the OSRA model for both low-probability catastrophic spills (**Appendix B**) and for other types of accidental events (**Table 3-5**) to frame the impacts analysis and better inform the decisionmaker.

CBD-20 The statement regarding BSEE's reliance on BOP's is not an accurate assessment. The BSEE views the entire drilling process as a whole in the prevention of losses of well control and well blowouts, and this Supplemental EIS notes that no one component could reasonably be expected to be a 100 percent fail safe in all scenarios. The BOP's should not be viewed in isolation, when they are one of only a number of technological devices and regulatory initiatives to prevent and, if necessary, contain and kill blowouts. The BSEE also directed significant energies on improving the way wells are designed and drilled to prevent the occurrence of a well control incident that would require the use of the BOP (**Chapter 1.3.1**). Even with all of these improvements on well design and drilling practices and the changes to increase the reliability of the BOP stacks, BSEE did not stop there. In addition to prevention, BSEE focused resources on improvements to containment capabilities as well. Therefore, BSEE is not putting an unreasonable amount of reliance on the BOP's, viewed in the context of a number of overlapping and complementary initiatives to prevent and, in the unlikely event a loss of well control results in a spill, contain and kill the spill. The BSEE has addressed this problem from every possible angle with the intent of reducing the overall risk.

CBD-21 See the response to Comment CBD-20.

CBD-22 Although this Supplemental EIS introduces and evaluates new information on containment systems as they are relevant to the proposed action and alternatives and in light of the DWH event, containment is being reviewed in more detail on a per application for permit to drill (APD) basis. An APD is not approved unless the operator has demonstrated a capability to contain a subsea blowout. To date, containment has been successfully demonstrated by several operators through the postlease process. Currently, containment is being provided by the Marine Well Containment Corporation (MWCC) and the Helix Well Containment Group. All equipment and containment strategies utilized by these organizations are inspected and reviewed by experts at BSEE. At this time, MWCC is not utilizing floating risers similar to Petrobras. While BP did utilize this technology during the DWH event without incident, MWCC has decided to utilize proven riser systems deployed from mobile offshore drilling units. Free-standing risers systems similar to Petrobras will not be utilized for containment until such a time that MWCC and BSEE can fully evaluate the technology. Although independent experts are free to opine on equipment and containment strategies, BSEE remains the Federal agency with oversight authority for oil and gas development on the OCS, including requirements for the drilling, safety, and oil-spill response, and it must make its own informed decision on whether an operator is complying with BSEE's containment requirements. In any event, this issue is outside of the purview of this document or NEPA generally.

CBD-23 See the response to Comment CBD-14. The OSRA model is a trajectory analysis, combined with the probability of spill occurrence. Past spill data used in the OSRA models, both for accidental spills and catastrophic runs, indicate that there is no trend of an increased number of spills based on exploration in deeper water prior to Macondo. For purposes of this Supplemental EIS, BOEM believes that it is appropriate to run the OSRA model for both low-probability catastrophic spills (**Appendix C**) and for other types of accidental events (**Table 3-5**) to frame the impacts analysis and better inform the decisionmaker.

CBD-24 See the responses to Comments CBD-14 and CBD-23.

CBD-25 The CBD's request that this Supplemental EIS be withdrawn until the OSRP review and/or certification processes have been made subject to public notice and comment has no precedence under NEPA. The regulations implementing the OSRP/certification requirements were the subject of notice and comment. Public notice and comment on individual OSRP submissions and certifications is not provided for in the statutes or regulations and raises a number of complicating factors (such as proprietary and personal contact information that must be included). Even if BSEE could subject the OSRP and certification processes to public notice and comment in the future, that is not a basis for withdrawing this Supplemental EIS now. Public notice and comment on the OSRP and certification process would be unlikely to result in information relevant to the reasonably foreseeable significant adverse impacts of the proposed action or the alternatives analyzed in this Supplemental EIS. If anything, public notice and comment would only be expected to further reduce the potential for impacts during the postlease process rather than increase the potential for heightened or new impacts. Thus, this Supplemental EIS remains conservative in its evaluation of potential impacts from oil spills and the potential for OSRP's to reduce or minimize this potential.

CBD-26 **Appendix B** is intended to be an overview of potential effects of a catastrophic spill, not specifically the DWH event. It was never envisioned to provide a site-specific analysis but instead to be a reference to the type of impacts associated with a catastrophic spill. A specific spill scenario is too speculative. The analysis contained in **Appendix B** best suits a situation where there are a wide range of scenarios associated with an unexpected and unlikely low-probability event.

The best example for long-term impacts from a catastrophic oil spill in the Gulf of Mexico is the *Ixtoc* spill of 1979, which BOEM has incorporated where appropriate in this Supplemental EIS. The *Exxon Valdez* spill occurred in such vastly different conditions and circumstances in Alaska that it probably is a less reliable example of impacts and recovery from an oil spill in the Gulf of Mexico, although BOEM subject-matter experts may find the spill relevant to discussions of impacts of oil on individual resources.

Since publication of the Draft Supplemental EIS on July 1, 2011, the subject-matter experts have incorporated relevant information and have updated this Supplemental EIS accordingly. The incorporation of relevant information is time consuming, as it must be obtained and reviewed by subject-matter experts in the context of the source of the data, research methodology, and data quality. As is necessary under every NEPA analysis, at some point the subject-matter experts had to finalize their analyses to allow time for the Final Supplemental EIS to be prepared and presented to the decisionmaker.

CBD-27 See the response to Comment CBD-17. Available peer-reviewed modeling cited by CBD in their comment (e.g., Antonio et al., 2011) was incorporated into the text where appropriate.

CBD-28 See response to Comment CBD-17. As noted in this Supplemental EIS, extrapolation from this raw data is not reliable at this point in time. Clarifying language has been added to **Chapter 4.1.1.14.1**, but it notes that the reference on the *Exxon Valdez* spill in the comment (Piatt et al., 1996) is dated 1996, which is 7 years after the *Exxon Valdez* spill, and it was published 15 years ago. The reference is cited as reporting that, "Due to direct losses and changes in the habitat, several populations of seabirds have not recovered, even though it has been more than 20 years since that catastrophic spill event." As such, the text added reflects that several populations had not recovered when the article was published in 1996, about 7 years since the catastrophic spill event, with citation of the reference.

CBD-29 See the responses to Comments CBD-17 and CBD-28. Also, please note that the year of the reference cited in the comment (Piatt et al., 1990) is given incorrectly (it is given as 1996 instead of 1990 in the comment). This citation date is correct in **Appendix B**.

CBD-30 Clarifying language has been added to **Appendix B**.

CBD-31 **Appendix B** is a general analysis and is not specific to the DWH spill, but it is the most relevant example of a catastrophic spill in the Gulf of Mexico. Further, the commenter's discussion of the timing of bluefin tuna spawning and larval stages to the DWH spill is an example of the possible effects from a long-term, population-level impact to one species and of the possible effects this may have on fisheries in the future. Sections 2.2.2.2, 3.2.2.2, 4.2.2.2, and 5.2.2.2 of **Appendix B** discuss the possible impacts on fish, while Sections 2.2.2.5, 3.2.2.6, 3.2.2.7, and 5.2.2.8 of **Appendix B** discuss the impacts on benthic habitat; Sections 2.2.3.2, 3.2.3.2, 4.2.3.2, and 5.2.3.2 of **Appendix B** discuss impacts on commercial fishing; and Sections 2.2.3.3, 3.2.3.3, 4.2.3.3, and 5.2.3.3 of **Appendix B** discuss impacts on recreational resources and fishing. Section 3.2.2.2 of **Appendix B** also states "early life stages of animals are usually more sensitive to oil than adults (Boesch and Rabalais, 1987; NRC, 2005)"; the analysis is consistent with the point that the commenter makes here.

CBD-32 The BOEM agrees with CBD; the example of the areas closed to fisheries is an important impact, as exemplified by the areas closed as a result of the DWH spill. **Appendix B** discusses these impacts in Sections 2.2.3.2, 3.2.3.2, 4.2.3.2, and 5.2.3.2 regarding impacts on commercial fishing and in Sections 2.2.3.3, 3.2.3.3, 4.2.3.3, and 5.2.3.3 regarding impacts on recreational resources and fishing.

CBD-33 The quoted language is from the "Summary" in this Supplemental EIS and is based on the analysis of accidental events expected as a result of the proposed action, which is provided in **Chapter 4.1.1.17.3**. It is not based on an analysis of a catastrophic oil spill. **Appendix B** includes the discussion of potential impacts from a low-probability, large-volume catastrophic oil spill on commercial fishing (Sections 2.2.3.2, 3.2.3.2, 4.2.3.2, and 5.2.3.2 of **Appendix B**). Clarifying language has been added to the "Summary" and to the resource summaries in **Chapter 2** to indicate that a catastrophic spill analysis is provided in **Appendix B.**

CBD-34 A discussion of the UME is included in **Chapter 4.1.1.11.1**.

CBD-35 See the response to Comment CBD-17.

CBD-36 See the response to Comment CBD-17. It is important to note that evaluations underway by NMFS have not yet confirmed the cause of death, and it is possible that not all carcasses were related to the DWH event oil spill. As such, it would be premature to speculate on what role, if any, the shrimping industry and/or turtle excluder devices have on these strandings.

CBD-37 While **Appendix B** ("Catastrophic Oil Spill Analysis") does not discuss the full life history, habitats, and range of sea turtles, this Supplemental EIS does provide this information in **Chapter 4.1.1.11** and discusses the impacts from an accidental event on these life cycles. The same is also incorporated by reference from the Multisale EIS and the 2009-2012 Supplemental EIS, which provide a thorough background on sea turtles.

Sea turtles are discussed in Sections 2.2.2.4, 3.2.2.4, 4.2.2.4, and 5.2.2.4 of **Appendix B**. Section 4.2.2.4 of **Appendix B** discusses the three species of sea turtle that nest in the U.S. Gulf of Mexico and the impacts that a catastrophic oil spill could have on nesting sea turtles.

CBD-38 *Sargassum* is discussed in Section 3.2.2.5 of **Appendix B** for offshore habitats, as well as in Section 4.2.2.4 for sea turtles and finally in Section 5.2.2.7 for open water habitats. Sections

4.2.2.6 and 5.2.2.7 discuss seagrass beds. Coral reefs are discussed in Sections 2.2.2.5, 3.2.2.6, 3.2.2.7, and 5.2.2.6. Further, Section 3.2.2.4 for sea turtles also discusses coral reefs as important sea turtle habitat. Consistent with the discussions in these sections, BOEM agrees with the commenter that the destruction of these habitats from a catastrophic oil spill would be harmful to sea turtles. The BOEM agrees that declines in the food supply for sea turtles, which include invertebrates and sponge populations, could also affect sea turtle populations. Section 5.2.2.4 of **Appendix B** has been updated to reflect this change.

CBD-39 Comment noted. Activities of the U.S. Coast Guard are not within BOEM's jurisdiction. The sea turtle nest relocation program is discussed in **Chapter 4.1.1.11.1**.

CBD-40 **Chapter 4.1.1.11.2** discusses the impacts from routine events on sea turtles, which includes offshore activities. **Chapter 4.1.1.11.3** discusses the impacts from accidental events on sea turtles. This chapter states, in regards to an accidental event at the lease sale site, "exposure to hydrocarbons persisting in the sea following the dispersal of an oil slick are expected to most often result in sublethal impacts (e.g., decreased health and/or reproductive fitness, increased vulnerability to disease) to sea turtles."

In **Appendix B**, sea turtles are discussed in Sections 2.2.2.4, 3.2.2.4, 4.2.2.4, and 5.2.2.4. Section 2.2.2.4 discusses how sea turtles may be impacted near the site of a catastrophic event if they are near the blowout and within the initially released oil. Section 3 of this analysis is specific to a catastrophic oil spill that is growing in size. Section 3.2.2.4 states that sea turtles are more likely to be affected by a catastrophic spill in shallow water, citing the typical habitat for Kemp's ridley, hawksbill, and green sea turtles. This is not to say that sea turtles could not or would not be affected by an oil spill in the open ocean. The BOEM agrees with the commenter that sea turtles travel through the open ocean.

It was not the intent in **Appendix B** and the main text of this Supplemental EIS to downplay the impacts of an offshore catastrophic oil spill on essential habitat for turtles in the open ocean convergence zones; rather, **Appendix B** only states that more sea turtles are likely to be affected in shallower waters.

CBD-41 The BOEM agrees that catastrophic oil spills have the potential to affect sea turtles in many ways, including the following: (1) oil or dispersants on the sea turtle's skin and body can cause skin irritation, chemical burns, and infections; (2) inhalation of volatile petroleum compounds or dispersants can damage the respiratory tract and lead to diseases; (3) ingesting oil or dispersants may cause injury to the gastrointestinal tract; and (4) chemicals that are inhaled or ingested may damage liver, kidney, and brain function, cause anemia and immune suppression, or lead to reproductive failure or death.

Chapter 4.1.1.11.3 discusses impacts from accidental events on sea turtles. Sections 2.2.2.4, 3.2.2.4, 4.2.2.4, and 5.2.2.4 of **Appendix B** furthers the discussion of the impacts on sea turtles. However, clarifying language on the commenter's list of potential impacts has been added to Section 5.2.2.4 of **Appendix B**.

CBD-42 **Chapter 4.1.1.11.3** provides a general overview of the impacts from accidental events on sea turtles, while the effects of a catastrophic oil spill on sea turtles are further discussed in Sections 2.2.2.4, 3.2.2.4, 4.2.2.4, and 5.2.2.4 of **Appendix B**. Effects on nesting sites were discussed in Section 4.2.2.4 of **Appendix B**. The full life history of sea turtles are discussed in the Multisale EIS and the 2009-2012 Supplemental EIS, which were incorporated by reference, as well as in **Chapter 4.1.1.11**. **Appendix B** discusses sea turtle habitat (including *Sargassum*), seagrass beds, and coral reefs throughout the appendix. **Appendix B** has been updated, however, to reflect the examples and suggestions from this commenter, which improve upon the discussion on impacts to prey species and the effects on sea turtles. Information that is currently available on population impacts, including strandings and mortalities both before and after the DWH event, have been included in this Supplemental EIS.

CBD-43 Information was added to **Appendix B** to include the role of plankton in the marine environment. Phytoplankton and zooplankton do play a role in the marine environment. However, several laboratory and field experiments and observations in the past decades have shown that impacts to planktonic and microbial populations are generally short lived and do not affect all groups evenly, and in some cases stimulate growth of important species (Gonzalez et al., 2009; Graham et al., 2010; Hing et al., 2011; Dunstan et al., 1975, in **Appendix B**).

CBD-44 Comment noted. This Supplemental EIS was revised in response to this comment.

CBD-45 Results of foraminifera studies following the DWH event are not yet available, and there is no timeline available for when these studies are expected to be completed and released; as such, they could not be incorporated into this NEPA analysis. The BOEM subject-matter experts have identified areas such as this where information remains incomplete or unavailable, have determined whether it is essential to a reasoned choice among alternatives, and if it could not be obtained or would require exorbitant costs to obtain it, and have used what scientifically credible information was available, using accepted scientific methodologies.

CBD-46 Deepwater studies are being conducted as part of the NRDA process, but the data and conclusions have not been released to the public at this time. Remotely operated vehicles surveyed sites around the well after it was capped and collected benthic megafauna and mesopelagic/bathypelagic megaplankton distribution and abundance data using video and still photography (Putt, 2011; Benfield, official communication, 2011). Data collected following the capping of the well was compared with data collected in the area before the oil spill, and it will be compared with additional data collected during the NRDA process to determine if there were changes in the communities following the spill (Putt, 2011; Benfield, official communication, 2011). The BOEM subject-matter experts have identified areas such as this where information remains incomplete or unavailable, have determined whether it is essential to a reasoned choice among alternatives, and if it could not be obtained or would require exorbitant costs to obtain it, and used what scientifically credible information was available, using accepted scientific methodologies.

CBD-47 Additional information on methane release and microbiological respiration has been included in this Supplemental EIS since publication of the Draft Supplemental EIS. This information is in the "Description of the Affected Environment" section for coastal and offshore water quality in **Chapters 4.1.1.2.1.1 and 4.1.1.2.2.1**, respectively.

CBD-48 This Supplemental EIS does not state that corals are immune to oil, rather, the discussion states that the effects would vary depending on the level of exposure. The summary by Shigenaka supports the statement that corals have a high tolerance to oil. The full discussion in that section describes the types of possible negative effects that may result from contact with oil and that were named in the comment. This does not, however, change the fact that, because deepwater corals are relatively scarce in the Gulf of Mexico, BOEM subject-matter experts consider contact may be less likely for any specific spill event depending on size and location. Indeed, BOEM subject-matter experts included a discussion in **Chapter 4.1.1.10** of the coral beds that were identified as visibly oiled less than 7 mi (11 km) from the Macondo wellhead. Additional information and discussion have been added to this chapter since publication of the Draft Supplemental EIS.

CBD-49 The BOEM agrees with CBD and with the data from the Census of Marine Life. **Appendix B** is a general analysis and therefore does not include all species. It is also not specific to the DWH spill, but takes it, along with the *Ixtoc* spill, into account for informing what potential impacts may occur in the event of a catastrophic event. Since most data from the DWH spill have not yet been released on the effects to individual species or to biodiversity, BOEM has considered the effects from the *Ixtoc* spill and what scientifically credible information is available applied using scientifically accepted methodology. The data from the *Ixtoc* spill indicate that the impacts were relatively short term and did not significantly reduce the biodiversity of the Gulf of Mexico. However, BOEM agrees with the commenter that the overall ecosystem and the biodiversity in the Gulf of Mexico could be disrupted in the case of another catastrophic oil spill, and this is reflected in **Appendix B**.

CBD-50 Most of the MPA sites you refer to are coastal sites in State waters outside of BOEM's and BSEE's jurisdiction. The MPA's that are located on the OCS are mentioned in **Appendix B**, and BOEM acknowledges that they may be threatened by or impacted by a catastrophic event. Nevertheless, the relevant impacts to the MPA's from a catastrophic oil-spill event are more appropriately discussed in the individual resource analyses in **Appendix B**; the potential impacts from a catastrophic event are tied to the resource involved, rather than the legal status afforded any specific area. As such, the risk of contact from a spill to reach various portions of the coast is addressed and covers any specific sites such as the MPA's mentioned.

CBD-51 The microbial loop is an essential part of the marine ecosystem. The comments are noted and **Appendix B** has been updated. However, the study cited (Widger et al., 2011) does not support the argument of lasting effects to the spill on coastal microbial communities and pathogens. The study had only one pre-spill and one during spill time-point each, with no post-spill component to monitor trends. Further, the pathogens noted are commonly found in coastal waters after significant rain events and occur as a result of untreated freshwater reaching the coast (Stumpf et al., 2010; Wetz et al., 2008; Hsieh et al., 2007). The study (Widger et al., 2011) does not address the potential that the increase in microbial pathogens are a result of storm water run-off, and indeed it does not even address if there was a significant rain event upstream that could have carried these terrestrial-derived pathogens to the coastal zone. (The above references can be found in **Appendix B**.)

CBD-52 **Appendix B** is a general overview of hypothetical impacts from a nonspecific hypothetical catastrophic spill and, thus, there are no specific locations or maps associated with it.

CBD-53 The BOEM does not have access to the NRDA data that is being generated, as much of it has not been made publicly available. It may well be years before the results of NRDA are made available. While we do not dispute the other facts in the comment, they do not add value to the impact analysis for the proposed lease sale or **Appendix B**. The BOEM subject-matter experts have included relevant NRDA data that has been released to the public in their resources analyses in **Chapter 4**, such as the large number of water quality samples collected and analyzed, and the raw data on animals recovered after the DWH event.

CBD-54 The BOEM agrees with CBD that **Appendix B** in no way is a complete list of all species and subspecies that may have been affected by the DWH oil spill or that may be affected by any future catastrophic events in the Gulf of Mexico. The Campagna et al. (2011) paper referenced by the commenter states that there are many unprotected species that were also likely affected, including bluefin tuna, several species of sharks, and several coral species. The BOEM agrees that, assuming a catastrophic spill, such impacts would be probable. Thus, **Appendix B** addresses impacts that are common among resources or species and addresses those impacts. In cases where the discussion requires, for purpose of impact analysis, a distinction between species, such distinction is made. Section 3.2.2.2 of **Appendix B** does discuss particular concern for whale sharks based on sightings after the DWH oil spill. Further, **Chapter 4.1.1.16** does list many species of fish and sharks that could be impacted. Bluefin tuna and corals generally are likewise discussed in **Appendix B**.

CBD-55 Comment noted. Since publication of the Draft Supplemental EIS on July 1, 2011, the subject-matter experts have incorporated newly available relevant information and have updated this Supplemental EIS accordingly.

SKYTRUTH

A Non-Profit 501(c)(3) Organization

August 16, 2011

Department of the Interior
Bureau of Ocean Energy Management, Regulation and Enforcement
Attention: Regulations and Standards Branch
381 Elden Street, MS-4024
Herndon, Virginia 20170-4817

RE: Comments of SkyTruth on Central Planning Area Lease Sale 216/222, Draft Supplemental Environmental Impact Statement (BOEMRE 2011-027)

Dear Sirs/Madams,

I have ten years of experience working as an exploration geologist at Washington, DC-area consulting firms, using satellite images to identify prospective targets for oil, gas, minerals and groundwater exploration worldwide on behalf of clients including independent and major multinational energy companies, mining companies, and government agencies. I have 20 years of experience processing and analyzing satellite images and other types of remote-sensing data to conduct geologic mapping, environmental analysis, and offshore pollution detection and monitoring. At SkyTruth we processed, analyzed and published aerial and satellite imagery to track oil slicks associated with coastal and offshore infrastructure damage caused by Hurricanes Katrina[i] and Ike[ii]; the blowout of a shallow-water well being drilled in the Timor Sea off the coast of Australia[iii]; and the BP *Deepwater Horizon* spill[iv] in the Gulf of Mexico last year. In November 2010, I testified to Congress on the ongoing risks posed by offshore drilling[v].

Please accept and consider these comments from SkyTruth on the DSEIS referenced above. This document revisits the predicted impacts of oil and gas leasing in the Gulf of Mexico in the wake of the BP *Deepwater Horizon* disaster last year. We have identified what we consider significant weaknesses in this document: an unrealistic appraisal of catastrophic oil spill response capabilities; insufficient data to draw conclusions about Gulf economic and ecosystem impacts in the wake of a catastrophic spill; and a lack of environmental monitoring to detect, assess and quantify large and small pollution incidents from all causes.

Spill Response and Cleanup Capability

Section 3.2.1.5.2 (page 3-39) of the DSEIS discusses various techniques proposed for offshore oil spill response and cleanup. Aside from source containment (addressed below), these are the same techniques that proved grossly inadequate[vi] throughout the BP *Deepwater Horizon* spill: mechanical recovery of oil from the ocean surface using the same, or similar, skimmer vessels; in-situ burning; and disaggregation of the oil by applying chemical dispersants (see Section 9.b.4 – Worst Case

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SKY-1

Discharge Response). Skimmer vessels proved far less capable of oil recovery than they were rated, and conditions for effective surface burning were infrequent. Insufficient scientific research has been conducted to verify that the application of chemical dispersants, whether subsea at the wellhead or on the surface, is a safe and effective response action; indeed, recently released preliminary research findings question the subsea injection of dispersants as a useful response, and suggest that dispersant use in general may increase the toxicity of an oil spill (see http://www.wtsp.com/news/article/194981/19/Oil-spill-study-sees-cloudy-results#). And the government's peer-reviewed Deepwater Horizon Oil Budget report on the BP *Deepwater Horizon* spill[vii] states that only 16% of the oil released was destroyed or collected using those means, a cumulative total of only 784,000 barrels of oil throughout the months-long cleanup operation. That's a daily average success rate of only 9,000 bopd at best, assuming all cleanup operations were halted on July 15, the day BP's Macondo well was fully capped.

SKY-2

In our opinion this major gap between demonstrated response capabilities and the expected oil release from a catastrophic event similar to the BP *Deepwater Horizon* spill would likely result in significant damage to fisheries, the environment, and businesses based on the seafood, tourism and recreation industries. These economic and environmental damages should be explicitly analyzed and quantified in the DSEIS.

Well control and source containment. The blowout preventer (BOP) is still considered the main line of defense against a catastrophic spill due to a loss of well control. Forensic investigation of the blowout preventer that failed to stop the Macondo blowout in 2010 revealed that the device functioned as designed, suggesting that blowout preventers currently in operation are not built to operate reliably under the conditions commonly encountered by deepwater wells,[viii] leading former MMS chief engineer Bud Danenberger to comment "They have to rethink the whole design."[ix] BOPs should be re-engineered and rigorously tested to ensure that they are adequate to the task of deepwater, high-pressure well control.

SKY-3

New, interim well-containment devices have been developed by the Marine Well Containment Company and Helix Energy Solutions Group, based on the design of the final, successful capping stack that controlled the Macondo well in 2010. While these devices appear promising, we believe this should be considered at best a theoretical response capability until the devices have been rigorously and successfully deployed and tested in the full range of oceanographic and geologic environments where leasing activity is anticipated. We are not aware that either device has been mobilized, deployed and field-tested in a realistic response drill, particularly in a deepwater location, far offshore, where it is most likely to be needed. These devices are also unable to handle the full flow rates of uncontrolled deepwater wells in a worst-case scenario discharge; the prospect of an uncontrolled spill of as much as 300,000 barrels (12.6 million gallons) per day, given the response gap discussed above, underscores the need for this DSEIS to explicitly acknowledge and analyze the likely damage from a worst-case scenario spill.

Insufficient Data on Catastrophic Spill Impacts

The BP *Deepwater Horizon* spill represents the most recent opportunity to understand the short- and long-term economic, social and environmental impacts of a catastrophic offshore oil spill. Section 4.1.1.3.1 of the DSEIS (page 4-48) states "At the time of preparation of this Supplemental EIS, there was little conclusive scientific information on the impacts of the spill. The available information presented here is primarily from accounts based on interviews with scientists or personnel with the USCG's Oil Spill Response Team at the Unified Command Post overseeing cleanup operations. Various wildlife and resource agencies have launched SCAT to locate the oil as it appears in order to engage cleanup teams. Other agencies are involved in the NRDA process that is collecting data to identify and quantify the impacts of the spill. To date, none of this information is publicly available; therefore, the information presented here only notes what resources have been contacted by the spilled oil based on the SCAT observation maps and data available from interviews of local scientists participating in the oil response effort."

SKY-4

In other words, the information related to impacts of the BP *Deepwater Horizon* spill is largely incomplete. For this reason, the conclusion of the DSEIS in Section 4.1.1.2.2.3 (page 4-41) that "… the CPA proposed action would not significantly change the water quality of the Gulf of Mexico over a large spatial or temporal scale" is not supportable.

Monitoring Plan

SKY-5

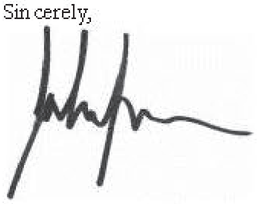
This document proposes no baseline assessment of existing oil pollution, from either human causes or natural sources; and no plan for continuous monitoring during drilling activity and until permanent plugging and abandonment to ensure that additional oil pollution is not occurring, and to provide the means for rapid response, assessment and resource targeting should an accidental spill occur. During the BP *Deepwater Horizon* spill, satellite imagery was demonstrated a cost-effective tool for daily wide-area surveillance and monitoring of the northern Gulf of Mexico, and provided important information to determine the flow rate of the Macondo well and the areas directly impacted by oil slicks throughout the incident[x]. Satellite imagery was also useful for detecting and estimating the volume of a much smaller, chronic oil spill[xi] from hurricane-damaged wells unrelated to the BP *Deepwater Horizon* incident.[xii]

SKY-6

We believe that offshore leasing should be preceded by a baseline pollution assessment to establish pre-drilling conditions, including the existence of any chronic or intermittent sources of pollution from human activity or from natural seepage; and that routine, public monitoring of the area should be conducted using appropriate satellite images supplemented by other imagery, observations, and field data collection as necessary to detect, document and quantify any additional pollution that occurs during drilling activity and throughout the lifetime of the wells, until they are permanently plugged and abandoned. Such a program could be conducted using capabilities and skills that currently exist within the national NGO, academic research, and government science communities, and could be deployed rapidly if those existing capabilities are effectively organized and funded.

Please feel free to contact SkyTruth if you'd like to discuss these comments in more detail.

Sincerely,



John Amos
President, SkyTruth

i. Amos, J., 2007, "Hurricane Katrina – Gulf of Mexico oil spills," SkyTruth blog, December 12, 2007, http://blog.skytruth.org/2007/12/hurricane-katrina-gulf-of-mexico-oil.html

ii. Amos, J., 2008, "AP – Hurricane Ike environmental toll apparent," SkyTruth blog, October 8, 2008, http://blog.skytruth.org/2008/10/ap-hurricane-ike-environmental-toll.html

iii. Amos, J., 2009, "Timor Sea drilling spill: two months and still going," SkyTruth blog, October 22, 2009, http://blog.skytruth.org/2009/10/timor-sea-drilling-spill-two-months-and.html

iv. Amos, J., 2011, "SkyTruth's work cited in National Oil Spill Commission's final report," January 13, 2011, http://blog.skytruth.org/2011/01/skytruths-work-cited-in-national-oil.html

v. United States Senate Committee on Energy and Natural Resources, full committee hearing to receive testimony on environmental stewardship policies related to offshore energy production, November 19, 2009, http://energy.senate.gov/public/index.cfm?FuseAction=Hearings.Hearing&Hearing_ID=c129bd12-a00d-67c6-dbdc-78a685496298

vi. Amos, J., 2010, "Gulf oil slick dwarfs response vessels," SkyTruth blog, April 27, 2010, http://blog.skytruth.org/2010/04/gulf-oil-slick-dwarfs-response-vessels.html

vii. http://www.restorethegulf.gov/release/2010/11/23/federal-interagency-group-issues-peer-reviewed-%E2%80%9Coil-budget%E2%80%9D-technical-documentati

viii. Fowler, T., and J. Dlouhy, 2011, "Blowout preventer report could prompt design changes." *Houston Chronicle*, March 23, 2011, http://www.chron.com/disp/story.mpl/business/energy/7488430.html

ix. Casselman, B., and R. Gold, 2011, "Device's design flaw let oil spill freely." *Wall Street Journal*, March 24, 2011, http://online.wsj.com/article/SB10001424052748704050204576218653335935720.html

x. http://marinewellcontainment.com/interim_system.php

xi. Norse, E.A., and J. Amos, 2010, "Impacts, Perception, and Policy Implications of the Deepwater Horizon Oil and Gas Disaster." The Environmental Law Reporter – News & Analysis, v40 n11, November 2010, http://mcbi.org/publications/pub_pdfs/Norse-and-Amos-2010.pdf

xii. Amos, J., 2010, "Leaking well at Platform 23051 location – rate?" SkyTruth blog, June 21, 2010, http://blog.skytruth.org/2010/06/leaking-well-at-platform-23051-location_21.html

xiii. Amos, J., 2010, "National Oil Spill Commission Hearing, December 2-3, 2010 - SkyTruth Comment on Monitoring," SkyTruth blog, December 3, 2010, http://blog.skytruth.org/2010/12/national-oil-spill-commission-hearing.html

SKY-1 The BOEM believes that this Supplemental EIS has accurately depicted the containment capabilities and challenges identified during the DWH event and in developments made since that event. The BOEM has also been careful to point out that no one response technique is likely to be wholly effective and that a suite of response capabilities are likely to be deployed in the event of a future spill. Although the DWH event did highlight that certain containment capabilities were not as efficient in deep water or offshore as expected, e.g., the skimmers, significant strides have been made and continue to be made, in both regulatory and technical approaches. In addition to the techniques discussed in **Chapter 3.2.1.5.2**, all operators that submit applications for permits to drill in deep water must also now demonstrate their ability to deploy containment equipment to control and abate the source of an oil spill. This capability should greatly reduce the amount of time that a well could flow, which in turn, would reduce the amount of oil lost to the environment in the unlikely event that a future catastrophic event occurs. Operators must also submit a revised oil-spill response plan that shows not only this increased subsea containment and control capability but also improvements in mechanical and alternative spill-response capabilities. These improvements are being manifested through acquisition of state-of-the-art skimmers, ocean boom, burn boom, infrared cameras for night operations, and other improvements that will increase the efficiency of offshore spill-response systems. Strategies are also being put in place to decrease response time by placing more ocean boom on offshore vessels and by the development of systems' approaches to respond in order to improve the encounter rate of oil. Additionally, BSEE and USCG are working closely together to address the spill-response issues that became evident during the DWH response. As a part of this effort, USCG and BSEE established workgroups to assess worst-case discharges of offshore oil-spill response plans by Captain of the Port zones and to conduct gap analysis of area contingency plans to provide assurances that equipment and strategies are adequate to mitigate risks from all potential sources of offshore oil spills.

The BOEM subject-matter experts have taken these advances and challenges into account in their analyses, where appropriate, and in the catastrophic spill event in **Appendix B**, which is meant to be conservative in its approach.

SKY-2 See the response to Comment SKY-1. Economic and environmental damage resulting from a catastrophic spill such as the DWH spill event is analyzed in **Appendix B**.

SKY-3 **Appendix B**, the catastrophic spill discussion, acknowledges and analyzes the potential impacts from a catastrophic spill in both shallow and deep water. **Appendix B** is conservative in its approach and does unduly rely on containment capabilities. In addition, all operators that submit applications for permits (APD) to drill in deep water must also now demonstrate their ability to deploy containment equipment to control and abate the source of an oil spill. For these applications, the operator must demonstrate well integrity utilizing a designated well containment screening program among other items within the APD. Based on the information submitted and the results of the BSEE Well Containment Screening Tool, BSEE will evaluate the well design. The BSEE will approve the well only if all elements of the review are acceptable and if the following conditions are met: (1) the well can be shut in with full wellbore integrity; (2) wellbore integrity cannot be demonstrated; however, the shut-in well will not result in an underground flow that broaches to the seafloor; or (3) wellbore integrity cannot be demonstrated and the shut-in well will result in an underground flow that broaches to the seafloor; however, the operator can demonstrate cap flow and collection capability. It is important to note that the above BSEE evaluation will not focus on requiring a predetermined surface collection flow capacity; it will instead rely upon the engineering flow analysis to determine the surface collection capacity (which is not the same as the operator's estimated worst-case discharge). The BSEE will not grant an approved APD for wells whose calculated discharge rate, based upon the engineering flow analysis, is greater than the present surface collection capacity until the operators demonstrate that they have increased their surface collection capacity.

SKY-4 The analyses in this Supplemental EIS considered changes to baseline conditions that may have occurred since the Multisale EIS and the 2009-2012 Supplemental EIS, including the DWH event. As acknowledged in this Supplemental EIS, credible scientific data regarding the potential short-term and long-term impacts of the DWH event remains incomplete at this time and may not be available for years. In light of the absence of this information, BOEM considered what information was relevant and essential to its analysis of alternatives based upon the resource analyzed. If essential to a reasoned choice among the alternatives, BOEM considered whether it was possible to obtain the information, if the cost of obtaining it is exorbitant, and if it cannot be obtained, used what scientifically credible information was available, applied using acceptable scientific methodologies, to inform the analysis in light of this incomplete or unavailable information. Information on many impacts of the DWH event and oil spill, particularly as part of the NRDA process, may not be available for years, and certainly not within the contemplated timeframe of this NEPA process. In its place, subject-matter experts have used the scientifically credible information available and scientific methodologies to evaluate impacts to the resources while this information is unavailable. Nevertheless, as noted in **Chapter 4.1.1.2.2.1**, thousands of water quality and sediment samples were collected and analyzed during and after the DWH event. The vast majority remained below USEPA benchmarks. As noted in that chapter, those that exceeded benchmarks were relatively close to the Macondo wellhead. As such, BOEM subject-matter experts believe the referenced statement remains accurate.

SKY-5 The Gulf of Mexico, including the CPA, is a dynamic environment that will be studied far into the future. There will never be a “final” assessment of baseline conditions in such an environment; any baseline would be constantly evolving. Satellite imagery has helped inform the existing body of data generally on this dynamic environment, and it is useful during accidental events to identify potential sources and the geographic scope of the event. But at the present time, it remains difficult to impossible to use daily satellite images to separate out routine or unknown sources of pollution in the presence of so many natural seeps in the Gulf. The BOEM subject-matter experts routinely examine the literature in their respective fields, including externally and internally funded research. In this Supplemental EIS, the best available scientifically credible information has been included by BOEM subject-matter experts, including results or information gleaned from satellite imagery where appropriate.

With regard to monitoring of potential pollution streams during OCS exploration and production activities, USEPA regulates all waste streams generated from offshore oil and gas activities, primarily by general permits. The USEPA may not issue a permit for a discharge into ocean waters unless the discharge complies with the guidelines established under Section 403(c) of the CWA. Monitoring requirements of these streams are identified by and enforced by USEPA.

SKY-6 See the response to Comment SKY-5.

TURTLE ISLAND RESTORATION NETWORK

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August 16, 2011

Comments on the CPA Lease Sale 216/222 Draft SEIS,
Regional Supervisor, Leasing and Environment (MS 5410),
Bureau of Ocean Energy Management, Regulation and Enforcement,
Gulf of Mexico OCS Region,
1201 Elmwood Park Boulevard,
New Orleans, LA 70123-2394.

RE: Draft Supplemental Environmental Impact Statement (SEIS) for Proposed Oil and Gas Lease Sale 216/222 in the Central Planning Area in the Gulf of Mexico

Dear Mr. Bromwich and BOEMRE Staff,

While the Gulf of Mexico Central Planning Area (CPA) Lease Sale 216/222 Draft Supplemental Environmental Impact Statement (SEIS) acknowledges the devastating impact of the BP Deepwater Horizon oil spill to endangered sea turtles and their habitat, The Sea Turtle Restoration Project (STRP) strongly objects to continuing this sale. Unless and until the full impacts of the Deepwater Horizon disaster are sufficiently documented to mitigate the environmental impacts of future offshore oil activities, STRP will oppose this and other such lease sales.

TIRN-1

The BP Deepwater Horizon oil spill caused the National Marine Fisheries Service (NMFS) and the U.S. Fish and Wildlife Service (USFWS) to reinitiate ESA Section 7 consultation on the existing GOM Multi-sale EIS on July 30, 2010. This action is not complete, and a valid Biological Opinion does not exist for the ongoing operations authorized by BOEMRE in the CPA. The existing GOM Multi-sale EIS has significant shortcomings, as described below, and lacks valid protective measures to mitigate environmental damage caused by offshore oil production activities during the interim consultation. Due to the absence of a valid Biological Opinion for the GOM offshore oil industry, the lack of new environmental protections for impacted sea turtles, and the ongoing impacts to all protected species in the Gulf of Mexico from the BP oil spill, STRP opposes Lease Sale 216/222.

Oil and gas operations are known to injure and kill sea turtles while also degrading marine and coastal habitat critical to their survival and recovery throughout the full life cycle of fossil fuel exploration, construction, extraction, operations, distribution, accidents, cleanup, restoration, and decommissioning. In the aftermath of the 2010 BP Deepwater Horizon oil spill, the U.S. government and Congress have made a clear, strong case for overhauling offshore oil and gas regulations to greater protect the environment and human communities.

Draft Supplemental Environmental Impact Statement (SEIS) for Proposed Oil and Gas Lease Sale 216/222 in the Central Planning Area in the Gulf of Mexico

The Sea Turtle Restoration Project of the Turtle Island Restoration Network recognizes the urgent need to protect endangered sea turtles in the Gulf of Mexico and other U.S. waters from increasing oil and gas exploration, construction, extraction, operations, distribution, accidents, cleanup, restoration, and decommissioning. To address this urgent need STRP/TIRN makes the following general recommendations for **protecting endangered and threatened sea turtles from oil and gas activities:**

TIRN-2
- Offshore oil and gas exploration, drilling, expansion and operations must avoid sea turtle breeding, foraging and migration habitat for any new or renewed oil and gas drilling platforms, pipelines, or ports;

TIRN-3
- Protected marine areas in ocean feeding and migratory habitat for sea turtles must be established where new oil and gas development is prohibited and existing operations phased out, specifically in the Gulf of Mexico;

TIRN-4
- New and existing offshore oil operations must be re-evaluated and modified in light of the BP oil spill and new science on sea turtle populations, their status and recovery to eliminate, prevent and avoid harm or jeopardizing their existence as required under the Endangered Species Act;

TIRN-5
- Oil and gas corporations must adopt rigorous monitoring and reporting schemes and fund new sea turtle research to better document the impacts of the full scope of oil and gas development, operations, oil spills and decommissioning on sea turtles and marine life.

In addition to providing these general recommendations for improving fossil fuel industry operations, this paper also provides:

- A brief overview of threats to sea turtles from oil and gas operations;
- Current sea turtle population status in the U.S.;
- Elements for oil spill response and recovery plans associated with oil and gas leases;
- Specific areas for environmental scoping for Bureau of Ocean Energy Management Regulation and Enforcement (BOEMRE) 2012 to 2017 Oil and Gas Leasing Program.

Offshore Oil Threats to Endangered Sea Turtles and Habitat

The expert members of the presidential panel investigating the causes of the BP oil spill in the Gulf of Mexico have recommended drastic, systematic changes in the oil industry and federal agencies to account for the environmental and human safety issues inherent in offshore oil operations. The regulatory overhaul must include new provisions to protect endangered and threatened sea turtles and marine wildlife, prioritize their rescue and rehabilitation during an oil spill, and ensure that responsible parties for the BP oil spill and future incidents take full financial responsibility for all cleanup and restoration work.

TIRN-6

Current offshore oil and gas regulations and environmental compliance documents related to exploration, construction, extraction, operations, distribution, accidents, cleanup, restoration, and decommissioning incorrectly imply that offshore oil operations have little to no effect on endangered sea turtles that inhabit U.S. oceans. The 2010 Macondo well blowout and the resulting BP oil spill killed hundreds of sea turtles through interactions with the oil itself, vessel traffic, and interactions with fisheries responding to the oil spill. Clearly, offshore oil operations and oil spills have a detrimental impact to sea turtles and marine life, and an overhaul of current regulations must include specific and mandatory provisions to protect ocean biodiversity.

TIRN-7

At least than 1,145 sea turtles were found dead or dying during the BP Oil spill and its aftermath. The spill occurred during the peak of nesting season for loggerheads and critically endangered Kemp's ridleys. While few were found visibly oiled, no independent wildlife observers were at sea recording sea turtles until late July, over 70 days after the spill began. About half of all sea turtles were found dead (608) and the rest alive (537). Many of these live sea turtles were rescued, rehabilitated and later released. A total of 278 sea turtle nests were moved from Gulf of Mexico nesting beaches contaminated with oil to the Atlantic coast resulting in over 14,000 hatchlings displaced and later released. A large number of the unoiled sea turtles likely died in shrimp nets where Turtle Excluder Device laws were ignored to accommodate fishing before and during the oil spill. The long-term impacts of oil exposure to sea turtles, fisheries and the environment are yet to be seen or understood.

Status of Sea Turtles in U.S. - Overview

All six species of sea turtles that inhabit U.S. waters are listed as endangered or threatened under the Endangered Species Act. No species has reached recovery goals despite being granted protections under the ESA since 1973. Clearly, stronger protections are need from activities that harm the survival and recovery of the species, including oil and gas development.

The Gulf of Mexico is habitat for five species of threatened and endangered sea turtles and is an area of high-density offshore oil extraction with chronic, low-level spills and occasional massive spills such as the Ixtoc I oil well blowout in 1979, the explosion and destruction the Mega Borg supertanker near Galveston in 1990, and the Macondo well blowout in 2010. The two primary feeding grounds for adult Kemp's Ridleys in the northern and southern Gulf of Mexico are both near major areas of near-shore and off-shore oil exploration and production. The Kemp's ridley is the most critically endangered species of sea turtles in the world, and its entire population relies on safe foraging and nesting areas within the Gulf of Mexico. Green, leatherback, hawksbill and loggerhead sea turtles also forage and nest in areas of high-density offshore oil. Critical habitat as defined by the Endangered Species Act has been petitioned for Kemp's ridley, leatherback, and loggerhead species in the Gulf of Mexico in early 2010 and is currently under review by the National Marine Fisheries Service.

The Atlantic Ocean continental shelf in the U.S. is an area inhabited by six species of threatened and endangered sea turtles. Florida contains the highest density and most important nesting beaches for the entire Atlantic population of loggerhead sea turtles. Loggerheads are currently listed as threatened in the U.S. Endangered Species Act, but due to declines in the populations, have been proposed to be uplisted to endangered status. Green, leatherback, olive ridley, hawksbill and Kemp's ridley sea turtles all migrate and forage along the Atlantic coast where offshore oil operations either currently exist or are in planning stages. Critical habitat as defined by the Endangered Species Act has been petitioned for loggerheads in the Atlantic in early 2010 and is currently under review by the National Marine Fisheries Service.

The Pacific Ocean continental shelf in the U.S. is inhabited by the critically endangered Pacific leatherback sea turtles and visited by olive ridley, green, and occasionally loggerhead sea turtles.

These threatened and endangered sea turtles migrate and forage through all migrate and forage along the Pacific coast where offshore oil operations either currently exist or are in planning stages. Critical habitat as defined by the Endangered Species Act was petitioned for leatherbacks in the Pacific in 2007 and the National Marine Fisheries Service will publish a final rule designating the critical habitat in 2011.

Summary of Oil Harm to Sea Turtles

Sea turtles are not known to have an avoidance response to oil slicks when an oil spill occurs. Adults will continue to migrate into and through an oil slick to their nesting beaches, deeply inhaling toxic fumes when surfacing for air in the slick. When the oil is fresh, concentrated vapors can limit the ability of their blood to hold oxygen. Hydrocarbon exposure impairs the olfactory system of sea turtles, which plays a key role in navigation during migration.

Adult sea turtles regularly ingest tar balls and marine life that is covered in oil, creating both physical blockages in their digestive system and toxic effects to metabolism. When an oil slick reaches shore, dense aggregations of oils and tar form at the high tide line, and nesting females must cross through it. Oiled sea turtles often die but have been successfully rescued, rehabilitated, and released back into the wild, but the success of such efforts relies on early detection and care.

Sea turtles typically migrate to the same nesting beach they hatched from, and if this beach is oiled, the oil can lead to disastrous consequences. Oiled sand may not support the natural processes needed for successful egg incubation. Oiled sand raises the normal temperature of the nest, which is critical to embryo survival as well as the male/female ratio of the developing embryos. Oxygen diffusion deep into the nest is critical to normal embryo development, and oiled sand can block natural gas exchange. If sea turtle eggs are oiled, they may also suffer from lack of oxygen, malformation, or even death. The top half of the individual sea turtle egg is where gas exchange occurs, and if oil coats this area the embryo does not receive vital oxygen. Carcinogens and toxins in the oil mixtures can penetrate the permeable egg and result in malformation of embryos and death. Developing blood vessels are especially prone to oil toxicity, which also impairs the ability of the blood to carry oxygen.

Hatchlings are at extremely high risk from the effects of an oil spill due to their small size, habitat use, and feeding behavior. Their small size means a greater surface area to volume ratio, a basic physical characteristic that dooms them to extremely high oil exposure. Their soft carapace and developing organs are more permeable and susceptible to the toxic effects of oil exposure. Hatchlings spend the majority of their life very close to the surface where the highest concentrations of oil are likely to be encountered. Their feeding behavior consists of ingesting anything that looks like food, and hatchlings are regularly observed eating tar balls and plastic debris. Hatchlings imprint to the beach they emerge from, and when hydrocarbon exposure disturbs their olfactory system it jeopardizes this critical behavior.

The oils spill and chronic oil exposure can have toxic and eco-toxic effects on adult, juvenile, and developing sea turtles as it disrupts normal biological functions, important ecological interactions, and basic physical processes. The acute physiological impacts of oil on the turtles include skin alteration, decreased blood glucose and increased white blood cell counts, while prolonged exposure to floating oil may lead to immunosuppression and other chronic health issues.

Sea turtles rely on productive ecology of estuary and pelagic zones for their diet. Chronic, low-level oil or acute oil spill exposure can devastate these productive zones and result in major challenges for the survival of sea turtles. Oysters and clams absorb oil and become toxic, crabs and fish may be less contaminated but not free of oily hydrocarbons, and feeding sea turtles are likely to encounter dangerous pockets of tar as they forage for food. The early life stages of marine invertebrates like oysters, crabs, and sponges are highly sensitive to the toxic effects of hydrocarbons and specifically to the mixture of crude oil and chemical dispersants. Areas inundated with oil are likely to be devoid of any life able to maintain healthy sea turtle populations, forcing new foraging strategies and reliance invertebrate food sources less sensitive to hydrocarbon toxicity.

Stronger Sea Turtle Protections Needed in Oil and Gas Regulations

The Sea Turtle Restoration Project of the Turtle Island Restoration Network strongly supports swift and decisive action to enact new laws to ensure private energy companies and our federal agencies improve safety and environmental regulations to meet or exceed the recommendations in the recent report *Deep Water -The Gulf Oil Disaster and the Future of Offshore Drilling, Report to the President*, National Commission on the BP Deepwater Horizon Oil Spill and Offshore Drilling, January 2011.

Specifically, improvements needed to offshore oil and drilling exploration, construction, extraction, operations, distribution, accidents, cleanup, restoration, and decommissioning operations regulations to account for and protect endangered sea turtles include:

TIRN-8

- **Offshore oil and gas exploration, drilling, expansion and operations must avoid sea turtle breeding, foraging and migration habitat for any new or renewed oil and gas drilling platforms, pipelines, or ports;**

No new offshore oil or drilling operations should be allowed in areas where endangered or threatened sea turtles migrate, forage or breed until a thorough, scientifically proven understanding of the impacts of these activities are understood. To harm or harass endangered species during new drilling or construction is illegal under the Endangered Species Act.

TIRN-9

- **Protected marine areas in ocean feeding and migratory habitat for sea turtles must be established where new oil and gas development is prohibited and existing operations phased out, specifically in the Gulf of Mexico;**

Marine zones free from oil and gas activities are necessary to provide a safe haven for sea turtles already surrounded by offshore and nearshore oil operations. Nearshore and offshore areas important to feeding, migrating, and breeding sea turtles must be designated as protected areas immediately. Activities known to harm or harass sea turtles shall be prohibited or restricted in these areas, specifically oil and gas operations, commercial vessel traffic, and commercial fisheries with sea turtle bycatch.

- **New and existing offshore oil operations must be re-evaluated and modified in light of the BP oil spill and new science on U.S. sea turtle populations, their status and**

TIRN-10

recovery to ensure the prevention of harm to sea turtles and avoid jeopardizing their existence as required under the Endangered Species Act;

Oil and gas exploration, construction, drilling, vessel traffic, and chronic low-level oil, along with massive oil spills and other activities have the potential to harm sea turtles. Given the devastating BP oil spill and new science on the status of sea turtle populations and recovery, a complete re-evaluation of all potential harm to sea turtles from the full range of activities from exploration to spills to decommissioning must be fully assessed and prevented. Clearly, a new biological opinion will be required under the ESA. See more details on the scope of environmental concerns below.

TIRN-11

- **Oil and gas corporations must adopt rigorous monitoring and reporting schemes and fund new sea turtle research to better document the impacts of the full scope of oil and gas development, operations and decommission including oil spills on sea turtles and marine life.**

Limited existing data shows acute oil exposure is toxic to sea turtles and offshore oil operations such as vessel traffic and chronic low-level oil spills can impact sea turtle health and the quality of their habitat. More information is needed to better assess these impacts and better determine the effects of oil drilling operations to sea turtles and their habitat. This monitoring should be funded by oil corporations and performed by independent scientists.

TIRN-12

Environmental Scoping Elements for Environmental Impact Statement 2012 to 2017 Oil and Gas Leasing Program – Sea Turtles

The Environmental Scoping for the Environmental Impact Statement for the 2012 to 2017 Oil and Gas Leasing Program must include a comprehensive re-evaluation of the threats and level of potential harm to sea turtles in response to the environmental harm and related outcomes from 2010 BP oil spill. Many of the assumptions about offshore oil drilling and operations made in previous environmental documents and biological opinions are completely outdated, disproven and no longer valid because of what happened with the BP oil spill.

For example, the 2007 National Marin Fisheries Service Endangered Species Act - Section 7 Consultation Biological Opinion issued on the 2007 – 2012 Oil and Gas Lease EIS (2007 Oil BiOp) states erroneously that: "*Spills occurring in offshore waters would be expected to have less a chance of affecting sea turtles due to their lower densities in deep water; however, leatherback sea turtles may be expected to have a greater risk of adverse effects in offshore environments than nearshore environments*"

Furthermore, the 2007 Oil BiOp states erroneously on page 80 that *"We estimate the following take of sea turtles from a major oil spill occurring during the 40-year lifetime of the proposed action: eight Kemp's ridley juveniles; one Kemp's ridley adult."*

Below is an excerpt from page 80 if the Biological Opinion:

Draft Supplemental Environmental Impact Statement (SEIS) for Proposed Oil and Gas Lease Sale 216/222 in the Central Planning Area in the Gulf of Mexico

Although the occurrence, size, time of year, and location of an oil spill is highly unpredictable, we expect sea turtles to be adversely affected by a major oil spill. Due to the lack of data of life history stages and the unpredictable location of a major oil spill occurring, we have made the assumption that hatchlings/juveniles and adult sea turtle have an equal chance of being affected by an oil spill; however, when the number of individuals taken is an odd number, we expect adults to have the slightly higher risk of tarball ingestion due to their generally greater amount of prey ingested than smaller individuals. We estimate the following take of sea turtles from a major oil spill occurring during the 40-year lifetime of the proposed action.

Species	Sheen		Tarball Ingestion	
	Lethal	Non-Lethal	Lethal	Non-Lethal
Hatchlings/Juveniles (0.50 lethal)				
leatherback	2	2	0	0
green	11	11	0	2
Kemps' ridley	8	7	0	1
loggerhead	35	34	0	7
Adults (0.10 lethal)				
leatherback	0	4	0	1
green	2	20	0	3
Kemps' ridley	1	7	0	1
loggerhead	7	62	0	8
hawksbill	0	0	0	1

Numbers greater than 0.50 have been rounded up to the nearest whole number. The risk of hawksbill sea turtles being is low, but spills occurring in south Texas may affect this species through tarball ingestion.

The estimated lethal takes to sea turtles from "a major oil spill occurring during the 40-year lifetime of the proposed action" total 66, while non-lethal takes total 147.

We know now that an offshore oil spill from currently-allowed deepwater drilling operations has the potential to harm, kill, and displace all species of sea turtles and inundate nesting beaches with toxic oil to a greater degree than was ever estimated in previous environmental compliance reports, such as the 2007 Oil BiOp. During the BP oil spill, Kemp's ridleys were oiled and killed, loggerhead nests were inundated, and a whole generation of sea turtles relocated with the hopes of preventing wholesale loss of the cohort nesting on Eastern Gulf beaches.

Several relevant policy developments, pending regulatory decisions, and exiting threats to sea turtle health and populations will need to be considered in the environmental scoping, such as:

1. **Loggerhead status review and reclassification to endangered status:** National Marine Fisheries Service is recommending that all U.S. loggerheads populations including the Florida and the Gulf populations be reclassified from threatened to endangered status in the Endangered Species Act. This will require stronger protections from all activities and makes any harm from oil and gas operations more of a threat to the survival and recovery of the species.
2. **Kemp's ridley critical habitat:** The National Marine Fisheries Service is expected to act on a petition to establish critical habitat in the Gulf of Mexico for the critically

endangered Kemp's ridley. This species died by the hundreds in the BP oil spill and nesting in 2010 decreased. Designation of long-overdue critical habitat for the species will require stronger protections all activities and makes any harm from oil and gas operations more of a threat to the survival and recovery of the species.

3. **Cold stunning of green sea turtles:** Thousands of endangered and threatened green sea turtles on Texas beaches reconfirmed the importance of Gulf of Mexico waters to this species and the need for greater protections to prevent population decline from all human activities including oil and gas.
4. **Fisheries Bycatch:** The loss of thousands of sea turtles in federal and state commercial fisheries in the Gulf of Mexico continues nearly a decade after Turtle Excluder Devices were required in U.S. shrimp fleets. New assessments of fishery bycatch indicate that the promise of 97 percent reduction in sea turtle bycatch has been compromised by non-compliance. Instead the reduction is only 40 to 60 percent. High sea turtle strandings recorded during the BP oil spill revealed that tow times are not an effective tool either. Skimmer trawls and try nets are also capturing and drowning sea turtles. The relevance of these statistics to the BOEMRE environmental scoping is that the cumulative impacts of fishery and other harm to sea turtles from human activities makes any harm from oil and gas operations more of a threat to the survival and recovery of the species. The true extent of sea turtle fishery bycatch must be considered in the environmental scoping for oil and gas leasing.
5. **Shrimp Trawl Fishery Impacts:** During April of 2011 over 350 dead sea turtles washed ashore on the beaches of Alabama, Mississippi and Louisiana breaking all previous records for this month. The unusual level of deaths was attributed to the shrimp trawl fishery but many experts believe the increased drownings of the sea turtles were due to the cumulative impacts caused by the BP oil spill. NMFS is engaged in ESA Section 7 review of this fishery and intends to propose new rules to provide additional sea turtle protections in the area of the proposed lease sale.
6. **Ongoing Physiology and Habitat Research:** Scientist around the world focus their studies in areas of U.S. offshore oil operations providing new information on the vital migratory pathways, foraging areas, breeding areas and areas of high concentrations for sea turtles. Toxicology and behavioral studies concerning the effects of oil operations have increased as well. Vital science necessary to better understand offshore oil impacts to sea turtles must increase, be funded by oil corporations, and be used to assess impacts.

In addition to the key considerations above, the following elements of oil and gas exploration, construction, extraction, operations, distribution, accidents, cleanup, restoration, and decommissioning operations and the potential harm to sea turtles must be considered in the environmental scoping:

1) **Oil spills:** Chronic oil spills, mid-size oil spills, and massive oil spills. The 2007 Oil BiOp estimates 9 lethal Kemp's ridley takes from 40 years of oil activity, an estimate invalidated by the BP spill of 2010. Oil spill jeopardize sea turtles.
2) **Vessel strikes in sea turtle habitat:** Speeds must be limited to 10 knots or less to prevent harm to sea turtles and independent observers record interactions. Ships should be denied entry in waters where sea turtles are mating during nesting season. Vessel

strikes often go unreported so their true impact jeopardizing sea turtles is likely greater that known.

3) **Vessel operations:** Ballast water management; discharge of sewage, graywater, oily water; discharge of solid wastes, plastics and all garbage; accidental spills of fuel oil, engine lubrication oil; disposal and spillage of solvents and other hazardous liquids and chemicals; residues of antifouling paint, sediment disturbance by propeller wash from large vessels, disposal of toxic wastes; air pollution from engines, generators and incinerators all jeopardize sea turtles and habitat.
4) **Toxic discharges:** Chemicals and chemical oil dispersants released from oil rigs and associated infrastructure, vessels, helicopters and ports jeopardize the health and survival of juvenile sea turtles.
5) **Wastewater discharges:** Pathogens released from oil rigs and associated infrastructure, vessels, helicopters and ports jeopardize the health and survival of juvenile sea turtles.
6) **Debris discharges:** Plastic, litter, and chemicals released from oil rigs and associated infrastructure, vessels, helicopters and ports jeopardize the health and survival of juvenile sea turtles.
7) **Noise from seismic testing:** Chronic low frequency noise causes harassment and alteration of normal sea turtle feeding, migration, and breeding behavior.
8) **Drilling and construction noise:** Acute, sporadic, low frequency noise causes harassment and alteration of normal sea turtle feeding, migration, and breeding behavior.
9) **Offshore rig operations noise:** Chronic, low frequency noise causes harassment and alteration of normal sea turtle feeding, migration, and breeding behavior.
10) **Vessel and helicopter noise:** Low frequency noise causes harassment and alteration of normal sea turtle feeding, migration, and breeding behavior.
11) **Drilling:** Noise, seismic disruptions, waste discharge and turbidity caused by drilling and pile driving result in sea turtle displacement and destruction of habitat.
12) **Pipeline construction:** Noise, seismic disruptions, waste discharge and turbidity caused by pipeline construction result in sea turtle displacement and destruction of habitat.
13) **Turbidity:** sediments suspended by offshore oil operations contain heavy metals and result in destruction of sea turtle habitat.
14) **Dredging of project site and navigation channels:** Sea turtles will be entrained and killed during dredging during construction and maintenance.
15) **Lighting:** All artificial light source during construction and on-going operations of offshore oil can disrupt normal sea turtle behavior, especially juvenile sea turtles.
16) **Gas flaring from natural gas processing plants:** The gas flaring impacts normal sea turtle behavior through air pollution and artificial light.
17) **Air pollution:** Particles released into the air during construction and on-going operations are toxic to sea turtles and destroy their habitat.
18) **Water pollution:** heavy metals release during construction and on-going operations combined with debris, pathogens and other toxic chemicals impacts sea turtle health and habitat quality.
19) **Loss of nesting habitat:** Oil spills, construction and on-going operations destroy and degrade sea turtle nesting beaches.
20) **Explosions from decommissioning:** Offshore oil facilities that are no longer in operation often support marine biodiversity and should never be demolished with deadly

explosives. The combined effects of acoustic and seismic injury from the explosions with the habitat loss are further jeopardizing sea turtle populations.

As new technologies are introduced into offshore oil exploration, construction, extraction, operations, distribution, accidents, cleanup, restoration, and decommissioning operations they must be assessed to determine their impacts to endangered sea turtles.

A Call For Immediate Action to Overhaul Offshore Oil Regulation

The Bureau of Ocean Energy Management, Regulation and Enforcement (BOEMRE) and other federal and state agencies must work to correct the current flaws that allow offshore oil and gas operations to proceed with very little environmental compliance regulations and in ways that harm sea turtles, sensitive marine life, and jeopardize the safety of offshore oil workers and coastal communities.

The horrific BP oil spill is direct evidence of the results of poor regulations, poor oversight, and limited or nonexistent enforcement of environmental protection laws. Hundreds of sea turtles perished during the BP spill, but most disappointing of all, the exact toll on sea turtles and marine life from the most toxic oil near the spill source will never be known because of the restrictive access to independent scientists and observers to these areas during the early weeks of the incident. The contamination has spread beyond the marine ecosystem and has had detrimental impacts to the health of coastal communities and their economies.

Immediate action by BOEMRE is needed to correct the current situation and ensure another BP oil spill disaster is prevented. There is much work to do, and it will require the cooperation of President Obama and Congress. Without improved regulations, the continued contamination and degradation of public trust resources such as air, water, marine life, and seafood will continue and likely increase, all in the name of profits for multinational corporations.

Rescue, Recovery and Restoration - Oil Spill Response for Sea Turtles

The BP oil spill led to hundreds of endangered sea turtle deaths, but many more likely perished in the first weeks before any on-water rescue began. Scientists recruited by the Sea Turtle Restoration Project and fishermen in Louisiana were organized to join forces with Unified Command and improve wildlife rescue in June, but were rudely ignored throughout the months of June and July while innocent endangered species perished. On-water rescue of sea turtles and marine life was virtually non-existent in May, had only one boat team throughout June, and began expanding in July. By August, oil was dispersed and Unified Command increased rescue crews, which then recovered more sea turtles from Gulf seas in one week than they had found in the previous two months.

The lessons learned during the BP spill response must be part of a permanent changes to improve response and rescue plans for oil spills in the Gulf of Mexico and all U.S. seas where endangered sea turtles are present.

Specifically, the Sea Turtle Restoration Project recommends that all oil spills response and recovery plans should include these measures:

- **Independent observers on all oil spill response vessels to record wildlife sightings.**

It is unacceptable that responsible parties that would suffer fines and criminal prosecution for harming endangered sea turtles and also allowed to be observing and recording interactions during an oil spill incident response. Independent wildlife observers must be present for all cleanup operations immediately.

- **Sea turtle rescuers be required on all cleanup vessel teams.**

In 2010 the Coast Guard developed training protocols for rescue teams to be trained and equipped to recover oiled sea turtles from cleanup vessels. The personnel and equipment must be deployed immediately during an oil spill to rescue sea turtles from all cleanup vessels and onshore crews. Simply calling for rescue task force boats does not provide timely or adequate response to rescue all impacted sea turtles.

- **Double or triple the number of qualified wildlife rescue teams on-call.**

A wildlife rescue effort must match the size and scope of the oil spill, and the response for sea turtles in 2010 was too small and too slow. On-water rescue operations must increase and teams should be deployed from multiple locations immediately.

- **Establishment of a volunteer protocol for wildlife rescue assistance workers.**

Hundreds of volunteers experienced in wildlife handling and care stepped forward to help during the BP spill, most were ignored and turned away because of a lack of infrastructure and proper protocols. Denying trained helpers the ability to assist with rescue of their local wildlife resources is unethical and may be illegal.

- **Maintenance of an effective level of search effort for sea turtles and wildlife.**

Multiple boat teams must be deployed at all times and an adequate search effort constantly maintained if endangered sea turtles are to be quickly found and rescued during an oil spill.

- **Endangered species prioritized for rescue and rehabilitation.**

Rather than wait for wildlife to wash ashore dead and dying, proactive rescue of endangered species such as sea turtle must be prioritized in actions ordered by incident command during an oil spill.

- **Sea turtle nesting beaches prioritized for placement of offshore oil booms.**

The cleaning of spilled oil from sand on sea turtle nesting beaches is destructive to the habitat and near ineffective for dispersed oil. Offshore booms must be used to stop oil from coming to sea turtle nesting beaches as a top priority in their deployment.

- **Chemical dispersants and "controlled burns" banned where endangered species are present.**

Cleanup operations during an oil spill must not further jeopardize endangered sea turtle, and both the use of chemical dispersants applied directly to the ocean surface and the controlled burns to remove surface oil caused direct injury to sea turtles.

A complete restoration of the Gulf of Mexico sea turtle populations and essential habitat must be fully funded by the responsible parties for the BP oil spill, namely, BP, Transocean, and Halliburton. Allocation of funds to federal, state, local, and non-governmental agencies for a diverse set of restoration strategies to address oil cleanup, habitat restoration, and reduction of other threats to sea turtles must occur.

Offshore Oil Responsible Parties Must Cleanup and Restore Damage Done

Offshore oil and gas lease agreements must include the necessary actions needed to restore habitats to benefit endangered Kemp's ridley and all sea turtles after catastrophic oil spills.

Of critical importance during a the aftermath of an offshore oil spill incident is the need to take immediate action to reduce or eliminating deadly threats to endangered sea turtles in their habitat for restoration projects to be effective. Specifically,

Protected marine areas must be established. Feeding, breeding and migratory habitat offshore can be preserved and improved by eliminating commercial fishing and phasing out oil and gas development within a series of marine reserves for sea turtles.

Overhaul offshore oil operations. Offshore oil and gas exploration, drilling, expansion and operations must avoid sea turtle breeding, foraging and migration habitat for any new or renewed oil and gas drilling platforms, pipelines, or ports. When offshore oil platforms are decommissioned, the underwater structures should remain as reef habitat and the use of explosives to remove any offshore structures should be made illegal.

Reduce commercial trawl and longline fishing. During the BP spill, we sued to stop the opening of shrimping season, and our lawsuit resulting in the National Marine Fisheries Service taking action to re-evaluate shrimping laws to protect sea turtles. Shrimp trawling killed an estimated 5,365 sea turtles in 2009. Longline fishing in the Gulf kills hundreds, perhaps thousands, more. Area and seasonal closures of these fisheries, or their complete closures, are necessary to restore sea turtle populations.

Failure to reduce fishery and offshore oil threats to sea turtles will doom any other restoration projects to failure as well.

We support the following habitat restoration projects for sea turtles for 5-year lease planning, as it is likely they will be needed after a catastrophic oil spill.

Clean all nesting beaches to be oil-free to a depth of 30 inches. Trace amounts of toxic oil residue coating Gulf beaches can be toxic to the normal development and survival of sea turtle embryos in their eggs.

Construct protective corrals for sea turtle nests. In areas of clean sands, construct protective corrals to increase nesting and hatchling success. Public educational and scientific projects should be supported in all corals. We seek your immediate support of efforts to construct a coral near Galveston.

Improved wetland health and barrier island ecosystem health. Post-nesting and juvenile sea turtles regularly forage in wetlands, coastal embayments and around barrier islands. We support ongoing efforts to improve these habitats so they support healthy crabs, oysters, and other creatures in the sea turtle diet.

The Sea Turtle Restoration Project of the Turtle Island Restoration Project feels strongly that the responsible parties for the oil spill should pay for all cleanup, restoration projects, and for the damage done to endangered species sea turtles. Federal biologists must be allowed continue to the important work they were engaged in before the spill took over their jobs.

The NRDA process must share with the public its findings on sea turtle mortalities, ecosystem health, and the health of coastal communities so public policy efforts can shape necessary reform. Specifically, the NRDA process must

1) **Estimate all sea turtles killed or harmed during the spill.** On-water observations during the spill were few and far between in an area home to hundreds of thousands of sea turtles. Expert opinions and modeling must be combined to provide an accurate estimate of the thousands of sea turtles likely impacted.
2) **Improve Gulf of Mexico Sea Turtle Stranding Network.** Currently, a loose partnership has been established, but for the NRDA process to successfully record sea turtle deaths from the BP spill, a cohesive network must be formed that patrols all Gulf beaches and estuary habitat for dead or dying sea turtles.
3) **Nesting beach sands tested and cleaned to 30 inches.** Sea turtle nests were covered in tarballs along Alabama and Florida beaches. These habitats must be cleaned and testing to ensure they are not toxic to sea turtle embryos and that information shared with the public.
4) **Foraging habitat health assessments.** Blue crab, jellyfish, oyster, and other bivalves are important food sources for all sea turtles, and their health and the health of offshore feeding areas must be determined. If the food sources contain toxic oil, more restoration and cleanup must be prioritized.
5) **No sand dredging in sea turtle foraging habitat.** Some restoration projects steal sand from offshore islands, important feeding habitat for sea turtles. Dredging operations kill sea turtles. Sand dredging must be halted to ensure the habitat and sea turtles are not harmed.

A Crisis Crossroads – Ending Offshore Oil to Save Sea Turtles and Ourselves
Offshore oil was the cause of the largest environmental disaster in U.S. history. Allowing corporations free reign of the seas to extract poison for profit will continue to result in increased sea turtle habitat destruction, sea turtle deaths, global warming, and economic polarization between those exploiting and those that are exploited for oil. Our seas in the U.S. are public trust managed by public servants giving each and every citizen a say in how they are used and by whom.

Ending offshore oil can be the first step towards shifting U.S. energy resources towards clean, renewable options. Ending offshore oil can be the first step towards ending the toxic, acoustic, and aesthetic pollution propagating from each drilling or pumping operation at sea. Ending offshore oil will forever put the chance of another drilling explosion and BP-like gusher permanently in the history books. Ending offshore is a relatively small negative change in the overall corporate oil machine that can have enormous benefits to the health of the oceans and the coastal communities that depend on them.

Sea turtles and their populations are being driven to extinction by the poisoning, the habitat loss, and the climate change brought on by offshore oil and the fossil fuel frenzy as a whole.

The Sea Turtle Restoration Project of the Turtle Island Restoration Network opposes the Gulf of Mexico Central Planning Area (CPA) Lease Sale 216/222 due to continued reliance on an invalid

TIRN-13

Biological Opinion and the insufficient mitigations contained within it, and therefore, the fact that the current SEIS falls short of meeting its requirements.

Due to the lack of a valid Biological Opinion for the GOM offshore oil industry, the insufficient measures provided by the previous Biological Opinion in the wake of the BP oil spill, the lack of new environmental protections for impacted sea turtles 2010-2011, and the ongoing impacts to all protected species in the Gulf of Mexico from the BP oil spill, the Sea Turtle Restoration Project of the Turtle Island Restoration Network opposes Lease Sale 216/222 and finds the current SEIS incomplete.

Thank you for this opportunity to provide public comments and for your consideration. We look forward to your response.

Sincerely yours,

Teri Shore, Program Director, Turtle Island Restoration Network

Chris Pincetich, Ph.D., Marine Biologist, Sea Turtle Restoration Project of the Turtle Island Restoration Network

TIRN-1 The BOEM acknowledges that consultation has been reinitiated in light of the DWH event, is still underway, and may not be concluded prior to the printing of this Supplemental EIS. Because this is a lease sale that does not in and of itself make any irreversible or irretrievable commitment of resources that would foreclose the development or implementation of any reasonable and prudent alternative measures to comply with the Endangered Species Act (ESA), BOEM may proceed with publication of this Supplemental EIS and finalize a decision among the alternatives even if consultation is not complete, consistent with Section 7(d) of the ESA. The 2007 Biological Opinion remains in effect during the reinitiated consultation. The BOEM and BSEE will continue to comply with all reasonable and prudent measures and the terms and conditions under these existing consultations, along with implementing the current BOEM-imposed mitigation, monitoring, and reporting requirements. While consultation is ongoing, BOEM and BSEE are developing an interim coordination program with NMFS and FWS.

TIRN-2 Protocols described in this Supplemental EIS are followed to protect sea turtles. In addition, BOEM remains subject to a 2007 Biological Opinion. The BOEM and BSEE will continue to comply with all reasonable and prudent measures and the terms and conditions of its existing consultations with NMFS. The BOEM has reinitiated consultation with NMFS, and BOEM and BSEE are developing an interim coordination program with NMFS while this reinitiated consultation is ongoing. Potential mitigation measures are discussed in the main text of this Supplemental EIS. The BOEM will continue to consult with NMFS and, during the postlease approval process, BOEM and BSEE may consider imposing additional mitigations or conditions of approval where appropriate to minimize or avoid impacts on sea turtles.

TIRN-3 To the extent that the Turtle Island Restoration Network is requesting the creation of additional protected marine sanctuaries, NOAA's National Marine Sanctuaries program has exclusive jurisdiction over the creation and protection of such areas. The BOEM does not have authority over the creation of marine sanctuaries. There are currently no specific sea turtle protected marine sanctuaries in the Gulf. For marine sanctuaries that have been designated by NOAA, BOEM complies with all No Activity Zones in place to protect those sanctuaries. In addition, across the Gulf, BOEM has sea turtle and marine mammal mitigations in place as described in this Supplement EIS.

TIRN-4 The BOEM and BSEE continually evaluate offshore oil operations under its jurisdiction to ensure that our Nation's offshore energy reserves are managed and developed in the most environmentally sound and safe manner possible. To this end, BSEE promulgated new regulations on drilling safety and new requirements for supplemental environmental management systems in light of lessons learned from the DWH event. With regard to BOEM's continuing compliance with the Endangered Species Act and the status of the reinitiated consultation, please see the responses to Comments TIRN-1 and TIRN-2. New information on sea turtles that is available since previous NEPA documents has been included in this Supplemental EIS.

TIRN-5 The BOEM already requires operators to monitor their activities as they relate to sea turtles and marine mammals, and it imposes additional mitigations as appropriate. For example, 30 CFR 250.282, 30 CFR 550.282, and NTL 2007-G04 provide guidelines for monitoring procedures and vessel strike avoidance measures for sea turtles and other protected species. These mitigations and monitoring requirements are described in **Chapter 4**.

TIRN-6 As discussed in this Supplemental EIS, BOEM's analysis of routine activities related to the proposed action are expected to result in sublethal impacts that are not likely to rise to population-level effects. The BOEM admits that a low-probability, large-impact catastrophic spill similar to the DWH event, although exceedingly remote, has the potential to significantly impact sea turtles and potentially at a population level. Although a number of turtle carcasses have been collected both before and after the DWH event, NMFS has not identified or released the causes of death for these turtles; therefore, it would be premature to link all of them to the DWH event at this point. Regulations, monitoring requirements, and mitigations, where applicable, are in place to minimize and avoid impacts to sea turtles wherever possible. In addition, BOEM has reinitiated consultations with NMFS, and BOEM and BSEE will continue to comply with all reasonable and prudent measures and the terms and conditions of the existing Biological Opinion to continue to protect sea turtles.

TIRN-7 See the response to Comment TIRN-6. As noted above, NMFS has not identified a cause of death for most, if not all, of the turtles collected just before and after the DWH event. As such, BOEM can offer no opinion as to whether shrimp nets or turtle excluder devices played any role with the turtles collected. Information currently available on the impacts of oil exposure and the DWH event on turtles and the status of collected animals is included in **Chapter 4**.

TIRN-8 Migration patterns of sea turtles are not well defined and, to date, NMFS has not identified any critical habitat for sea turtles in the Gulf of Mexico. As mandated by the Endangered Species Act, BOEM consulted with NMFS and FWS on possible and potential impacts from the CPA proposed action on endangered/threatened species and designated critical habitat under their jurisdiction. See the response to Comment TIRN-1 for the status of reinitiated consultation with NMFS. Operators are required to comply with the Endangered Species Act, and BOEM imposes additional mitigations and monitoring requirements as necessary to provide protections to sea turtles.

TIRN-9 See the response to Comment TIRN-3.

TIRN-10 See the response to Comment TIRN-4.

TIRN-11 See the response to Comment TIRN-5. Studies and information on sea turtles are evolving, and the NRDA process is continuing to investigate potential impacts to sea turtles in light of the DWH event.

TIRN-12 Comments on the 2012-2017 5-Year Program EIS are outside the scope of this Supplemental EIS.

TIRN-13 See the response to Comment TIRN-1 for the status of the reinitiated consultation and compliance with the Endangered Species Act. The ongoing consultation under the Endangered Species Act does not prevent BOEM from meeting its obligations under NEPA in this Supplement EIS.

July 9, 2011
Sarasota, Florida

U.S. Department of the Interior
Bureau of Ocean Energy Management
Regulation & Inforcement
Gulf of Mexico OCS Region (MS5410)
1201 Elmwood Park Blvd.
New Orleans, LA. 70123-2394

Gentlemen/Ladies:

I was raised on the Gulf Coast and will not have any part in further destroying it. My family have traveled a great deal but FLORIDA is home and has been for generations, six generations to be exact.

GOLD-1

When we could no longer get our "rubber' supply from the Burma area during WW2 our scientists and psychologists went to work and invented synthetic rubber. We need to do the same thing with OIL. So, let them get to work and quit ruining our Gulf.

Most sincerely,

Viola L. Goldberg
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GOLD-1 Comment noted.

CHAPTER 6

REFERENCES CITED

6. REFERENCES CITED

Abramson, D., I. Redlener, T. Stehling-Ariza, J. Sury, A. Banister, and Y. Park. 2010. Impact on children and families of the *Deepwater Horizon* oil spill. National Center for Disaster Preparedness. Mailman School of Public Health, Columbia University, New York, NY.

Acevedo, R., R. Morelock, and R.A. Olivieri. 1989. Modification of coral reef zonation by terrigenous sediment stress. Palaios 4:92-100.

Ackerman, J.T., J.Y. Takekawa, K.L. Kruse, D.L. Orthmeyer, J.L. Yee, C.R. Ely, D.H. Ward, K.S. Bollinger, and D.M. Mulcahy. 2004. Using radiotelemetry to monitor cardiac response of free-living tule greater white-fronted geese (*Anser albifrons elgasi*) to human disturbance. Wilson Bulletin 116:146-151.

Adams, J.A. 1960. A contribution to the biology and postlarval development of the Sargassum fish, *Histrio histrio* (Linnaeus), with a discussion of the Sargassum complex. Bull. Mar. Sci. of the Gulf and Caribbean 10:55-82.

Adcroft, A., R. Hallberg, J.P. Dunne, B.L. Samuels, J.A. Galt, C.H. Barker, and D. Payton. 2010. Simulations of underwater plumes of dissolved oil in the Gulf of Mexico. Geophys. Res. Lett. 37, L18605, doi:10.1029/2010GL044689.

Adriance, J. Official communication. Louisiana Dept. of Wildlife and Fisheries. Email regarding summer of 2011 fish kills in Louisiana. July 21, 2011.

Aguilar-Perera, A. and A. Tuz-Sulub. 2010. Non-native, invasive red lionfish (*Pterois volitans* [Linnaeus 1758]: Scorpaenidae), is the first recorded in the southern Gulf of Mexico, off the Northern Yucatan Peninsula, Mexico. Aquatic Invasions, Volume 5, Supplement 1:S9-S12.

Aguilera, F., J. Méndez, E. Pásaro, and B. Laffon. 2010. Review on the effects of exposure to spilled oils on human health. Journal of Applied Toxicology 30:291-301, doi:10.1002/jat.1521.

Alabama Coastal Area Board. 1980. Inventory of Alabama's coastal resources and uses. Alabama Coastal Area Board Technical Publication. 169 pp.

Alabama Dept. of Conservation and National Resources. 2010a. Alabama's artificial reef program (maps). Internet website: http://www.outdooralabama.com/fishing/saltwater/where/artificial-reefs/. Accessed April 15, 2011.

Alabama Dept. of Conservation and Natural Resources. 2010b. Fishing Alabama: WFF's guiding principles and strategies (fishing regulations). Internet website: https://www.outdooralabama.com/fishing/. Accessed April 15, 2011.

Alabama Tourism Department. 2010. Travel economic impact report 2009. 36 pp.

Alexander, S.K. and J.W. Webb. 1987. Relationship of *Spartina alterniflora* growth to sediment oil content following an oil spill. In: Proceedings, 1987 Oil Spill Conference. . . April 6-9, 1988. Baltimore, MD. Washington, DC: American Petroleum Institute. Pp. 445-450.

Alexander-Bloch, B. 2010. Vietnamese-American fishers fight for oil spill claim approval. *The Times Picayune*. Internet website: http://www.nola.com/news/gulf-oil-spill/index.ssf/2010/12/vietnamese-american_fishermen.html. Accessed February 16, 2011.

Allen, T. 2010. Transcript press briefing by National Incident Commander Admiral Thad Allen. Press conference transcript, July 30, 2010. Internet website: http://www.restorethegulf.gov/release/2010/07/30/transcript-press-briefing-national-incident-commander-admiral-thad-allen. Accessed November 17, 2011.

Allen, A. 2011. The controlled burning of oil during the *Deepwater Horizon* oil spill. Petroleum Association of Japan, 2011 Oil Spill Response Workshop, Tokyo, Japan, March 2, 2011. 31 pp.

Internet website: http://www.pcs.gr.jp/doc/esymposium/2011/4Mr_AlanAllen_PPT.pdf. Accessed November 17, 2011.

Alonso-Alvarez, C., C. Perez, and A. Velando. 2007a. Effects of acute exposure to heavy fuel oil from the *Prestige* spill on a seabird. Aquatic Toxicology 84:103-110.

Alonso-Alvarez, C., I. Munilla, M. Lopez-Alonso, and A. Velando. 2007b. Sublethal toxicity of the *Prestige* oil spill on yellow-legged gulls. Environment International 33:773-781.

Alsop, F.J. III. 2001. Birds of North America. Smithsonian Handbook. New York, NY: DK Publishing. 1,008 pp.

Alpert, L., L. Schild, and W. Stronge. 2008. Florida visitor study. Prepared for the Florida Dept. of Environmental Protection. Contract # BSO14. 7 pp.

Alpert, L., R. Dow, J. Murley, and W. Stronge. 2005. Tourism in paradise: The economic impact of Florida beaches. Proceedings of the 14th Biennial Coastal Zone Conference. 6 pp.

Altuf'yev, Yu. V., A.A. Romanov, and N.N. Sheveleva. 1992. Histology of the striated muscle tissue and liver in Caspian Sea sturgeons. J. Ichthyol. 32:100-116.

American Association of Port Authorities. 2009. U.S. port ranking by cargo volume 2009. 2 pp. Internet website: http://aapa.files.cms-plus.com/Statistics/2009US_PORTRANKINGS_BY_CARGO_TONNAGE.pdf. Accessed June 6, 2011.

American Petroleum Institute (API). 1989. Effects of offshore petroleum operations on cold water marine mammals: A literature review. Washington, DC: American Petroleum Institute. 385 pp.

American Petroleum Institute (API). 2004. Development of a safety and environmental management program for offshore operations and facilities. Recommended Practice (RP) 75.

America's Wetland Resource Center. 2011. Controlling the river: Maintaining the Mississippi River for national commerce. Internet website: http://www.americaswetlandresources.com/background_facts/detailedstory/LouisianaRiverControl.html. Accessed November 1, 2011.

Arismendez, S., R. Kalke, and P. Montagna. 2011a. Microtox® analysis of the effects of the *Deepwater Horizon* oil spill on offshore benthic habitats: Abstract. In: Proceedings of the 40th Benthic Ecology Meeting, Mobile, AL. March 16-20, 2011.

Arismendez, S., R. Kalke, and P. Montagna. 2011b. Microtox® analysis of the effects of the *Deepwater Horizon* oil spill on offshore benthic habitats. Presentation given at the 40th Benthic Ecology Meeting, Mobile, AL, March 16-20, 2011.

Amos, A.F. 1989. The occurrence of hawksbills (*Eretmochelys imbricata*) along the Texas coast. Proceedings of the 9th Annual Workshop on Sea Turtle Conservation and Biology. NOAA Technical Memorandum NMFS-SEFSC-232. Pp. 9-11.

Anchor Environmental CA, L.P. 2003. Literature review of effects of resuspended sediments due to dredging operations. Prepared for the Los Angeles Contaminated Sediments Task Force, Los Angeles, CA 140 pp.

Anderson, C.M. and R.P. LaBelle. 2000. Update of comparative occurrence rates for offshore oil spills. Spill Science and Technology Bulletin 6(5/6):302-321.

Anderson, D.W., F. Gress, and D.M. Fry. 1996. Survival and dispersal of oiled brown pelicans after rehabilitation and release. Marine Pollution Bulletin 32:711-718.

Anton, A., J. Cebrian, C.M. Duarte, K.L. Heck, Jr., and J. Goff. 2009. Low impact of Hurricane Katrina on seagrass community structure and functioning in the northern Gulf of Mexico. Bulletin of Marine Science 85(1):45-59.

Antonio, F.J., R.S. Mendes, and S.M. Thomaz. 2011. Identifying and modeling patterns of tetrapod vertebrate mortality rates in the Gulf of Mexico oil spill. Aquatic Toxicology 105(1-2):177-179.

Armstrong, H.W., K. Fucik, J.W. Anderson, and J.M. Neff. 1977. Effects of oilfield brine effluent on benthic organisms in Trinity Bay, Texas. API Publication No. 4201. Washington, DC: American Petroleum Institute.

Atauz, A.D., W. Bryant, T. Jones, and B. Phaneuf. 2006. Mica shipwreck project: Deepwater archaeological investigation of a 19th century shipwreck in the Gulf of Mexico. U.S. Dept. of the Interior, Minerals Management Service, Gulf of Mexico OCS Region, New Orleans, LA. OCS Study MMS 2006-072. 116 pp.

Aten, L.E. 1983. Indians of the upper Texas coast. New York, NY: Academic Press. 370 pp.

Atkins, M., S. Mirza, J. Skinner, A. Mathew, and T. Edward. 2006. Pipeline damage assessment from Hurricane Ivan in the Gulf of Mexico. Minerals Management Service, Herndon, VA. TA&R 553.

Atkins, M., T. Edward, D. Johnson, and M. Dance. 2007. Pipeline damage assessment from Hurricanes Katrina and Rita in the Gulf of Mexico. U.S. Dept. of the Interior, Minerals Management Service, Herndon, VA. TA&R 581.

Atlantic and Gulf States Marine Fisheries Commissions. 2004. Guidelines for marine artificial reef materials. Second edition. Number 121. 205 pp. Internet website: http://www.gsmfc.org/pubs/SFRP/Guidelines_for_Marine_Artificial_Reef_Materials_January_2004.pdf.

Atlas, R.M. and T.C. Hazen. 2011. Oil bioremediation: A tale of the two worst spills in U.S. history. Environmental Science and Technology 45:6709-6715.

Aurell, J. and B.K. Gullett. 2010. Aerostat sampling of PCDD/PCDF emissions from the Gulf oil spill in situ burns. U.S. Environmental Protection Agency, Office of Research and Development, National Risk Management Research Laboratory, Research Triangle Park, NC. 22 pp. Internet website: http://www.epa.gov/research/dioxin/docs/Gulfinsituburnemissionsampling.pdf.

Austin, D., K. Coelho, A. Gardner, R. Higgins, and T. McGuire. 2002a. Social and economic impacts of outer continental shelf activities on individuals and families. Volume I: Final report. U.S. Dept. of the Interior, Minerals Management Service, New Orleans, LA. OCS Study MMS 2002-022. 298 pp.

Austin, D.E., A. Gardner, R. Higgins, J. Schrag-James, S. Sparks, and L. Stauber. 2002b. Social and economic impacts of outer continental shelf activities on individuals and families. Volume II: Case studies of Morgan City and New Iberia, Louisiana. U.S. Dept. of the Interior, Minerals Management Service, New Orleans, LA. OCS Study MMS 2002-023. 197 pp.

Australian Maritime Safety Authority. 2003. Post spill monitoring: Background paper. Prepared by Wardrop Consulting and the Cawthron Institute for the Australian Maritime Safety Authority and the Marine Safety Authority of New Zealand. Canberra: Australian Marine Safety Authority, Canberra. ISBN: 0 642 70991 2.

Australian Maritime Safety Authority. 2010. Oil spill dispersants: Top 20 frequently asked questions (FAQs). Internet website: http://www.amsa.gov.au/Marine_Environment_Protection/National_plan/General_Information/Dispersants_Information/FAQ_Oil_Spills_Dispersants.asp. Accessed June 29, 2010.

Avens, H.J., K.M. Unice, J. Sahmel, S.A. Gross, J.J. Keenan, and D.J. Paustenbach. 2011. Analysis and modeling of airborne BTEX concentrations from the *Deepwater Horizon* spill. Environmental Science Technology 45(17) :7372–7379, doi:10.1021/es200963x. Internet website: http://pubs.acs.org/doi/abs/10.1021/es200963x.

Aversa, J. 2010. Oil spill's economic damage may not go beyond Gulf. Internet website: http://dailycaller.com/2010/06/28/oil-spills-economic-damage-may-not-go-beyond-gulf/. Accessed February 16, 2011.

Avery, M.L., P.F. Springer, and N.S. Dailey. 1980. Avian mortality at man-made structures: An annotated bibliography (revised). U.S. Dept. of the Interior, Fish and Wildlife Service, Biological Services Program. FWS/OBS-80/54.

Avian Power Line Interaction Committee. 1994. Mitigating bird collisions with power lines: The state of the art in 1994. Edison Electric Institute, Washington, DC.

Awbrey, F.T. and A.E. Bowles. 1990. The effects of aircraft noise and sonic booms on raptors: A preliminary model and a synthesis of the literature on disturbance. Prepared for Noise and Sonic Boom Impact Technology (NSBIT), Advanced Development Program Office, Human Systems Division, OL-AC HSD-NSBIT, Wright-Patterson Air Force Base, OH. NSBIT Technical Operating Report No. 12.

Baca, B.J., T.E. Lankford, and E.R. Gundlach. 1987. Recovery of Brittany coastal marshes in the eight years following the *Amoco Cadiz* incident. In: Proceedings of the 1987 International Oil Spill Conference. Washington, DC: American Petroleum Institute. Pp. 459-464.

Baca, B., G.A. Ward, C.H. Lane, and P.A. Schuler. 2005. Net environmental benefit analysis (NEBA) of dispersed oil on nearshore tropical ecosystems derived from the 20 year "TROPICS" field study. In: Proceedings of the International Oil Spill Conference. May 15-19, 2005. Miami Beach, FL.

Bahr, L.M., Jr., J.W. Day, and J.H. Stone. 1982. Energy cost accounting of Louisiana fishery production. Estuaries 5(3):209-215.

Bailey H. and P. Thompson. 2010. Effect of oceanographic features on fine-scale foraging movements of bottlenose dolphins. Marine Ecology Progress Series 418:223-233.

Baird, P.H. 1990. Concentrations of seabirds at oil-drilling rigs. Condor 92:768-771.

Bak, R.P. 1978. Lethal and sublethal effects of dredging on coral reefs. Marine Pollution Bulletin 9(1):14-16.

Bak, R.P.M. and J.H.B.W. Elgershuizen. 1976. Patterns of oil-sediment rejection in corals. Marine Biology 37:105-113.

Baker, J.M., R.B. Clark, and P.F. Kingston. 1991. Two years after the spill: Environmental recovery in Prince William Sound and the Gulf of Alaska. Institute of Offshore Engineering, Heriot-Watt University, Edinburgh, EH14 4AS, Scotland. 31 pp.

Baker, J.M., M.L. Guzman, P.D. Bartlett, D.I. Little, and C.M. Wilson. 1993. Long-term fate and effects of untreated thick oil deposits on salt marshes. In: Proceedings of the 1993 International Oil Spill Conference. Washington, DC: American Petroleum Institute. Pp. 395-399.

Balsam, W.L. and J.P. Beeson. 2003. Sea-floor sediment distribution in the Gulf of Mexico. Deep Sea Research Part I. Oceanographic Research Papers 50(12):1421-1444.

Balseiro, A., A. Espi, I. Marquez, V. Perez, M.C. Ferreras, J.F. Garcia Marin, and J.M. Prieto. 2005. Pathological features in marine birds affected by the *Prestige*'s oil spill in the north of Spain. Journal of Wildlife Diseases 41:371-378.

Banks, P. 2011. Comprehensive report of the 2010 oyster mortality study in Breton Sound and Barataria Basins. Louisiana Dept. of Wildlife and Fisheries.

Bankston, C.L. and M. Zhou. 1996. Go fish: The Louisiana Vietnamese and ethnic entrepreneurship in an extractive industry. National Journal of Sociology 10(1):37-55.

Barker, K. 2011. Gulf counties tax receipts before and after the spill. *ProPublica*, April 13, 2011. Internet website: http://projects.propublica.org/tables/gulf-sales-tax-receipts. Accessed September 8, 2011.

Barkuloo, J.M. 1988. Report on the conservation status of the Gulf of Mexico sturgeon, *Acipenser oxyrhunchus desotoi*. U.S. Dept. of the Interior, Fish and Wildlife Service, Panama City, FL.

Barnea, N., J. Michel, B. Bray, Z. Nixon, G. Imahori, and C. Moegling. 2009. Marine debris response planning in the north-central Gulf of Mexico. June 2009. U.S. Dept. of Commerce, National Oceanic and Atmospheric Administration. NOAA Technical Memorandum NOS-OR&R-31.

Barras, J.A. 2006. Land area change in coastal Louisiana after the 2005 hurricanes—a series of three maps: U.S. Dept. of the Interior, Geological Survey. Open-File Report 2006-1274. Internet website: http://pubs.usgs.gov/of/2006/1274/.

Barras, J.A. 2007a. Satellite images and aerial photographs of the effects of Hurricanes Katrina and Rita on coastal Louisiana. U.S. Dept. of the Interior, Geological Survey. Geological Survey Data Series 281. Internet website: http://pubs.usgs.gov/ds/2007/281. Accessed April 15, 2011.

Barras, J.A. 2007b. Land area changes in coastal Louisiana after Hurricanes Katrina and Rita (Chapter 5). In: Farris, G.S., G.J. Smith, M.P. Crane, C.R. Demas, L.L. Robbins, and D.L. Lavoie, eds. Science and the storms: The USGS response to the hurricanes of 2005. U.S. Dept. of the Interior, Geological Survey. Geological Survey Circular 1306. Pp. 97-112. Internet website: http://pubs.usgs.gov/circ/1306/pdf/c1306_ch5_b.pdf. Accessed April 15, 2011.

Barras, J.A. 2009. Land area change and overview of major hurricane impacts in coastal Louisiana, 2004-08: U.S. Dept. of the Interior, Geological Survey. Scientific Investigations Map 3080, scale 1:250,000, 6 p. pamphlet.

Barras, J.A., S. Beville, D. Britsch, S. Hartley, S. Hawes, J. Johnston, P. Kemp, Q. Kinler, A. Martucci, J. Porthouse, D. Reed, K. Roy, S. Sapkota, and J. Suhayda. 2003. Historical and projected coastal Louisiana land changes: 1978-2050. USGS Open File Report 03-334.

Barras, J.A., J.C. Bernier, and R.A. Morton. 2008. Land area change in coastal Louisiana: 1956 to 2006 (abstract). In: Lavoie, D. and B. Rosen, eds. USGS Gulf Coast Science Conference and Florida Integrated Science Center Meeting: Proceedings with Abstracts, October 20-23, 2008, Orlando, FL. U.S. Dept. of the Interior, Geological Survey, St. Petersburg, FL. Geological Survey Open-File Report 2008-1329. P. 22.

Barringer, F. 2010. As mess is sent to landfills, officials worry about safety. *The New York Times*, June 14, 2010. Internet website: http://www.nytimes.com/2010/06/15/science/earth/15waste.html. Accessed July 1, 2010.

Barry A. Vittor and Associates, Inc. 1985. Tuscaloosa Trend regional data search and synthesis study. Volume I: Synthesis report. U.S. Dept. of the Interior, Minerals Management Service, Gulf of Mexico Regional OCS Office, Metairie, LA. OCS Study MMS 85-0056. 398 pp.

Barry A. Vittor & Associates, Inc. 2009. Submerged aquatic vegetation mapping in Mobile Bay and adjacent waters of coastal Alabama in 2008 and 2009. Prepared for the Mobile Bay National Estuary Program. v + 16 pp. Internet website: http://www.mobilebaynep.com/wp-content/uploads/2010/07/SAVfinal_Jan2010.pdf.

Barstow, D., L. Dodd, J. Glanz, S. Saul, and I. Urbina. 2010. Regulators failed to address risks in oil Rig fail-safe device. *The New York Times*, June 20, 2010. Internet website: http://www.nytimes.com/2010/06/21/us/21blowout.html?_r=1&pagewanted=1. Accessed January 28, 2011.

Bartha, R. and R.M. Atlas. 1983. Transport and transformations of petroleum: Biological processes. In: Boesch, D.F. and N.N. Rabalais, eds. Long-term environmental effects of offshore oil and gas development. Abingdon, UK: Taylor and Francis. Pp. 287-342.

Bass, A.S. and R.E. Turner. 1997. Relationships between salt marsh loss and dredged canals in three Louisiana estuaries. Journal of Coastal Research 13(3):895-903.

Bassin, N.J. and T. Ichiye. 1977. Flocculation behavior of suspended sediments and oil emulsions. Journal of Sedimentary Research 47(2):671-677.

Bateman, D.H. and M.S. Brim. 1994. Environmental contaminants in Gulf sturgeon of northwest Florida 1985-1991. U.S. Dept. of the Interior, Fish and Wildlife Service, Panama City, FL. 23 pp.

Baumann, R.H. and R.E. Turner. 1990. Direct impacts of outer continental shelf activities on wetland loss in the central Gulf of Mexico. Environ. Geo. Water Sci. 15(3):189-198.

Baumann, P.C., I.R. Smith, and C.D. Metcalfe. 1996. Linkages between chemical contaminants and tumors in benthic Great Lake fishes. J. Great Lakes Res. 22(2):131-152.

Baxter II, L., E.E. Hays, G.R. Hampson, and R.H. Backus. 1982. Mortality of fish subjected to explosive shock as applied to oil well severance on Georges Bank. Woods Hole Oceanographic Institution, Woods Hole, MA. Technical Report WHOI-82-54. 69 pp.

Bea, R.G., N.W. Lai, A.W. Niedoroda, and G.H. Moore. 1983. Gulf of Mexico shallow-water wave heights and forces. In: Proceedings of the Offshore Technical Conference, Houston, TX, May 1983. OTC 4586. Pp. 49-62.

Beale, C.M. 2007. The behavioral ecology of disturbance responses. International Journal of Comparative Psychology 20:111-120.

Beauchamp, G. 2002. Higher-level evolution of intraspecific flock-feeding in birds. Behavioral Ecology and Sociobiology 51:480-487.

Beauchamp, G. 2004. Reduced flocking by birds on islands with relaxed predation. Proceedings of the Royal Society of London B 271:1039-1042.

Beauchamp, G. 2008. What is the magnitude of the group-size effect on vigilance? Behavioral Ecology 19(6):1361-1368.

Beauchamp, G. and G.D. Ruxton. 2008. Disentangling risk dilution and collective detection in the antipredator vigilance of semipalmated sandpipers in flocks. Animal Behavior 75:1837-1842.

Beerkircher, L.R. 2009. Official communication. Email regarding seabird bycatch in longline fisheries. U.S. Dept. of Commerce, National Oceanic and Atmospheric Administration, National Marine Fisheries Service.

Behrens, E.W. 1988. Geology of a continental slope oil seep, northern Gulf of Mexico. American Association of Petroleum Geologists Bulletin 72(2):105-114.

Beiras, R. and L. Saco-Álvarez. 2006. Toxicity of seawater and sand affected by the *Prestige* fuel-oil spill using bivalve and sea urchin embryogenesis bioassays. Water, Air, and Soil Pollution 177:457-466.

Belanger, L. and J. Bedard. 1990. Energetic cost of man-induced disturbance to staging snow geese. Journal of Wildlife Management 54:36-41.

Bell, W.B. 1972. Animal response to sonic booms. Journal of the Acoustic Society of America 51:758-765.

Bellrose, F.C. 1980. Ducks, geese, and swans of North America: A Wildlife Management Institute book sponsored jointly with the Illinois Natural History Survey. Washington, DC: Stackpole Books. 540 pp.

Benfield, M. 2011. Official communication. BP spill paper. Presentation given at the Twenty-Sixth Gulf of Mexico Information Transfer Meeting, March 22-24, 2011. Sponsored by the U.S. Dept. of the Interior, Bureau of Ocean Energy Management, Regulation and Enforcement, Gulf of Mexico OCS Region, New Orleans, LA.

Benson, J.B., W.W. Schroeder, and A.W. Shultz. 1997. Sandstone hardbottoms along the western rim of the De Soto Canyon, northeastern Gulf of Mexico. Gulf Coast Assoc. Geo. Soc. Trans. XLVII:43-48.

Bent, A.R. 1926. Life histories of North American marsh birds. Smithsonian Institution, United States National Museum, Bulletin 135, Government Printing Office, Washington, DC.

Berecz, E. and M. Balla-Achs. 1983. Gas hydrates. New York, NY: Elsevier. 343 pp.

Berg, J. 2006. A review of contaminant impacts on Gulf of Mexico sturgeon, *Acipenser oxyrinchus desotoi*. U.S. Dept. of the Interior, Fish and Wildlife Service, Panama City, FL.

Berman, A.E. 2005. The debate over subsidence in coastal Louisiana and Texas. Houston Geological Society. Internet website: http://www.hgs.org/en/art/?691. Posted November 24, 2005. Accessed October 5, 2010.

Berns, D.M. 2003. Physiological responses of *Thalassia testudinum* and *Ruppia maritima* to experimental salinity levels. M.Sc. Thesis, University of South Florida, St. Petersburg, FL. 71 pp.

Biggs, D.C. and P.H. Ressler. 2001. Distribution and abundance of phytoplankton, ichthyoplankton, and micronekton in the deepwater Gulf of Mexico. Gulf of Mexico Science 2001:7-29.

Bindoff, N.L., J. Willebrand, V. Artale, A, Cazenave, J. Gregory, S. Gulev, K. Hanawa, Le Quéré, S. Levitus, Y. Nojiri, C.K. Shum, L.D. Talley, and A. Unnikrishnan. 2007. Observations; oceanic climate change and sea level. In: Solomon, S., D. Qin, M. Manning, Z. Chen, M. Marquis, K.B. Avery, M. Tignor and H.L. Miller, eds. Climate change 2007: The physical science basis. Contribution of Working Group I to the Fourth Assessment Report of the Intergovernmental Panel on Climate, Cambridge University Press, Cambridge, United Kingdom and New York, NY, USA. Internet website: http://www.ipcc.ch/publications_and_data/ar4/wg1/en/ch5.html.

Birchwood, R., S. Noeth, and E. Jones. 2008. Safe drilling in gas-hydrate prone sediments: Findings from the 2005 drilling campaign of the GOM gas hydrates Joint Industry Project (JIP). U.S. Dept. of Energy, National Energy Technology Laboratory, Fire in the Ice. Methane Hydrate Newsletter. Winter 2008. Pp. 1-8. Internet website: http://www.netl.doe.gov/technologies/oil-gas/FutureSupply/MethaneHydrates/newsletter/newsletter.htm.

Birkett, S.H. and D.J. Rapport. 1999. A stress-response assessment of the northwestern Gulf of Mexico ecosystem. In: Kumpf, H., K. Steidinger, and K. Sherman, eds. The Gulf of Mexico large marine ecosystem: Assessment, sustainability, and management. Malden, MA: Blackwell Science, Inc. Pp. 438-458.

Bittner, J.E. 1996. Cultural resources and the *Exxon-Valdez* oil spill: An overview. In: Proceedings of the *Exxon-Valdez* Oil Spill Symposium. American Fisheries Society Symposium 18:814-818.

Blanchet, H. 2010. Official communication. Fish kill in Bay Joe Wise. Louisiana Dept. of Wildlife and Fisheries. September 24, 2010.

Block, B.A., H.D. Susanna, B. Blackwell, T.D. Williams, E.D. Prince, C.J. Farwell, A. Boustany, S.L.H. Teo, A. Seitz, A. Walli, and D. Fudge. 2001. Migratory movements, depth preferences, and thermal biology of Atlantic bluefin tuna. Science 293(5533):1310-1314.

Bloomberg. 2010. Oil spill may cost $4.3 billion in property values. Internet website: http://www.bloomberg.com/news/2010-06-11/bp-spill-may-cost-homeowners-4-3-billion-in-property-values-along-shore.html. Accessed June 11, 2011.

Blum, M.D. and H.H. Roberts. 2009. Drowning of the Mississippi Delta due to insufficient sediment supply and global sea-level rise. Nature Geoscience 2:488-491. Internet website: http://www.deltas2010.com/blum2009.pdf.

Boehm, P.D. 1983. Transport processes regarding hydrocarbon and metal pollutants in offshore sedimentary environments. In: Boesch, D.F. and N.N. Rabalais, eds. Long-term environmental effects of offshore oil and gas development. Abingdon, UK: Taylor and Francis.

Boehm, P.D. and D.L. Fiest. 1982. Subsurface distributions of petroleum from an offshore well blowout. The *Ixtoc I* Blowout, Bay of Campeche. Environmental Science and Technology 16(2):67-74.

Boehm, P., D. Turton, A. Raval, D. Caudle, D. French, N. Rabalais, R. Spies, and J. Johnson. 2001. Deepwater program: Literature review, environmental risks of chemical products used in Gulf of Mexico deepwater oil and gas operations. Volume I: Technical report. U.S. Dept. of the Interior, Minerals Management Service, Gulf of Mexico OCS Region, New Orleans, LA. OCS Study MMS 2001-011. 326 pp.

Boesch D.F. and N.N. Rabalais, eds. 1987. Long-term environmental effects of offshore oil and gas development. Abingdon, Oxford, UK: Taylor and Francis.

Boesch, D.F., M.N. Josselyn, A.J. Mehta, J.T. Morris, W.K. Nuttle, C.A. Simestad, and D.J.P. Swift. 1994. Scientific assessment of coastal wetland loss, restoration and management in Louisiana. Journal of Coastal Research Special Issue 20:1-103.

Boland, G.S. 1986. Discovery of co-occurring bivalve *Acesta* sp. and chemosynthetic tube worms Lamellibrachia. Nature 323:759.

Boland, G. 2011. Official communication. Email regarding mud used in "top kill." U.S. Dept. of the Interior, Bureau of Ocean Energy Management, Regulation and Enforcement, Herndon, VA. August 24, 2011.

Boland, G.S. and P.W. Sammarco. 2005. Observations of the antipatharian "black coral" *Plumapathes pennacea* (Pallas, 1766) (Cnidaria: Anthozoa), northwest Gulf of Mexico. Gulf of Mexico Science 23:127-132.

Boland, G., G. Brewer, E. Cordes, A. Demopoulos, C. Fisher, C. German, and K. Sulka. 2010. Mississippi Canyon 252 incident NRDA Tier 1 for deepwater communities: Work plan and SOPs. June 27, 2010. 37 pp. Internet website: http://www.nature.nps.gov/environmentalquality/OilSpillWorkplans/docs/2010_07_02_Deepwater_Communities_Signed.pdf.

Bolden, S. 2010. Official communication. Information concerning the critical habitat and damage assessments of the Gulf sturgeon. U.S. Dept. of Commerce, NOAA Fisheries, St. Petersburg, FL.

Bologna, P.A.X. and K.L. Heck, Jr. 1999. Macrofaunal associations with seagrass epiphytes: Relative importance of trophic and structural characteristics. Journal of Experimental Marine Biology and Ecology 242(1):21-39.

Borrell, B. 2010. Oil spill threatens history. Archaeology 63(5), September/October.

Borkhataria, R.R., P.C. Frederick, R. Hylton, A.L. Bryan, Jr., and J.A. Rodgers. 2008. A preliminary model of wood stork population dynamics in the southeastern United States. Waterbirds 31 (Special Publication 1):42-49.

Bortone, S.A., P.A. Hastings, and S.B. Collard. 1977. The pelagic Sargassum ichthyofauna of the eastern Gulf of Mexico. Northeast Gulf Science 1:60-67.

Boswell, R., T. Collett, D. McConnell, M. Frye, B. Shedd, S. Mrozewski, G. Guerin, A. Cook, P. Godfriaux, R. Dufrene, R. Roy, and E. Jones. 2009. Joint industry project Leg II discovers rich gas hydrate accumulations in sand reservoirs in the Gulf of Mexico. U.S Dept. of Energy, National Energy Technology Laboratory, Fire in the Ice. Methane Hydrate Newsletter. Summer 2009. Pp. 1-5. Internet website: http://www.netl.doe.gov/technologies/oil-gas/FutureSupply/MethaneHydrates/newsletter/newsletter.htm.

Bourgeois, M. 2010a. Official communication. Email regarding fish kills in the MRGO. Louisiana Dept. of Wildlife and Fisheries. August 23, 2010.

Bourgeois, M. 2010b. Official communication. Email regarding oyster kill in Bay Jacques. Louisiana Dept. of Wildlife and Fisheries. June 20, 2010.

Boyd, R. and S. Penland, eds. 1988. A geomorphologic model for Mississippi Delta evolution. Transactions—Gulf Coast Association of Geological Societies 38:443-452.

Boyd, R.S., J.M. Moffett, and M.C. Wooten. 2003. Effects of post-hurricane dune restoration and revegetation techniques on the Alabama beach mouse. Final report submitted to U.S. Dept. of the Interior, Fish and Wildlife Service. Auburn University, Alabama. 308 pp.

Brassieur, R., C.E. Colten, and J. Edwards. 2000. Atchafalaya trace heritage area: Historic and cultural resources analysis. Atchafalaya Trace Commission, Baton Rouge, LA.

Bricker, S., B. Longstaff, W. Dennison, A. Jones, K. Boicourt, C. Wicks, and J. Woerner. 2007. Effects of nutrient enrichment in the Nation's estuaries: A decade of change. U.S. Dept. of Commerce, National Oceanic and Atmospheric Administration, National Centers for Coastal Ocean Science, Silver Spring, MD. NOAA Coastal Ocean Program Decision Analysis Series No. 26. 328 pp.

Briggs, K.T., S.H. Yoshida, and M.E. Gershwin. 1996. The influence of petrochemicals and stress on the immune system of seabirds. Regulatory Toxicology and Pharmacology 23:145-155.

Bright, T.J. and Rezak, R. 1977. Chapter 6: Reconnaissance of reefs and fishing banks of the Texas continental shelf. In: Geyer, R.A., ed. 1977. Submersibles and their use in oceanography and ocean engineering. Amsterdam: Elsevier Scientific Publishing Company.

Bright, T.J. and R. Rezak. 1978. Northwestern Gulf of Mexico topographic features study: Final report. U.S. Dept. of the Interior, Bureau of Land Management, New Orleans OCS Office, New Orleans, LA. Study No. 1978-4. 692 pp. Internet website: http://www.gomr.boemre.gov/PI/PDFImages/ESPIS/3/4069.pdf.

Bright, T.J., R. Rezak, A.H. Bouma, W.R. Bryant, and W.E. Pequegnat. 1976. A biological and geological reconnaissance of selected topographical features on the Texas continental shelf. Final report to the U.S. Dept. of the Interior, Bureau of Land Management, New Orleans OCS Office, New Orleans, LA. Contract # 08550-CT5-4.

Britsch, L.D. and J.B. Dunbar. 1993. Land loss rates: Louisiana coastal plain. Journal of Coastal Research 9(2):324-338.

Broder, J.M. 2010. Drillers fault study on moratorium losses. *The New York Times*. Internet website: http://green.blogs.nytimes.com/2010/09/16/drillers-fault-study-on-moratorium-losses/. Accessed December 12, 2010.

Brody, S., S. Bernhardt, H. Grover, C. Spence, Z. Tang, and B. Whitaker. 2006. Identifying potential conflict associated with oil and gas exploration in Texas state coastal waters: A multi-criteria spatial analysis. Environmental Management 38:597-617.

Brooks, J.M., ed. 1991. Mississippi-Alabama continental shelf ecosystem study: Data summary and synthesis. Volume I: Executive summary and Volume II: Technical summary. U.S. Dept. of the Interior, Minerals Management Service, Gulf of Mexico OCS Region, New Orleans, LA. OCS Study MMS 91-0062 and 91-0063. 43 and 368 pp., respectively.

Brooks, J.M. and C.P. Giammona. 1990. Mississippi-Alabama marine ecosystem study: Annual report; Year 2. Volume I: Technical narrative. U.S. Dept. of the Interior, Minerals Management Service, Gulf of Mexico OCS Region, New Orleans, LA. OCS Study MMS 89-0095. 348 pp.

Brooks, J.M. and R.M. Darnell. 1991. Executive summary. In: Brooks, J.M. and C.P. Giammona, eds. Mississippi-Alabama continental shelf ecosystem study: Data summary and synthesis. Volume I: Executive summary. U.S. Dept. of the Interior, Minerals Management Service, Gulf of Mexico OCS Regional Office, New Orleans, LA. OCS Study MMS-91-0062. 43 pp.

Brooks, J.M., M.C. Kennicutt II, and R.R. Bidigare. 1986. Final cruise report for Offshore Operators Committee study of chemosynthetic marine ecosystems in the Gulf of Mexico. Texas A&M University, Dept. of Oceanography, Geophysical and Environmental Research Group, College Station, TX. 102 pp.

Brooks, J.M., C. Fisher, H. Roberts, B. Bernard, I. McDonald, R. Carney, S. Joye, E. Cordes, G. Wolff, and E. Goehring. 2009. Investigations of chemosynthetic communities on the lower continental slope of the Gulf of Mexico: Interim report 2. U.S. Dept. of the Interior, Minerals Management Service, Gulf of Mexico OCS Region, New Orleans, LA. OCS Study MMS 2009-046. 360 pp. Internet website: http://www.gomr.boemre.gov/PI/PDFImages/ESPIS/4/4877.pdf.

Brown, J.S., D. Beckmann, L. Bruce, and S. Mudge. 2010. PAH depletion ratios document the rapid weathering and attenuation of PAHs in oil samples collected after the *Deepwater Horizon* incident. Presentation at the SETAC North America 31st Annual Meeting, Portland, OR, November 7-11, 2010.

Bryant, W. and J.Y. Lui. 2000. Chapter 3: Geology. In: Continental Shelf Associates, Inc. Deepwater Gulf of Mexico environmental and socioeconomic data search and literature study. Volume I: Narrative report. U.S. Dept. of the Interior, Minerals Management Service, Gulf of Mexico OCS Region, New Orleans, LA. OCS Study MMS 2000-049. Pp. 25-59.

Bryant, W., N. Slowey, S. DiMarco, D. Bean, and D. Berti. 2004. DeepSea furrows: Physical characteristics, mechanisms of formation and associated environmental processes. Final report prepared for Research Partnership to Secure Energy for America. 4 pp.

Burdeau, C. and J. Collins. 2010. Gulf's marshes showing new life: Worst fears about spill's effect ease as plants sprout anew. *The Columbus Dispatch*, August 12, 2010. (Interviews with Louisiana Dept. of Wildlife and Fisheries, Matt Boasso; Louisiana Universities Marine Consortium, Alexander S. Kolker; British Petroleum, Ivor Van Heerden; and U.S. Dept. of Commerce, National Oceanic and Atmospheric Administration, Ben Sherman). Internet website: http://www.dispatch.com/live/content/national_world/stories/2010/08/12/gulfs-marshes-showing-new-life.html?sid=101. Accessed April 2, 2011.

Burger, J. 1977. Determinants of hatching success in diamond-back terrapin, *Malaclemys terrapin*. American Midland Naturalist 97:444-464.

Burger, J. 1981. Behavioural responses of herring gulls *Larus argentatus* to aircraft noise. Environmental Pollution Series A, Ecological and Biological 24:177-184.

Burger, A.E. 1993. Estimating the mortality of seabirds following oil spills: Effects of spill volume. Marine Pollution Bulletin 26:140-143.

Burger, J. 1994. Immediate effects of oils spills on organisms in the Arthur Kill. In: Burger, J., ed. Before and after an oil spill: The Arthur Kill. New Brunswick, NJ: Rutgers University Press. Pp. 115-130.

Burns, K.A. and A.H. Knap. 1989. The Bahia las Minas oil spill. Hydrocarbon uptake by reef building corals. Marine Pollution Bulletin 20(8):391-398.

Burns, K.A. and J.M. Teal. 1973. Hydrocarbons in the pelagic sargassum community. Deep Sea Research and Oceanographic Abstracts 20(2):207-211.

Burns, K.A., S.D. Garrity, and S.C. Levings. 1993. How many years until mangrove ecosystems recover from catastrophic oil spills? Marine Pollution Bulletin 26(5):239-248.

Burns III, G.H., C.A. Benson, T. Eason, J. Michel, S. Kelly, and B. Benggio. 1994. Recovery of submerged oil at San Juan, Puerto Rico 1994. International Oil Spill Conference. Internet website: http://www.iosc.org/papers/01798.pdf.

Burns, K.A., S. Codi, M. Fyrnas, D. Heggie, D. Holdway, B. King, and F. McAllister. 1999. Dispersion and fate of produced formation water constituients in an Australian northwest shelf shallow water ecosystem. Marine Pollution Bulletin 38(7):593-603.

Butler, R.G., A. Harfenist, F.A. Leighton, and D.B. Peakall. 1988. Impact of sublethal oil and emulsion exposure on the reproductive success of Leach's storm-petrels: Short and long-term effects. Journal of Applied Ecology 25:125-143.

Butler, J.A., R.A. Seigel, and B. Mealey. 2006. *Malaclemys terrapin*—diamondback terrapin. In: Meylan, P.A., ed. Biology and conservation of Florida turtles. Chelonian Research Monographs 3:279-295.

Byrd, G.V., J.H. Reynolds, and P.L. Flint. 2009. Persistence rates and detection probabilities of bird carcasses on beaches of Unalaska Island, Alaska, following the wreck of the M/V *Selendang Ayu*. Marine Ornithology 37:197-204.

Byrne, C. 1989. Effects of the water-soluble fractions of No. 2 fuel oil on the cytokinesis of the Quahog clam (*Mercenaria mercenaria*). Bulletin of Environmental Contamination and Toxicology 42:81-86.

Byrne, C.J. and J.A. Calder. 1977. Effect of the water-soluble fractions of crude, refined, and waste oils on the embryonic and larval stages of the Quahog clam *Mercenaria* sp. Marine Biology 40:225-231.

Byrne, J.H. and J.L. Roberts, eds. 2009. From molecules to networks: An introduction to cellular and molecular neuroscience. 2nd ed. Elsevier: New York, NY.

Byrnes, M.R., R.M. Hammer, B.A. Vittor, J.S. Ramsey, D.B. Snyder, K.F. Bosma, J.D. Wood, T.D. Thibaut, and N.W. Phillips. 1999. Environmental survey of identified sand resource areas offshore Alabama: Volume I: Main text. Volume II: Appendices. U.S. Dept. of the Interior, Minerals Management Service, International Activities and Marine Minerals Division (INTERMAR), Herndon, VA. OCS Report MMS 99-0052. 326 pp. + 132 pp. appendices.

Byron, D. and K.L. Heck, Jr. 2006. Hurricane effects on seagrasses along Alabama's Gulf Coast. Estuaries and Coasts 29(6A):939-942.

Caetano, M., M.J. Madureira, and C. Vale. 2003. Metal remobilization during resuspension of anoxic contaminated sediment: Short-term laboratory study. Water, Air, and Soil Pollution 143:23-40.

Caffey, R.H. 2009. Official communication. Preliminary estimates of economic damages to Louisiana fisheries and aquaculture sectors as a result of Hurricanes Ike and Gustav in September 2008. Unpublished data, updated September 28, 2008. 2 pp.

Cagle, F.R. 1952. A Louisiana terrapin population (*Malaclemys*). Copeia 1952:74-76.

Camilli, R., C.M. Reddy, D.R. Yoerger, B.A.S. Van Mooy, M.V. Jakuba, J.C. Kinsey, C.P. McIntyre, S.P. Sylva, and J.V. Maloney. 2010. Tracking hydrocarbon plume transport and biodegradation at Deepwater Horizon. Published online August 19, 2010. Science 8 October 2010: 330:6001(201-204). doi:10.1126/science.1195223.

Campagna, C., F.T. Short, A.A. Polidoro, R. McManus, B.B. Collette, N.J. Pilcher, Y.S. de Mitcheson, S.N. Stuart, and K.E. Carpenter. 2011. Gulf of Mexico oil blowout increases risks to globally threatened species. Bioscience 61:393.

Campbell, T., L. Benedict, and C.W. Finkl. 2005. Regional strategies for coastal restoration along Louisiana barrier islands. Journal of Coastal Research Special Issue 44. Pp. 245-267.

Camphuysen, K.C.J., M. Heubeck, S.L. Cox, R. Bao, D. Humple, C. Abraham, and A. Sandoval. 2002. The *Prestige* oil spill in Spain. Atlantic Seabirds 4:131-140.

Camphuysen C.J., J. Chardine, M. Frederiksen, and M. Nunes. 2005. Review of the impacts of recent major oil spills on seabirds. In: Anonymous, ed. Report of the Working Group on Seabird Ecology, Texel, 29 March – 1 April 2005. Oceanography Committee, ICES CM 2005/C:05, Ref. ACME+E, International Council for the Exploration of the Sea. Copenhagen, Denmark.

Canadian Wildlife Service and U.S. Dept. of the Interior, Fish and Wildlife Service. 2007. International recovery plan for the whooping crane. Ottawa, Canada: Recovery of Nationally Endangered Wildlife (RENEW) and U.S. Dept. of the Interior, Fish and Wildlife Service, Albuquerque, NM. 162 pp.

Cardiff, S. 2006. Official communication. List of seabirds of the northern Gulf of Mexico. Avian Biologist, Louisiana State University Museum of Natural Sciences, Baton Rouge, LA.

Carls, M.G., G.D. Marty, T.R. Meyers, R.E. Thomas, and S.D. Rice. 1998. Expression of viral hemorrhagic septicemia virus in prespawning Pacific herring (*Clupea pallasi*) exposed to weathered crude oil. Canadian Journal of Fisheries and Aquatic Sciences 55(10):2300-2309.

Carlson, P.R., Jr. and K. Madley. 2007. Statewide summary for Florida. In: Handley, D.A., D. Altsman, and R. DeMay, eds. Seagrass status and trends in the northern Gulf of Mexico: 1940-2002. U.S. Dept. of the Interior, Geological Survey Scientific Investigations Report 2006-5287 and U.S. Environmental Protection Agency 855-R-04-003. Pp. 99-114. Internet website: http://pubs.usgs.gov/sir/2006/5287/. Accessed May 13, 2011.

Carlson, P.R., Jr., L.A. Yarbro, K.A. Kaufman, and R.A. Mattson. 2010. Vulnerability and resilience of seagrasses to hurricane and runoff impacts along Florida's west coast. Hydrobiology 649:39-53.

Carney, R. 1993. Presentation at the Thirteenth Gulf of Mexico Information Transfer Meeting, December 4-6, 1993. Sponsored by the U.S. Dept. of the Interior, Minerals Management Service, Gulf of Mexico OCS Region, New Orleans, LA.

Carney, R.S. 1997. Workshop on environmental issues surrounding deepwater oil and gas development: Final report. U.S. Dept. of the Interior, Minerals Management Service, Gulf of Mexico OCS Region, New Orleans, LA. OCS Study MMS 98-0022. 164 pp.

Carney, R.S. 1999. Status of environmental and physical oceanography information on the continental slope in the Gulf of Mexico—results of a workshop. In: McKay, M. and J. Nides, eds. Proceedings: Seventeenth annual Gulf of Mexico information transfer meeting, December 1997. U.S. Dept. of the Interior, Minerals Management Service, Gulf of Mexico OCS Region, New Orleans, LA. OCS Study MMS 99-0042. 419 pp. Internet website: http://www.gomr.boemre.gov/PI/PDFImages/ESPIS/3/3206.pdf.

Carney, K.M. and W.J. Sydeman. 1999. A review of human disturbance effects on nesting colonial waterbirds. Waterbirds 22:68-79.

Carney, R.S., R.L. Haedrich, and G.T. Rowe. 1983. Zonation of fauna in the deep sea. In: Rowe, G.T., ed. Deep-Sea Biology. New York, NY: John Wiley & Sons. Pp. 371-398.

Carpenter, E.J. and J.L. Cox. 1974. Production of pelagic Sargassum and a blue-green epiphyte in the western Sargasso Sea. Limnology and Oceanography 19(3):429-436.

Carr, A. 1983. All the way down upon the Suwannee River. Audubon Magazine. April:80-101.

Carr, A. 1987. New perspectives on the pelagic stages of sea turtle development. Conservation Biology 1(2):103-121.

Carr, A. and A.B. Meylan. 1980. Evidence of passive migration of green turtle hatchlings in Sargassum. Am. Soc. Ichthyologists and Herpetologists 2:366-368.

Carr, R.S., D.C. Chapman, B.J. Presley, J.M. Biedenbach, L. Robertson, P. Boothe, R. Kilada, T. Wade, and P. Montagna. 1996. Sediment porewater toxicity assessment studies in the vicinity of offshore oil and gas production platforms in the Gulf of Mexico. Canadian Journal of Fisheries and Aquatic Science 53:2618-2682.

Carson, R.T. and W.M. Hanemann. 1992. A preliminary economic analysis of recreational fishing losses related to the *Exxon Valdez* oil spill. A Report to the Attorney General of the State of Alaska. 16 pp.

Cash, R.W., D. Naar, B. Donahue, R. Viso, and P. Gayes. 2010. Pulley Ridge: What newly mapped areas reveal about sea-level change. A presentation at the meeting of the Geological Society of America, March 15, 2010. Internet website: http://gsa.confex.com/gsa/2010NE/finalprogram/abstract_169166.htm.

Casselman, B. 2010. Aging oil rigs, pipelines expose Gulf to accidents. *The Wall Street Journal*. December 14, 2010. Internet website: http://online.wsj.com/article/SB10001424052748704584804575644463302701660.html. Accessed December 2010.

Casselman, B. and D. Gilbert. 2011a. Drilling is stalled even after ban is lifted. *The Wall Street Journal*. Internet website: http://online.wsj.com/article/SB10001424052970204204004576050451696859780.html?mod=WSJ_hp_LEFTTopStories. Posted January 3, 2011. Accessed January 3, 2011.

Castege, I., Y. Lalanne, V. Gouriou, G. Hemery, M. Girin, F. D'Amico, C. Mouches, J. D'Elbe, L. Soulier, J. Pensu, D. Lafitte, and F. Pautrizel. 2007. Estimating actual seabirds mortality at sea and relationship with oil spills: lesson from the "Prestige" oil spill in Aquitaine (France). Ardeola 54:289-307.

Castellanos, D.L. and L.P. Rozas. 2001. Nekton use of submerged aquatic vegetation, marsh, and shallow unvegetated bottom in the Atchafalaya River Delta, a Louisiana tidal freshwater ecosystem. Estuaries 24(2):184-197.

Centers for Disease Control and Prevention. 2010. Gulf oil spill 2010: Light crude oil information for health professionals. Internet website: http://emergency.cdc.gov/gulfoilspill2010/light_crude_health_professionals.asp. Accessed October 28, 2011.

Chabreck, R.H., T. Joanen, and S.L. Paulus. 1989. Southern coastal marshes and lakes. In: Smith, L.M., R.L. Pederson, and R.M. Kaminski, eds. Habitat management for migrating and wintering waterfowl in North America. Texas Tech University Press, Lubbock.

Chaisson, C. 2011. Official communication. Email regarding Port Fourchon post-moratorium status as of June 2011. Executive Director, Greater Lafourche Port Commission, Port Fourchon, LA. June 27, 2011.

Chan, E.I. 1977. Oil pollution and tropical littoral communities: Biological effects of the 1975 Florida Keys oil spill. In: Proceeding of the 1977 Oil Spill Conference, March 8-10, 1977, New Orleans, LA. Washington, DC: American Petroleum Institute.

Chapman, P.M., E.A. Power, R.N. Dexter, and H.B. Andersen. 1991. Evaluation of effects associated with and oil platform, using the sediment quality triad. Environmental Toxicology and Chemistry 10:407-424.

Chapman, F.A., S.F. O'Keefe, and D.E. Campton. 1993. Establishment of parameters critical for the culture and commercialization of Gulf of Mexico sturgeon, *Acipenser oxyrhynchus desotoi*. University of Florida, Dept. of Fisheries and Aquatic Science, Gainesville, FL. U.S. Dept. of Commerce, National Marine Fisheries Service, St. Petersburg, FL. Project Final Report—NOAA No. NA27FD0066-01.

Chermock, R.L. 1974. The environment of offshore and estuarine Alabama: Alabama Geological Survey Information Series 51. 135 pp.

Chiappone, M. and K.M. Sullivan. 1994. Ecological structure and dynamics of nearshore hard-bottom communities in the Florida Keys. Bulletin of Marine Science 54(3):747-756.

Chin, C.S. and J. Church. 2010. Field report: Fort Livingston, Grand Terre Island (September 9-10, 2010. National Center for Preservation Technology and Training, Natchitoches, LA. Internet website: http://www.ncptt.nps.gov/2011/field-report-fort-livingston-grand-terre-island/. Accessed March 18, 2011.

Cho, H.J. and C.A. May. 2008. Short-term spatial variations in the beds of *Ruppia maritima* (Ruppiaceae) and *Halodule wrightii* (Cymodoceaccae) at Grand Bay National Estuarine Research Reserve, Mississippi, USA. Journal of the Mississippi Academy of Sciences 53(2-3):133-145.

Cho, H.J., P. Biber, and C. Nica. 2009. The rise of *Ruppia maritima* in seagrass beds: changes in coastal environment and research needs. In: Drury, E.K. and T.S. Pridgen, eds. Handbook on Environmental Quality. Hauppauge, NY: Nova Science Publishers, Inc. 418 pp.

Church, R.A. and D.J. Warren. 2008. Viosca Knoll wreck: Discovery and investigation of an early nineteenth-century sailing ship in 2,000 feet of water. U.S. Dept. of the Interior, Minerals Management Service, Gulf of Mexico OCS Region, New Orleans, LA. OCS Study MMS 2008-018. 41 pp.

Church, R., D. Warren, R. Cullimore, L. Johnston, W. Schroeder, W. Patterson, T. Shirley. M. Kilgour, N. Morris, and J. Moore. 2007. Archaeological and biological analysis of World War II shipwrecks in the Gulf of Mexico: Artificial reef effect in deep water. U.S. Dept. of the Interior, Minerals Management Service, Gulf of Mexico OCS Region, New Orleans, LA. OCS Study MMS 2007-015. 387 pp.

City of New Orleans. n.d. The New Orleans city assisted evacuation plan. Internet website: http://www.nola.gov/~/media/Files/Emergency%20Prepardness/Emergency%20Preparedness%20Documents/Assisted_Evac_Plan.ashx. Accessed February 17, 2011.

Clapp, R.B., R.C. Banks, D. Morgan-Jacobs, and W.A. Hoffman. 1982. Marine birds of the southeastern United States and Gulf of Mexico. U.S. Dept. of the Interior, Fish and Wildlife Service, Office of Biological Services, Washington, DC. FWS/OBS-82/01. 3 vols.

Clark, R.B. 1982. The impact of oil pollution on marine populations, communities, and ecosystems: A summing up. Philosophical Transactions of the Royal Society of London. B 297:433-443.

Clark, R.B. 1984. Impact of oil pollution on seabirds. Environmental Pollution Series A 33:1-22.

Clark, C.E. and J.A. Veil. 2009. Produced water volumes and management practices in the United States. Prepared by the Environmental Science Division, Argonne National Laboratory for the U.S. Dept. of Energy, Office of Fossil Energy, National Energy Technology Laboratory under Contract DE-AC02-06CH11357. ANL/EVS/R-09/1. Internet website: http://www.evs.anl.gov/pub/dsp_detail.cfm?PubID=2437.

Clarke, D.G. and D.H. Wilber. 2000. Assessment of potential impacts of dredging operations due to sediment resuspension. DOER Technical Notes Collection. ERDC TN-DOER-EP. U.S. Dept. of the Army, Research and Development Center, Vicksburg, MS.

Clausen, C.J. and J.B. Arnold III. 1975. Magnetic delineation of individual shipwreck sites; a new control technique. Bull. of the Texas Archaeological Soc. 46:69-86.

Cleveland, C. 2010. *Deepwater Horizon* oil spill. In: Hogan, C.M. and P. Saundry, eds. Encyclopedia of Earth. Washington, DC: Environmental Information Coalition, National Council for Science and the Environment. Internet website: http://www.eoearth.org/article/Deepwater_Horizon_oil_spill?topic=50364. Accessed May 18, 2011.

Clugston, J.P. 1991. Gulf sturgeon in Florida prey on soft-bodied macroinvertebrates. U.S. Dept. of the Interior, Fish and Wildlife Service. Research Information Bulletin No. 90-31. 2 pp.

Clugston, J.P., A.M. Foster, and S.H. Carr. 1995. Gulf sturgeon, *Acipenser onyrinchus desotoi*, in the Suwannee River, Florida, USA. In: Gershanovich, A.D. and T.I.J. Smith, eds. Proceedings of the International Symposium on Sturgeons, September 6- 11, 1993, Moscow, Russia. 370 pp.

Coastal Environments, Inc. (CEI). 1977. Cultural resources evaluation of the northern Gulf of Mexico continental shelf. Prepared for the U.S. Dept. of the Interior, National Park Service, Office of Archaeology and Historic Preservation, Interagency Archaeological Services, Baton Rouge, LA. 4 vols.

Coastal Environments, Inc. (CEI). 1982. Sedimentary studies of prehistoric archaeological sites. Prepared for the U.S. Dept. of the Interior, National Park Service, Division of State Plans and Grants, Baton Rouge, LA.

Coastal Response Research Center. 2007. Submerged oil—State of the practice and research needs. Prepared by the Coastal Response Research Center, Durham, NN. 29 pp. + app. Internet website: http://www.crrc.unh.edu/workshops/submerged_oil/submerged_oil_workshop_report.pdf. Accessed December 27, 2010.

Cohen, Y., A. Nissenbaum, and R. Eisler. 1977. Effects of Iranian crude oil on the Red Sea octocoral *Heteroxenia fuscescens*. Environmental Pollution 12:173-186.

Cole, K.L. and S.F. DiMarco. 2010. Low-frequency variability of currents in the deepwater eastern Gulf of Mexico. U.S. Dept. of the Interior, Minerals Management Service, Gulf of Mexico OCS Region, New Orleans, LA. OCS Study MMS 2010-015. 136 pp.

Coleman, F.C., G. Dennis, W. Jaap, C. Koenig, and S. Reed. 2009. The Florida Middle Grounds: Habitat area of particular concern. Florida State University, Coastal and Marine Laboratory, St. Teresa, FL. Internet website: http://www.bio.fsu.edu/coleman_lab/florida_middle_grounds. Accessed April 17, 2011.

Collard, S. 1990. Leatherback turtles feeding near a water mass boundary in the eastern Gulf of Mexico. Marine Turtle Newsletter 50:12-14.

Collard, S.B. and A. Lugo-Fernandez. 1999. Coastal upwelling and mass mortalities of fishes and invertebrates in the northeastern Gulf of Mexico during spring and summer 1998. U.S. Dept. of the Interior, Minerals Management Service, Gulf of Mexico OCS Region, New Orleans, LA. OCS Study MMS-99-0049. 20 pp.

Collett, T.S. 2002. Energy resource potential of natural gas hydrates. American Association of Petroleum Geologists Bulletin 86(11):1971-1992.

Collins, M.A. 1995. Dredging-induced near-filed resuspended sediment concentrations and source strengths. Final Report D-95-2. U.S. Dept. of the Army, Corps of Engineers. 229 pp.

Collins Center for Public Policy. 2010. Potential impacts of oil and gas explorations in the Gulf. A report to the Century Commission for a Sustainable Florida. 40 pp.

Conan, G. 1982. The long-term effects of the *Amoco Cadiz* oil spill. Philosophical Transactions of the Royal Society of London. Series B, Biological Sciences 297(1087). The long-term effects of oil pollution on marine populations, communities, and ecosystems. Pp. 323-333.

Conant, T.A., P.H. Dutton, T. Eguchi, S.P. Epperly, C.C. Fahy, M.H. Godfrey, S.L. MacPherson, E.E. Possardt, B.A. Schroeder, J.A. Seminoff, M.L. Snover, C.M. Upite, and B.E. Witherington. 2009. Loggerhead sea turtle (*Caretta caretta*) 2009 status review under the U.S. Endangered Species Act. Report of the Loggerhead Biological Review Team to the National Marine Fisheries Service, August 2009. 222 pp. Internet website: http://www.nmfs.noaa.gov/pr/pdfs/statusreviews/loggerheadturtle2009.pdf/. Accessed July 17, 2011.

Connor, M. 2010. US oil spill not sticking to bond issuers-Moody's. Internet website: http://www.xe.com/news/2010-11-22%2015:20:00.0/1539229.htm. Accessed December 8, 2010.

Continental Shelf Associates, Inc. (CSA). 1980. Video and photographic reconnaissance of Phleger and Sweet Banks, northwest Gulf of Mexico. Prepared for the U.S. Dept. of the Interior, Bureau of Land Management. Contract No. AA551-CT9-36.

Continental Shelf Associates, Inc. (CSA). 1988. Photodocumentation survey of Pulley Ridge Area Block 799, eastern Gulf of Mexico. Report prepared for Mobil Exploration & Producing U.S., Inc, New Orleans, LA. 37 pp.

Continental Shelf Associates, Inc. (CSA). 1990. Synthesis of available biological, geological, chemical, socioeconomic, and cultural resource information for the south Florida area. U.S. Dept of the Interior, Minerals Management Service, Gulf of Mexico OCS Region, New Orleans, LA. OCS Study MMS 90-0019. 727 pp.

Continental Shelf Associates, Inc. (CSA). 1992a. Mississippi-Alabama shelf pinnacle trend habitat mapping study. U.S. Dept. of the Interior, Minerals Management Service, Gulf of Mexico OCS Region, New Orleans, LA. OCS Study MMS 92-0026. 114 pp. + 2 plates.

Continental Shelf Associates, Inc. (CSA). 1992b. Preliminary report of potential effects of oil spilled from Texaco's proposed pipeline from Platform A in Garden Banks Block 189 to the subsea tie-in with High Island Pipeline System's (HIPS) existing pipeline in High Island Area Block A-377 (modified route). Prepared for Texaco Pipeline, Inc., Jupiter, FL.

Continental Shelf Associates, Inc. (CSA). 1994. Analysis of potential effects of oil spilled from proposed structures associated with Oryx's High Island Block 384 unit on the biota of the East Flower Garden Bank and on the biota of Coffee Lump Bank. Prepared for Oryx Energy Company, Jupiter, FL.

Continental Shelf Associates, Inc., (CSA). 1997a. Radionuclides, metals, and hydrocarbons in oil and gas operational discharges and environmental samples associated with offshore production facilities on the Texas/Louisiana continental shelf with an environmental assessment of metals and hydrocarbons: Prepared for the U.S. Dept. of Energy, Bartlesville, OK.

Continental Shelf Associates, Inc. (CSA). 1997b. Gulf of Mexico produced water bioaccumulation study: Definitive component technical report. Prepared for the Offshore Operators Committee. 258 pp.

Continental Shelf Associates, Inc. (CSA). 2000. Deepwater Gulf of Mexico environmental and socioeconomic data search and literature synthesis. Volume I: Narrative report. U.S. Dept. of the

Interior, Minerals Management Service, Gulf of Mexico OCS Region, New Orleans, LA. OCS Study MMS 2000-049. 340 pp.

Continental Shelf Associates, Inc. (CSA). 2004a. Geological and geophysical exploration for mineral resources on the Gulf of Mexico outer continental shelf: Final programmatic environmental assessment. U.S. Dept. of the Interior, Minerals Management Service, Gulf of Mexico OCS Region, New Orleans, LA. OCS EA/EIS MMS 2004-054. 466 pp.

Continental Shelf Associates, Inc. (CSA). 2004b. Gulf of Mexico comprehensive synthetic based muds monitoring program: Final report. Volume II: Technical. Prepared for SMB Research Group. 358 pp. Internet website: http://www.gomr.boemre.gov/PI/PDFImages/ESPIS/2/3051.pdf.

Continental Shelf Associates, Inc. (CSA). 2006a. Effects of oil and gas exploration and development at selected continental slope sites in the Gulf of Mexico. Volume II: Technical report. U.S. Dept. of the Interior, Minerals Management Service, Gulf of Mexico OCS Region, New Orleans, LA. OCS Study MMS 2006-045. 636 pp.

Continental Shelf Associates, Inc. (CSA). 2006b. Effects of oil and gas exploration and development at selected continental slope sites in the Gulf of Mexico. Volume I: Executive Summary. U.S. Dept. of the Interior, Minerals Management Service, Gulf of Mexico OCS Region, New Orleans, LA. OCS Study MMS 2006-044. 51 pp.

Continental Shelf Associates, Inc. (CSA) and Martel Laboratories, Inc. 1985. Florida Big Bend seagrass habitat study: Narrative report. U.S. Dept. of the Interior, Mineral Management Services, Gulf of Mexico Region, New Orleans, LA. OCS Study MMS 85-0088. Contract No. 14-12-0001-30188. 114 pp.

Continental Shelf Associates, Inc. (CSA) and Texas A&M University, Geochemical and Environmental Research Group (GERG). 2001. Mississippi/Alabama pinnacle trend ecosystem monitoring: Final synthesis report. U.S. Dept. of the Interior, Geological Survey, Biological Resources Division, USGS/BRD/CR-2001-0007 and Minerals Management Service, Gulf of Mexico OCS Region, New Orleans, LA. OCS Study MMS 2001-080. 415 pp. + apps.

Cook, C.B. and A.H. Knap. 1983. Effects of crude oil and chemical dispersant on photosynthesis in the brain coral *Diploria strigosa*. Marine Biology 78:21-27.

Corliss, J.B., J. Dymond, L. Gordon, J.M. Edmond, R.P. von Herzen, R.D. Ballard, K. Green, D. Williams, A. Bainbridge, K. Crane, and T.H. Van Adel. 1979. Submarine thermal springs on the Galapagos Rift. Science 203:1073-1083.

CoreLogic. 2010. New CoreLogic data shows the potential impact of the BP *Deepwater Horizon* oil spill on coastal real estate. Internet website: http://www.corelogic.com/About-Us/News/New-CoreLogic-Data-Shows-the-Potential-Impact-of-the-BP-Deepwater-Horizon-Oil-Spill-on-Coastal-Real-Estate.aspx. Accessed November 9, 2010.

Coston-Clements, L., L.R. Settle, D.E. Hoss, and F.A. Cross. 1991. Utilization of the Sargassum habitat by marine invertebrates and vertebrates, a review. U.S. Dept. of the Interior, National Marine Fisheries Service, NOAA, Southeast Fisheries Science Center, Beaufort Laboratory, Beaufort, NC. 32 pp.

Coulter, M.C., J.A. Rodgers, J.C. Ogden, and F.C. Depkin. 1999. Wood stork (*Mycteria americana*), the birds of North America online (A. Poole, ed.). Ithaca: Cornell Lab of Ornithology; retrieved from the Birds of North America online: http://bna.birds.cornell.edu/bna/species/409.

Council on Environmental Quality. 2010. Report regarding the Minerals Management Service's National Environmental Policy Act policies, practices, and procedures as they relate to Outer Continental Shelf oil and gas exploration and development, August 16, 2010. 41 pp. Internet website: http://www.whitehouse.gov/sites/default/files/microsites/ceq/20100816-ceq-mms-ocs-nepa.pdf.

Cowan, F.B.M. 1990. Does the lachrymal gland of *Malaclemys terrapin* have a significant role in osmoregulation? Canadian Journal of Zoology 68:1520-1524.

Cox, S.A., E.H. Smith, and J.W. Tunnell, Jr. 1997. Macronektonic and macrobenthic community dynamics in a coastal saltmarsh: Phase I. Prepared for Texas Parks and Wildlife Dept., Wildlife Division. TAMU-CC-9701-CCS. Corpus Christi, TX. 67 pp.

Cox, J., C. Coomes, S. DiMarco, K. Donohue, G.Z. Forristall, P. Hamilton, R.R. Leben, and D.R. Watts. In Press. Study of deepwater currents in the eastern Gulf of Mexico. U.S. Dept. of the Interior, Bureau of Ocean Energy Management, Regulation and Enforcement, Gulf of Mexico OCS Region, New Orleans, LA. OCS Study BOEMRE 2010-041. 473 pp.

Cranswick, D. 2001. Brief overview of Gulf of Mexico OCS oil and gas pipelines: Installation, potential impacts, and mitigation measures. U.S. Dept. of the Interior, Minerals Management Service, Gulf of Mexico OCS Region, New Orleans, LA. OCS Report MMS 2001-067. 19 pp.

Creef, E. 2011. Official communication. Concerning updates on dredged material placement and volume. U.S. Dept. of the Army, Corps of Engineers, Operations Division, New Orleans District, New Orleans, LA. June 15, 2011.

Cruz-Kaegi, M.E. 1998. Latitudinal variations in biomass and metabolism of benthic infaunal communities. Ph.D. Dissertation, Texas A&M University, College Station, TX.

Culter, J.K., K.B. Ricthie, S.A. Earle, D.E. Guggenheim, R.B. Halley, K.T. Ciembronowicz, A.C. Hine, B.D. Jarrett, S.D. Locker, W.C. Jaap. 2005. Pulley Reef: A deep photosynthetic coral reef on the West Florida Shelf, USA. 1 p. Springer-Verlag. Coral Reefs (2006) DOI 10.1007/s00338-006-0097-6. Internet website: http://isurus.mote.org/Keys/microbiology/CRPulfinal.pdf. Accessed December 17, 2010.

Cummins, J.L. 2005. The federal role in restoring private forest land after Hurricane Katrina. 10 pp. Internet website: http://www.growthevote.org/afpa/HouseResourcesCommitteeTestimony-Cummins.pdf. Accessed September 2006.

Cutter, S.L., L. Barnes, M. Berry, C.G. Burton, E. Evans, E.C. Tate, and J. Webb. 2008. Community and regional resilience: Perspectives from hazards, disasters, and emergency management. CARRI Research Report 1. Oak Ridge, TN: Community and Regional Resilience Institute. 33 pp. Internet website: http://www.resilientus.org/library/FINAL_CUTTER_9-25-08_1223482309.pdf. Accessed February 16, 2011.

Dahl, T.E. 1990. Wetlands losses in the United States 1780's to 1980's. U.S. Dept. of the Interior, Fish and Wildlife Service, Washington, DC. 21 pp.

Dale, D. and K. Santos. 2006. Gulf of Mexico habitat areas of particular concern. Internet website: http://sero.nmfs.noaa.gov/hcd/pdfs/efhdocs/gom_efhhapc_poster.pdf. Accessed November 18, 2011.

Dalton, M.S. and S.A. Jones, comps. 2010. Southeast regional assessment project for the National Climate Change and Wildlife Science Center, U.S. Geological Survey. U.S. Dept. of the Interior, Geological Survey, Reston, VA. Open-File Report 2010–1213. v + 38 pp. Internet website: http://serap.er.usgs.gov/docs/SerapOFR2010_1213.pdf.

Dames & Moore, Inc. 1979. Mississippi, Alabama, Florida outer continental shelf baseline environmental survey; MAFLA, 1977/78. Volume I-A. Program synthesis report. U.S. Dept. of the Interior, Bureau of Land Management, Washington, DC. BLM/YM/ES-79/01-Vol-1-A. 278 pp.

Dauterive, L.D. 2000. Rigs-to-Reefs policy, progress, and perspective. U.S. Dept. of the Interior, Minerals Management Service, Gulf of Mexico OCS Region, New Orleans, LA. OCS Report MMS 2000-073. 8 pp.

Davidson, C. 2010. The Gulf Coast cleans up: Oil spill seeps into many coastal concerns. EconSouth, third quarter. Federal Reserve Bank of Atlanta, Atlanta, GA. 5 pp. Internet website: http://www.frbatlanta.org/documents/pubs/econsouth/10_q3_oil_spill.pdf.

Davis, H.C. 1958. Survival and growth of clam and oyster larvae at different salinities. Biological Bulletin, Marine Biological Laboratory 114(3):296-307.

Davis, R.W. and G.S. Fargion, eds. 1996. Distribution and abundance of cetaceans in the north-central western Gulf of Mexico: Final report. Volume II: Technical report. U.S. Dept. of the Interior, Minerals Management Service, Gulf of Mexico OCS Region, New Orleans, LA. OCS Study MMS 96-0027. 355 pp.

Davis, R.W., W.E. Evans, and B. Würsig, eds. 2000. Cetaceans, sea turtles and seabirds in the northern Gulf of Mexico: Distribution, abundance and habitat associations. Volume II: Technical report. U.S. Dept. of the Interior, Geological Survey, Biological Resources Division, USGS/BRD/CR-1999-0006 and Minerals Management Service, Gulf of Mexico OCS Region, New Orleans, LA. OCS Study MMS 2000-003. 346 pp.

Davis, B., D.S. Etkin, M. Landry, and K. Watts. 2004. Determination of oil persistence: A historical perspective. In: Proceedings, Fifth Biennial Freshwater Spills Symposium. Internet website: http://www.environmental-research.com/erc_papers/ERC_paper_19.pdf.

Dawes, C.J., J. Andorfer, C. Rose., C. Uranowski, and N. Ehringer. 1997. Regrowth of seagrass *Thalassia testudinum* into propeller scars. Aquatic Botany 59:139-155.

Dawes, C.J., R.C. Phillips, and G. Morrison. 2004. Seagrass communities of the Gulf Coast of Florida: Status and ecology. Florida Fish and Wildlife Conservation Commission, Fish and Wildlife Research Institute and the Tampa Bay Estuary Program, St. Petersburg, FL. iv + 74 pp. Internet website: http://gulfsci.usgs.gov/gom_ims/pdf/pubs_fl.pdf.

De Leon, M.T. and L.M. Smith. 1999. Behavior of migrating shorebirds at North Dakota prairie potholes. Condor 101:645-654.

Dean, T.A. and S.C. Jewett. 2001. Habitat-specific recovery of shallow subtidal communities following the *Exxon Valdez* oil spill. Ecological Applications 11(5):1456-1471.

DeCort, T. 2010. Official communication. Gas release estimate for *Macondo*. September 14, 2010. U.S. Dept. of the Interior, Bureau of Ocean Energy Management, Regulation, and Enforcement, Gulf of Mexico OCS Region, Resource Evaluation, New Orleans, LA.

Defenbaugh, R.E. 1976. A study of the benthic macroinvertebrates of the continental shelf of the northern GOM. Unpublished Ph.D. dissertation, Texas A&M University, College Station, TX. 476 pp.

Delaune, R.D. and A.L. Wright. 2011. Projected impact of *Deepwater Horizon* oil spill on U.S. Gulf Coast wetlands. Soil Science Society of America(SSAJ) 75(5):September-October 2011.

DeLaune, R.D., W.H. Patrick, and R.J. Buresh. 1979. Effect of crude oil on a Louisiana *Spartina alterniflora* salt marsh. Environmental Pollution 20:21-31.

DeLaune, R.D., R.P. Gambrell, J.H. Pardue, and W.H. Patrick, Jr. 1990. Fate of petroleum hydrocarbons and toxic organics in Louisiana coastal environments. Estuaries 132(1):72-80.

Deleersnijder, E., J.M. Beckers, , and E.J.M. Delhez. 2006. The residence time of settling particles in the surface mixed layer. Environmental Fluid Mechanics 6:25-42.

Deming, J. and J. Baross. 1993. The early diagenesis of organic matter: Bacterial activity. In: Engel, M. and S. Macko, eds. Organic geochemistry. New York, NY: Plenum. Pp. 119-144.

den Hartog, C. and R.P.W.M. Jacobs. 1980. Effects of the “Amoco Cadiz” oil spill on an eelgrass community at Roscoff (France) with special reference to the mobile benthic fauna. Helgoländer Meeresunters 33:182-191.

Dennis, G.D. and T.J.Bright. 1988. Reef fish assemblages on hard banks in the northwestern Gulf of Mexico. Bulletin of Marine Science 43(2):280-307.

Denson, C. 2010. Official communication. Fish kills in Mobile Bay. Alabama Dept. of Environmental Management. September 28, 2010.

Det Norske Veritas (DNV). 2010. Energy report: Beaufort Sea drilling risk study. Prepared for Imperial Oil Resources Venture Limited. Rev. 6, March 2010.

Devers, W. 2010. Official communication. Email regarding Mississippi fish kill summary and Long Beach fish kill. Marine Fisheries Scientist, Mississippi Dept. of Marine Sciences. September 27, 2010.

Dezember, R. 2010. Safety eludes some oil workers. U.S. News, October 8, 2010. Internet website: http://online.wsj.com/article/SB10001424052748703466104575530132869455658.html. Accessed October 13, 2011.

Di Silvestro, R. 2006. When hurricanes hit habitat. National Wildlife Magazine. Aug/Sep 2006 44(5):5 pp.

Diaz, R.J. and A. Solow. 1999. Ecological and economic consequences of hypoxia. Topic 2 Report for the Integrated Assessment on Hypoxia in the Gulf of Mexico. U.S. Dept. of Commerce, NOAA Coastal Ocean Program, Silver Spring, MD. NOAA Coastal Ocean Program Decision Analysis Series No. 16. 45 pp.

Diercks, A-R., R.C. Highsmith, V.L. Asper, DJ. Joung, Z. Zhou, L. Guo, A.M. Shiller, S.B. Joye, A.P. Teske, N. Guinasso, T.L. Wade, and S.E. Lohrenz. 2010. Characterization of subsurface polycyclic aromatic hydrocarbons at the *Deepwater Horizon* site. Geophysical Research Letters 37:L20602, doi:10.1029/2010GL045046.

Digital Petrodata. 2010. Digital Petrodata. Internet website: http://www.scribd.com/doc/29413777/4-2010-Digital-Petrodata-BLM-STATE-MMS-Oil-Gas-Lease-Sale-Auction-2010-April. Accessed November 30, 2010.

Dinsdale, E.A. and V.J. Harriot. 2004. Assessing anchor damage on coral reefs: A case study in selection of environmental indicators. Environmental Management 33(1):126-139.

Dismukes, D.E. 2010. Official communication. E-mail entitled GOM employment observations. Associate Director, Louisiana State University, Center for Energy Studies, Baton Rouge, LA. December 8, 2010.

Dismukes, D. 2011. Official communication. Email regarding scenario projections. Associate Director, LSU Center for Energy Studies, Baton Rouge, LA. June 29, 2011.

Dismukes, D.E. In preparation-a. OCS-related infrastructure fact book. Volume I: Post-hurricane impact assessment. U.S. Dept. of the Interior, Bureau of Ocean Energy, Management, Regulation and Enforcement, Gulf of Mexico OCS Region, New Orleans, LA. OCS Study BOEMRE 2011-043.

Dismukes, D.E. In preparation-b. Fact book: Offshore oil and gas industry support sectors. U.S. Dept. of the Interior, Minerals Management Service, Gulf of Mexico OCS Region, New Orleans, LA. OCS Study BOEMRE 2010-042.

Dismukes, D.E., M. Barnett, D. Vitrano, and K. Strellec. 2007. Gulf of Mexico OCS oil and gas scenario examination: Onshore waste disposal. U.S. Dept. of the Interior, Minerals Management Service, Gulf of Mexico OCS Region, New Orleans, LA. OCS Report MMS 2007-051. 5 pp.

Dloughy, J.A. 2010. Government gives notice on abandoned platforms: Rule tells industry to dismantle 'idle iron' and plug old oil, gas wells. *Houston Chronicle*, September 15, 2010. Internet website: http://www.reefrelieffounders.com/drilling/2010/09/16/houston-chroniclegovernment-gives-notice-on-abandoned-platforms-rule-tells-industry-to-dismantle-idle-iron-and-plug-old-oil-gas-wells-dont-blame-bp-alone-for-spill-hayward/. Accessed March 1, 2011.

Dobbs, C.D. and J.M. Vozarik. 1983. Immediate effects of a storm on coastal infauna. Marine Ecology Progress Series 11:273-279.

Dodge, R.E. 1982. Effects of drilling mud on the reef-building coral *Montastrea annularis*. Marine Biology 71:141-147.

Dodge, R.E., R.C. Aller, and J. Thomson. 1974. Coral growth related to resuspension of bottom sediments. Nature 247:574-577.

Dodge, R.E., S.C. Wyers, A.H. Knap, H.R. Frith, T.D. Sleeter, and S.R. Smith. 1984. The effects of oil and oil dispersants on hermatypic coral skeletal growth (extension rate). Coral Reefs 3:191-198.

Doe, K.G. and P.G. Wells. 1978. Acute toxicity and dispersing effectiveness of oil spill dispersants: results of a Canadian oil dispersant testing program (1973 to 1977). In: McCarthy, Jr., L.T., G.P. Lindblom, and H.F. Walter, eds. Chemical dispersants for the control of oil spills. Philadelphia, PA: American Society for Testing and Materials. Pp. 50-65.

Doering, F., I.W. Duedall, and J.M. Williams. 1994. Florida hurricanes and tropical storms 1871-1993: An historical survey. Florida Institute of Technology, Division of Marine and Environmental Systems, Florida Sea Grant Program, Gainesville, FL. Technical Paper 71. 118 pp.

Dokka, R. 2006. Modern-day tectonic subsidence in coastal Louisiana. Geology 34(4):281-284.

Dokka, R.K., G.F. Sella, and T.H. Dixon. 2006. Tectonic control of subsidence and southward displacement of southeast Louisiana with respect to stable North America. American Geophysical Union, Geophysical Research Letters Volume 33, L23308. Internet website: http://www.ngs.noaa.gov/CORS/Articles/2006GL027250.pdf.

Donato, K.M. 2004. Labor migration and the deepwater oil industry. U.S. Dept. of the Interior, Minerals Management Service, Gulf of Mexico OCS Region, New Orleans, LA. OCS Study MMS 2004-057. 125 pp.

Donato, K.M., D.T. Robinson, and C.L. Bankston III. 1998. To have them is to love them: Immigrant workers in the offshore industry. Paper read at the Annual Meeting of the Latin American Studies Association, Chicago, IL, September 1998. 18 pp. (unnumbered Xerox).

Donohue, K., P. Hamilton, R. Leben, R.Watts, and E. Waddell. 2008. Survey of deepwater currents in the northwestern Gulf of Mexico. Volume II: Technical report. U.S. Dept. ofthe Interior, Minerals Management Service, Gulf of Mexico OCS Region, New Orleans,LA. OCS Study MMS 2008-031. 375 pp.

Dooley, J.K. 1972. Fishes associated with the pelagic Sargassum complex, with a discussion of the Sargassum community. Contrib. Mar. Science. 16:1-32.

Doran, K.S., N.G. Plant, H.F. Stockdon, A.H. Sallenger, and K.A. Serafin. 2009. Hurricane Ike: Observations of coastal change. U.S. Dept. of the Interior, Geological Survey, Reston, VA. Open-File Report 2009-1061. vi + 35 pp. Internet website: http://pubs.usgs.gov/of/2009/1061/pdf/ofr2009-1061.pdf.

Douglass, S.L., T.A. Sanchez, and S. Jenkins. 1999. Mapping erosion hazard areas in Baldwin County, Alabama, and the use of confidence intervals in shoreline change analysis. Journal of Coastal Research SI (28):95-105.

Dovel, W.L., A.W. Pekovitch, and T.J. Berggren. 1992. Biology of the shortnose sturgeon (*Acipenser brevirostrum* Lesueur, 1818) in the Hudson River estuary. In: Smith, C.L., ed. Estuarine research in the 1980's. Albany, NY: State University of New York Press.

Drewitt, A.L. and R.H.W. Langston. 2008. Collision effects of wind-power generators and other obstacles on birds. Annals of the New York Academy of Sciences 1134:233266.

Driver, A. 2010. Helix readying Gulf oil spill containment system. Reuters. December 8, 2010. Internet website: http://www.reuters.com/article/2010/12/08/spill-helix-idUSN0818292520101208. Accessed December 27, 2010.

Duarte, C.M., J.J. Middelburg, and N. Caraco. 2005. Major role of marine vegetation on the oceanic carbon cycle. Biogeosciences 2:1-8.

Dubois, S., C.G. Gelpi Jr., R.E. Condrey, M.A. Grippo, and J.W. Fleeger. 2009. Diversity and composition of macrobenthic community associated with sandy shoals of the Louisiana continental shelf. Biodiversity and Conservation 18(14):3759-3784.

Ducklow, H.W. and R. Mitchell. 1979. Composition of mucus released by coral reef Coelenterates. Limnology and Oceanography 24(2):706-714.

Dunne, R. and E. Miller. 2007. Post-release survival of oiled, rehabilitated waterfowl. In: Massey, J.G., ed. Proceedings of the Ninth International Effects of Oil on Wildlife Conference, Monterey, CA, 2007, University of California at Davis Wildlife Health Center, Davis.

Dunton, K.H., S.V. Shonberg, S. Herzka, P.A. Montagna, and S.A. Holt. 1998. Characterization of anthropogenic and natural disturbance on vegetated and nonvegetated bay bottom habitats in the Corpus Christi Bay National Estuarine Program Study Area. Volume II: Assessment of scarring in seagrass beds. CCBNEP-25B. 23 pp.

Durako, M.J., M.O. Hall, F. Sargent, and S. Peck. 1992. Propeller scars in sea grass beds: An assessment and experimental study of recolonization in Weedon Island State Preserve, Florida. In: Web, F., ed. Proceedings, 19th Annual Conference of Wetland Restoration and Creation. Hillsborough Community College, Tampa, FL. Pp. 42-53.

Eddleman, W.R., F.L. Knopf, B. Meanley, F.A. Reid, and R. Zembal. 1988. Conservation of North American rallids. Wilson Bulletin 100:458-475.

Eggleton, J. and K.V. Thomas. 2004. A review of factors affecting the release and bioavailability of contaminants during sediment disturbance events. Environment International 30:973-980.

Ehrhart, L.M. 1978. Choctawhatchee beach mouse. In: Layne, J.N., ed. Rare and endangered biota of Florida. Volume I: Mammals. Gainesville, FL: University Presses of Florida. Pp. 18-19.

Eisler, R. 1987. Polycyclic aromatic hydrocarbon hazards to fish, wildlife, and invertebrates: A synoptic review. U.S. Dept of the Interior, Fish and Wildlife Service, Patuxent Wildlife Research Center. Laurel, MD. Biological Report 85 (1.11). Contaminant Hazard Reviews Report No. 11.

Eleuterius, L.N. 1987. Seagrass ecology along the coasts of Alabama, Louisiana, and Mississippi. Florida Marine Research Publications, No. 42. Pp. 11-24.

Elgershuizen, J.H.B.W. and H.A.M. De Kruijf. 1976. Toxicity of crude oils and a dispersant to the stony coral *Madracis mirabilis*. Marine Pollution Bulletin 7(2):22-25.

Elliott-Smith, E., S.M. Haig, and B.M. Powers. 2009. Data from the 2006 International Piping Plover Census: U.S. Geological Survey Data Series 426. 332 pp.

Ellis, M.S., E.A. Wilson-Ormond, and E.N. Powell. 1996. Effects of gas-producing platforms on continental shelf macroepifauna in the northwestern Gulf of Mexico: Abundance and size structure. Canadian Journal of Fisheries and Aquatic Science 53:2589-2605.

Ellwood, B.B., W.L. Balsam, and H.H. Roberts. 2006. Gulf of Mexico sediment sources and sediment transport trends from magnetic susceptibility measurements of surface samples. Marine Geology 230:237-248.

Elsner, J.B., T.H. Jagger, M. Dickinson, and D. Rowe. 2008. Improving multiseason forecasts of North Atlantic hurricane activity. American Meteorological Society 21:1210-1219. Internet website: http://myweb.fsu.edu/jelsner/PDF/Research/ElsnerJaggerDickinsonRowe2008.pdf.

Ely, C.R., D.H. Ward, and K.S. Bollinger. 1999. Behavioral correlates of heart rates of free-living greater white-fronted geese. Condor 101:390-395.

Emery, W.J., K. Cherkauer, B. Shannon, and RW. Reynolds. 1997. Hull-mounted sea surface temperatures from ships of opportunity. American Meteorological Society, Boston, MA. Journal of Atmospheric and Oceanic Technology 14:1237-1251.

Energo Engineering. 2010. Assessment of damage and failure mechanisms for offshore structures and pipelines in Hurricanes Gustav and Ike. U.S. Dept. of the Interior, Minerals Management Service, Herndon, VA. TA&R 642.

Energy Resources Co., Inc. (ERCO). 1982. Ixtoc oil spill assessment: Final report. 3 vols. Prepared for the U.S. Dept. of the Interior, Bureau of Land Management, Gulf of Mexico OCS Region, New Orleans, LA. Contract No. AA851-CTO-71. Study Nos. 1982-34, 1982-35, and 1982-37.

Engel, J. and R. Kvitek. 1998. Effects of otter trawling on a benthic community in Monterey Bay National Marine Sanctuary. Conservation Biology 12(6):1204-1214.

Engle, V.D., J.L. Hyland, and C. Cooksey. 2008. Effects of Hurricane Katrina on benthic macroinvertebrate communities along the northern Gulf of Mexico coast. Environmental Monitoring Assessment 150:193-209.

English, C. 2010. BP Gulf spill: Mississippi Canyon Block 252 crude oil analysis. Wednesday, June 9, 2010. Internet website: http://blog.restek.com/?cat=3. Accessed June 30, 2010.

Enright, J.M., R. Gearhart II, D. Jones, and J. Enright. 2006. Study to conduct National Register of Historic Places evaluations of submerged sites on the Gulf of Mexico outer continental shelf. U.S. Dept. of the Interior, Minerals Management Service, Gulf of Mexico OCS Region, New Orleans, LA. OCS Study MMS 2006-036. 136 pp.

ENSR Corporation. 2004. Assessment of Alabama beach mouse habitat flooding on the Fort Morgan Peninsula using FEMA digital flood insurance rate map (DFIRM) and the Coastal Hazard Assessment Program.

Environmental Science & Research Limited. 1998. The effects of air pollution on New Zealand ecosystems: Review of national and international research: Technical report no. 1. Ministry for the Environment, New Zealand. 77 pp. Internet website: http://www.mfe.govt.nz/publications/air/research-review-jun98.pdf. Accessed February 12, 2007.

Epperly, S.P., J. Braun, A.J. Chester, F.A Cross, J.V. Merriner, P.A. Tester, and J.H. Churchill. 1996. Beach strandings as an indicator of at-sea mortality of sea turtles. Bulletin of Marine Science 59:289-297.

Erftemeijer, P.L.A. and R.R.R. Lewis III. 2006. Environmental impacts of dredging on seagrass: A review. Marine Pollution Bulletin 52:1553-1572.

Essink, K. 1999. Ecological effects of dumping of dredging sediments; options for management. Journal of Coastal Conservation 5(1):69-80.

Etkin, D.S. 2009. Analysis of U.S. oil spillage. American Petroleum Institute, Regulatory and Scientific Affairs Department. 86 pp. API Publication 356. Internet website: http://www.api.org/ehs/water/spills/upload/356-Final.pdf.

European Inland Fisheries Advisory Commission. 2010. Methodologies for assessing socioeconomic benefits of European inland recreational fisheries. EIFAC Occasional Paper No. 46.

European Wind Energy Association. 2011. The European offshore wind industry key trends and statistics 2010. 3 pp. Internet website: http://www.ewea.org/fileadmin/ewea_documents/documents/00_POLICY_document/Offshore_Statistics/110120_Offshore_stats_Exec_Sum.pdf.

Exxon Valdez Oil Spill Trust Council. 2010. Killer whales—recovery status. Internet website: http://www.evostc.state.ak.us/Recovery/status_orca.cfm. Accessed June 2011

Fabacher, D.L., J.M. Besser, C.J. Schmitt, J.C. Harshbarger, P.H. Peterman, and J.A. Lebo. 1991. Contaminated sediments from tributaries of the Great Lakes: chemical characterization and cancer-causing effects in medaka (*Oryzias latipes*). Arch. Environ. Contam. Toxic. 20:17-35.

Fanning, K., K.L. Carder, and P.R. Betzer. 1982. Sediment resuspension by coastal waters: A potential mechanism for nutrient re-cycling on the ocean's margins. Deep-Sea Research 29:953-965.

Farmer, A. and F. Durbian. 2006. Estimating shorebird numbers at migration stopover sites. Condor 108:792-807.

Fauchald, K. and P.A. Jamurs. 1979. The diet of worms: A study of polychaete feeding guilds. Oceanography and Marine Biology: An Annual Review 17:193-284.

Fedde, M.R. and W.D. Kuhlmann. 1979. Cardiopulmonary responses to inhaled sulfur dioxide in the chicken. Poultry Science 58:1584-1591.

Federal Register. 1997a. Hydrogen sulfide requirements for operations in the outer continental shelf. Final rule. 62 FR 17, pp. 3793-3800. Internet website: http://www.boemre.gov/federalregister/PDFs/h2sfr.pdf.

Federal Register. 1997b. Blowout preventer (BOP) testing requirements for drilling and completion operations. Proposed rule. July 15, 1997. 62 FR 135, pp. 37819-37824. Internet website: http://www.boemre.gov/federalregister/PDFs/BOPTesting.PDF.

Federal Register. 1998. Blowout preventer (BOP) testing requirements for drilling and completion operations. Final rule. June 1, 1998. 63 FR 104, pp. 29604-29608. Internet website: http://www.boemre.gov/federalregister/PDFs/Bop.pdf.

Federal Register. 1999. Rules and regulations, Department of the Interior, Fish and Wildlife Service 50 CFR Part 17: Endangered and threatened wildlife and plants; removal of the American peregrine falcon from the Federal list of endangered and threatened wildlife and removal of the similarity of appearance provision for free-flying peregrines in the conterminous United States. Final rule. August 25, 1999. 64 FR 164, pp. 46542-46558.

Federal Register. 2001. Rules and regulations, Department of the Interior, Fish and Wildlife Service, 50 CFR Part 17: Endangered and threatened wildlife and plants; final determinations of critical habitat for wintering piping plovers. Final rule. July 10, 2001. 66 FR 132, pp. 36037-36086.

Federal Register. 2005. 30 CFR Parts 250 and 282: Oil and gas and sulphur operations in the outer continental shelf—plans and information. Final rule. 70 FR 167, pp. 51478-51519. Internet website: http://frwebgate1.access.gpo.gov/cgi-bin/PDFgate.cgi?WAISdocID=PoRRmE/2/2/0&WAISaction=retrieve. Accessed July 15, 2011.

Federal Register. 2006a. Oil and gas and sulphur in the outer continental shelf (OCS)—Safety and Environmental Management Systems. Advanced notice of proposed rule. 71 FR 98, pp. 29277-29280. Internet website: http://edocket.access.gpo.gov/2006/pdf/E6-7790.pdf.

Federal Register. 2006b. Oil and gas and sulphur operations in the outer continental shelf—Incident reporting requirements. Final rule. 71 FR 73, pp. 19640-19646. Internet website: http://www.boemre.gov/federalregister/PDFs/AC57-4-17-06.pdf.

Federal Register. 2007. Rules and regulations, Department of the Interior, Fish and Wildlife Service, 50 CFR Part 17: Endangered and threatened wildlife and plants; removal of the bald eagle from the federal list of endangered and threatened wildlife. Final rule. July 9, 2007. 72 FR 130, pp. 37346-37372.

Federal Register. 2008. Record of decision for the final programmatic environmental impact statement for alternative energy development and production and alternate use of facilities on the outer continental shelf. January 10, 2007. 73 FR 7, pp. 1894-1895.

Federal Register. 2009a. Safety and environmental management systems for outer continental shelf oil and gas operations. Proposed rule. 74 FR 115, pp. 28639-28654. Internet website: http://www.gpo.gov/fdsys/pkg/FR-2009-06-17/pdf/E9-14211.pdf.

Federal Register. 2009b. Renewable energy and alternate uses of existing facilities on the outer continental shelf. Final rule. April 29, 2009. 74 FR 81, pp. 19638-19871.

Federal Register. 2009c. Fisheries of the Caribbean, Gulf of Mexico, and South Atlantic; reef fish fishery of the Gulf of Mexico; Gulf reef fish longline restriction. May 1, 2009. 74 FR 83, pp. 20229-

20230. Internet website: http://frwebgate2.access.gpo.gov/cgi-bin/PDFgate.cgi?WAISdocID=KK4pFy/2/2/0&WAISaction=retrieve. Accessed May 18, 2011.

Federal Register. 2009d. Rules and regulations, Department of the Interior Fish and Wildlife Service 50 CFR Part 17: Endangered and threatened wildlife and plants; removal of the brown pelican (*Pelecanus occidentalis*) from the federal list of endangered and threatened wildlife. Final rule. November 17, 2009. 74 FR 220, pp. 59443-59472.

Federal Register. 2010a. Oil and gas and sulphur operations in the outer continental shelf—Safety and environmental management systems. Final rule. 75 FR 63610-63654. Internet website: http://www.gpo.gov/fdsys/pkg/FR-2010-10-15/pdf/2010-25665.pdf.

Federal Register. 2010b. Oil and gas and sulphur operations in the outer continental shelf—Increased safety measures for energy development on the outer continental shelf. Interim final rule. 75 FR 198, pp. 63346-63377. Internet website: http://www.gpo.gov/fdsys/pkg/FR-2010-10-14/pdf/2010-25256.pdf.

Federal Register. 2010c. Outer Continental Shelf (OCS),Western and Central Planning Areas, Gulf of Mexico (GOM) oil and gas lease sales for the 2007-2012 5-Year OCS Program. November 10, 2010. 75 FR 217, pp. 69122-69123.

Federal Register. 2010d. Outer Continental Shelf (OCS), Western and Central Planning Areas, Gulf of Mexico (GOM) oil and gas lease sales for the 2007-2012 5-Year OCS Program. November 16, 2010. 75 FR 220, pp. 70023-70024.

Federal Register. 2010e. Approval and promulgation of air quality implementation plans; Louisiana; Baton Rouge 8-hour ozone nonattainment area; determination of attainment of the 8-hour ozone standard. Final rule. 75 FR 174, pp. 54778-54779. Internet website: http://edocket.access.gpo.gov/2010/pdf/2010-22338.pdf. Accessed May 11, 2011.

Federal Register. 2010f. Listing endangered and threatened wildlife and plants; 90-day finding on a petition to list bluefin tuna as threatened or endangered under the Endangered Species Act. Proposed rule. 50 CFR 223 and 224. Tuesday, September 21, 2010.

Federal Register. 2010g Cancellation of oil and gas Lease Sale 215 in the Western Planning Area on the outer continental shelf in the Gulf of Mexico. U.S. Dept. of the Interior, Bureau of Ocean Energy Management, Regulation and Enforcement. July 28, 2010. 75 FR 144, p. 44276. Internet website: http://edocket.access.gpo.gov/2010/pdf/2010-18425.pdf.

Federal Register. 2011a. Reorganization of Title 30: Bureaus of Safety and Environmental Enforcement and Ocean Energy Management. 30 CFR Chapters II and V. Direct Final Rule. Tuesday, October 18, 2011.

Federal Register. 2011b. Endangered and threatened wildlife and plants: Endangered Species Act listing determination for Atlantic bluefin tuna. June 1, 2011. 50 CFR 223 and 224. 76 FR 105, pp. 31556-31570.

Federal Reserve Bank of Atlanta. 2010. Gulf oil spill updates: July 21, 2010. Internet website: http://www.frbatlanta.org/rein/rein-resources/econ-impacts/gulfspill/2010-07-21.cfm. Accessed December 15, 2010.

Feldman, S. 2009. China beats US to offshore wind development. Internet website: http://solveclimate.com/news/20090403/china-beats-us-offshore-wind-development. Posted April 3, 2009. Accessed March 23, 2011.

Fenner, D. and K. Banks. 2004. Orange cup coral *Tubastraea coccinea* invades Florida and the Flower Garden Banks, northwestern Gulf of Mexico. Coral Reefs 23(4):505-507.

Fertl, D., A.J. Shiro, G.T. Regan, C.A. Beck, N. Adimey, L. Price-May, A. Amos, G.A.J. Worthy, and R. Crossland. 2005. Manatee occurrence in the northern Gulf of Mexico, west of Florida. Gulf and Caribbean Research 17:69-94.

Fingas, M. 1995. Oil spills and their cleanup. Chemistry and Industry. Internet website: http://findarticles.com/p/articles/mi_hb5255/is_n24/ai_n28664618/. Accessed December 23, 2010.

Fingas, M., F. Ackerman, P. Lambert, K. Li, Z. Wang, J. Mullin, L. Hannon, D. Wang, A. Steenkammer, R. Hiltabrand, R. Turpin, and P. Campagna. 1995. The Newfoundland offshore burn experiment: Further results of emissions measurement. In: Proceedings of the Eighteenth Arctic and Marine Oilspill Program Technical Seminar, Volume 2, June 14-16, 1995, Edmonton, Alberta, Canada. Pp. 915-995.

Fire in the Ice. 2009. Gulf of Mexico gas hydrate drilling and logging expedition underway. U.S. Dept. of Energy, National Energy Technology Laboratory, Methane Hydrate Newsletter. Spring 2009. Pp. 1-10. Internet website: http://www.netl.doe.gov/technologies/oil-gas/publications/Hydrates/Newsletter/MHNewsSpring09.pdf#Page=1.

Firmin, B. 2011. Official communication. Telephone conversation concerning raptors on the coast of the Gulf of Mexico. Biologist, U.S. Dept. of the Interior, Fish and Wildlife Service, Ecological Services Office, Lafayette, LA.

Fischel, M., W. Grip, and I.A. Mendelssohn. 1989. Study to determine the recovery of a Louisiana marsh from an oil spill. In: Proceedings, 1989 Oil Spill Conference. February 13-16, 1989, San Antonio, TX. Washington, DC: American Petroleum Institute. Pp. 383-387.

Fisher, C.R. 1995. Characterization of habitats and determination of growth rate and approximate ages of the chemosynthetic symbiont-containing fauna. In: MacDonald, I.R., W.W. Schroeder, and J.M. Brooks, eds. 1995. Chemosynthetic ecosystems study: Final report. Volume 2: Technical report. U.S. Dept. of the Interior, Minerals Management Service, Gulf of Mexico OCS Region, New Orleans, LA. OCS Study MMS 95-0022. Pp. 5.1-5.47.

Fisher, C. 2010a. The final dive. Lophelia II: Oil seeps and deep reefs. November 3, 2010, dive log. NOAA Ocean Explorer. Internet website: http://oceanexplorer.noaa.gov/explorations/10lophelia/logs/nov3/nov3.html. Accessed March 3, 2011.

Fisher, C. 2011. Official communication. Oil spill impact on deep-water coral communities and future directions. Presentation given at the Twenty-Sixth Gulf of Mexico Information Transfer Meeting, March 22-24, 2011. Sponsored by the U.S. Dept. of the Interior, Bureau of Ocean Energy Management, Regulation and Enforcement, Gulf of Mexico OCS Region, New Orleans, LA.

Fisher, W.L., L.F. Brown, Jr., J.H. McGowen, and C.G. Groat. 1973. Environmental geologic atlas of the Texas coastal zone: Beaumont-Port Arthur area. Austin, TX: The University of Texas at Austin, Bureau of Economic Geology.

Fisher, C.R., I. Urcuyo, M.A. Simpkins, and E. Nix. 1997. Life in the slow lane: Growth and longevity of cold-seep vestimentiferans. Marine Ecology 18:83-94.

Flemer, D.A., B.F. Ruth, and C.M. Bundrick. 2002. Effects of sediment type on macrobenthic infaunal colonization of laboratory microcosoms. Hydrobiologia 485:83-96.

Florida A&M University. 1988. Meteorological database and synthesis for the Gulf of Mexico. U.S. Dept. of the Interior, Minerals Management Service, Gulf of Mexico OCS Region, New Orleans, LA. OCS Study MMS 89-0064. 430 pp.

Florida Dept. of Environmental Protection and U.S. Dept. of Commerce, National Oceanic and Atmospheric Administration. 2000. Final restoration plan/environmental assessment for the August 10, 1993 Tampa Bay oil spill. Volume 2: Human use and recreational injuries. 52 pp.

Florida Fish and Wildlife Conservation Commission. 2008. FAQs: Sea turtles and hurricanes. Internet website: http://myfwc.com/Newsroom/Resources/News_Resources_SeaTurtlesAndHurricanes.htm. Accessed September 5, 2008.

Florida Fish and Wildlife Conservation Commission. 2009. Florida's wildlife: On the front line of climate change. Climate Change Summit Report. 40 pp. Internet website: http://www.ces.fau.edu/floc/agenda.php. Accessed October 31, 2011.

Florida Fish and Wildlife Conservation Commission. 2010a. FWC FWRI manatee mortality statistics, 2010. Internet website. http://myfwc.com/media/1329325/2010_cumulative_category_summary09jun_2011.pdf. Accessed July 11, 2011.

Florida Fish and Wildlife Conservation Commission. 2010b. Index nesting beach survey totals (1989-2010). Internet website: http://www.myfwc.com/research/wildlife/sea-turtles/nesting/beach-survey-totals-1989-2010/. Accessed April 13, 2011.

Florida Fish and Wildlife Conservation Commission. 2010c. A good nesting season for loggerheads in 2010 does not reverse a recent declining trend. Internet website: http://www.myfwc.com/research/wildlife/sea-turtles/nesting/2010/. Accessed April 13, 2011.

Florida Fish and Wildlife Conservation Commission. 2010d. Saltwater fishing regulations. Internet website: http://myfwc.com/fishing/saltwater/regulations/. Accessed April 15, 2011.

Fodrie, F.J. and K.L. Heck, Jr. 2011. Response of coastal fishes to the Gulf of Mexico oil disaster. PLoS ONE 6(7):e21609. doi:10.1371/journal.pone.0021609.

Foley, B. 2010. Impact of fishing on shipwrecks: In: Archaeology in deep water. Woods Hole Oceanographic Institution, Woods Hole, MA. Internet website: http://www.whoi.edu/sbl/liteSite.do?litesiteid=2740&articleId=4965. Accessed August 31, 2010.

Ford, B., A. Borgens, W. Bryant, D. Marshall, P. Hitchcock, C. Arias, and D. Hamilton. 2008. Archaeological excavation of the Mardi Gras shipwreck (16GM01), Gulf of Mexico continental slope. U.S. Dept. of the Interior, Minerals Management Service, Gulf of Mexico OCS Region, New Orleans, LA. OCS Report MMS 2008-037. 313 pp.

Fourqurean, J.W. and L.M. Rutten. 2004. The impact of Hurricane Georges on soft-bottom, back reef communities: Site-and species-specific effects in south Florida seagrass beds. Bulletin of Marine Science 75(2):239-257.

Fowler, G.S., J.C. Wingfield, and P.D. Boersma. 1995. Hormonal and reproductive effects of low levels of petroleum fouling in Magellanic penguins (*Spheniscus magellancus*). Auk 112:382-389.

Fox, D.A. and J.E. Hightower. 1998. Gulf sturgeon estuarine and nearshore marine habitat use in Choctawhatchee Bay, Florida. Annual Report for 1998 to the U.S. Dept. of Commerce, National Marine Fisheries Service and the U.S. Dept. of the Interior, Fish and Wildlife Service, Panama City, FL. 29 pp.

Fox, D.A., J.E. Hightower, and F.M. Parauka. 2000. Gulf sturgeon spawning migration and habitat in the Choctawhatchee River System, Alabama-Florida. Transactions of the American Fisheries Society 129:811-826.

Fox, D.A., J.E. Hightower, and F.M. Parauka. 2002a. Estuarine and nearshore marine habitat use by Gulf sturgeon from the Choctawhatchee River System, Florida. American Fisheries Society Symposium 28:111-126.

Fox, D.A., J.E. Hightower, and F.M. Parauka. 2002b. Estuarine and nearshore marine habitat use by Gulf sturgeon from the Choctawhatchee River System, Florida. American Fisheries Society Symposium 00:19-34.

Frank, D.J., W. Sackett, R. Hall, and A. Fredericks. 1970. Methane, ethane, and propane concentrations in the Gulf of Mexico. American Association of Petroleum Geologist Bulletin 54:1933-1938.

Fraser G.S. and J. Ellis. 2008. Offshore hydrocarbon and synthetic hydrocarbon spills in eastern Canada: The issue of follow-up and experience. Journal of Environmental Assessment Policy and Management 10(2):173-187. June 2008.

Fraser, G.S., J. Russell, and W.M. von Zharen. 2006. Produced water from offshore oil and gas installations on the Grand Banks, Newfoundland and Labrador: Are the potential effects to seabirds sufficiently known? Marine Ornithology 34:147-156.

Frater, B. 2010. Official communication. Email regarding possible impact of cleanup relating to the *Deepwater Horizon* incident on possible beach mouse habitat in Florida. Biologist, U.S. Dept. of the Interior, Fish and Wildlife Service, Ecological Services Office, Panama City, FL. October 19, 2010.

Frater, B. 2011. Email regarding preliminary data for the impact of shoreline cleanup for the BP spill on beach mice. Restoration Specialist, U.S. Dept. of the Interior, Fish and Wildlife Service, Deepwater Horizon NRDAR Field Office, Fairhope, AL. September 1, 2011.

Frazier, D.E. 1967. Recent deltaic deposits of the Mississippi River: Their development and chronology. In: Sandridge, J.R., ed. Transactions Gulf Coast Association of Geological Societies, San Antonio, TX, 27:287-315. Internet website: http://search.datapages.com/data/gcags/data/017/017001/pdfs/0287.pdf.

Frederick, P.C. and J.C. Ogden. 1997. Philopatry and nomadism: Contrasting long-term movement behavior and population dynamics of white ibises and wood storks. Colonial Waterbirds 20:316-323.

Frederick, P.C. and K.D. Meyer. 2008. Longevity and size of wood stork (*Mycteria americana*) colonies in Florida as guides for an effective monitoring strategy in the southeastern United States. Waterbirds 31 (Special Publication 1):12-198.

Freese, L., P.J. Auster, J. Heifetz, and B.L. Wing. 1999. Effects of trawling on seafloor habitat and associated invertebrate taxa in the Gulf of Alaska. Marine Ecology Progress Series 182:119-126.

French-McCay, D.P. 2004. Oil spill impact modeling: Development and validation. Environmental Toxicology and Chemistry 23(10):2441-2456.

Frid, A. and L.M. Dill. 2002. Human-caused disturbance stimuli as a form of predation risk. Conservation Ecology 6:11. Internet website: http://www.consecol.org/vol6/iss1/art11/.

Frithsen, J.B., R. Elmgren, and D.T. Rudnick. 1985. Responses of benthic meiofauna to long-term, low-level additions of No. 2 fuel oil. Marine Ecology Progress Series 23:1-14.

Fritts, T.H., A.B. Irvine, R.D. Jennings, L.A. Collum, W. Hoffman, and M.A. McGehee. 1983. Turtles, birds, and mammals in the northern Gulf of Mexico and nearby Atlantic waters. U.S. Dept. of the Interior, Fish and Wildlife Service, Division of Biological Services, Washington, DC. FWS/OBS-82/65. 455 pp.

Fry, D.M., J. Swenson, L.A. Addiego, C.R. Grau, and A. Kang. 1986. Reduced reproduction of wedge-tailed shearwaters exposed to weathered Santa Barbara crude oil. Archives of Environmental Contamination and Toxicology 15:453-463.

Fry, D.M., S.I. Fefer, and L. Sileo. 1987. Ingestion of plastic debris by laysan albatross and wedge-tailed shearwaters in the Hawaiian islands. Marine Pollution Bulletin 18(6B):339-343.

Fucik, K.W., T.J. Bright, and K.S. Goodman. 1984. Measurements of damage, recovery, and rehabilitation of coral reefs exposed to oil. In: Cairns, J. and A.L. Buikema, Jr., eds. Restoration of habitats impacted by oil spills. Boston, MA: Butterworth Publishers. 1984.

Fucik, K.W., K.A. Carr, and B.J. Balcom. 1995. Toxicity of oil and dispersed oil to the eggs and larvae of seven marine fish and invertebrates from the Gulf of Mexico. In: Lane, P., ed. The use of chemicals in oil spill response. STP 1252. Ann Arbor, MI. Pp. 135-171.

Gabe, T., G. Falk, M. McCarty, and V.W. Mason. 2005. Hurricane Katrina: Social-demographic characteristics of impacted areas; November 4, 2005. Congressional Research Service Report for Congress. 35 pp. Internet website: http://gnocdc.s3.amazonaws.com/reports/crsrept.pdf. Accessed February 17, 2011.

Gagliano, S.M. 1999. Faulting, subsidence and land loss in coastal Louisiana. In: Louisiana Coastal Wetlands Conservation and Restoration Task Force and Wetlands Conservation and Restoration Authority, Coast 2050: Toward a Sustainable Coastal Louisiana, Appendix B—Technical methods, Louisiana Dept. of Natural Resources, Baton Rouge, LA.

Gagliano, S.M. 2005a. Effects of earthquakes, fault movements, and subsidence on the south Louisiana landscape. Reprinted from The Louisiana Civil Engineer, Journal of the Louisiana Section of The American Society of Civil Engineers, Baton Rouge, LA. February 2005, 13(2):5-7, 19-22. Internet website: http://www.coastalenv.com/EffectofEarthquakeFaultMovementsandSubsidence.pdf.

Gagliano, S.M. 2005b. Effects of natural fault movement on land submergence in coastal Louisiana. Proceedings, 14th Biennial Coastal Zone Conference, New Orleans, LA, July 17-21, 2005. 5 pp.

Gallaway, B.J. 1981. An ecosystem of oil and gas development on the Texas-Louisiana continental shelf. U.S. Dept. of the Interior, Fish and Wildlife Service, Office of Biological Services, Washington, DC. FWS/OBS-81/27. 89 pp.

Gallaway, B.J. and G.S. Lewbell. 1982. The ecology of petroleum platforms in the northwestern Gulf of Mexico: A community profile. U.S. Dept. of the Interior, Fish and Wildlife Service, Office of Biological Services, Washington, DC. FWS/OBS-82/27. Bureau of Land Management, Gulf of Mexico OCS Regional Office, New Orleans, LA. Open-File Report 82-03. xiv + 92 pp.

Gallaway, B.J. and M.C. Kennicutt II. 1988. Chapter 2. The characterization of benthic habitats of the northern Gulf of Mexico. In: Gallaway, B.J., ed. Northern Gulf of Mexico continental slope study, final report: Year 4. Vol. II: Synthesis report. U.S. Dept. of the Interior, Minerals Management Service, Gulf of Mexico OCS Region, New Orleans, LA. OCS Study MMS 88-0053. Pp. 2-1 to 2-45.

Gallaway, B.J., L.R. Martin, and R.L. Howard, eds. 1988. Northern Gulf of Mexico continental slope study, annual report: Year 3. Volume II: Technical narrative. U.S. Dept. of the Interior, Minerals Management Service, Gulf of Mexico OCS Region, New Orleans, LA. OCS Study MMS 87-0060. 586 pp.

Gallaway, B.J., J.G. Cole, and R.G. Fechhelm. 2003. Selected aspects of the ecology of the continental slope fauna of the Gulf of Mexico: A synopsis of the northern Gulf of Mexico continental slope study, 1983-1988. U.S. Dept. of the Interior, Minerals Management Service, Gulf of Mexico OCS Region, New Orleans, LA. OCS Study MMS 2003-072. 44 pp.

Ganning, B., D.J. Reish, and D. Straughan. 1984. Recovery and restoration of rocky shores, sandy beaches, tidal flats, and shallow subtidal bottoms impacted by oil spill. In: Cairns, J., Jr. and A.L. Buikema, Jr., eds. Restoration of habitats impacted by oil spills. Boston, MA.

Gardner, J.V., L.A. Mayer, J.E. Hughes Clarke, and A. Kleiner. 1998. High-resolution multibeam bathymetry of East and West Flower Gardens and Stetson Banks, Gulf of Mexico. Gulf of Mexico Science 16:131-143.

Gardner, J.V., P. Darnell, and K.J. Sulak. 2002a. Multibeam mapping of the pinnacles region, Gulf of Mexico. U.S. Dept. of the Interior, Geological Survey. Open File Report 02-006. Internet website: http://geopubs.wr.usgs.gov/open-file/of02-006/. Accessed September 20, 2010.

Gardner, J.V., J.D. Beaudoin, J.E. Hughes Clarke, and P. Dartnell. 2002b. Multibeam mapping of selected areas of the outer continental shelf, northwestern Gulf of Mexico—Data, images, and GIS. U.S. Dept. of the Interior, Geological Survey. Open File Report 02-411. Internet website: http://geopubs.wr.usgs.gov/open-file/of02-411/index.html. Accessed September 9, 2010.

Garrison, E.G., C.P. Giammona, F.J. Kelly, A.R. Tripp, and G.A. Wolf. 1989. Historic shipwrecks and magnetic anomalies of the northern Gulf of Mexico: Reevaluation of archaeological resource management. Volume II: Technical narrative. U.S. Dept. of the Interior, Minerals Management Service, Gulf of Mexico OCS Region, New Orleans, LA. OCS Study MMS 89-0024. 241 pp.

Garza, M.D., A. Prada, M. Marela and M.X. Vasquez Rodruguez. 2009. Indirect assessment of economic damages from the *Prestige* oil spill: Consequences for liability and risk prevention. Disasters 2009.

Gaston, G.R., C.F. Rakocinski, S.S. Brown, and C.M. Cleveland. 1998. Trophic function in estuaries: Response of macrobenthos to natural and contaminant gradients. Marine and Freshwater Research. 49:833-846.

Gearhart II, R., D. Jones, A. Borgens, S. Laurence, T. DeMunda, and J. Shipp. In press. Impacts of recent hurricane activity in historic shipwrecks in the Gulf of Mexico outer continental shelf. U.S. Dept. of the Interior, Bureau of Ocean Energy Management, Regulation and Enforcement, Gulf of Mexico OCS Region, New Orleans, LA. OCS Study BOEMRE 2011-003.

Gentner, B. and S. Steinback. 2008. The Economic contribution of marine angler expenditures in the United States, 2006. U.S. Dept. of Commerce, NOAA Technical Memorandum NMFS F/SPO-94.

Gentner Consulting Group. 2010. Economic impacts of recreational fishing closures resulting from the *Deep Horizon* oil spill: Preliminary estimates. Internet website: http://www.keepamericafishing.org/-/pdf/econimpactsgulfoil2.pdf.

Geoscience Earth & Marine Services, Inc. 2005. Integrated study of the Great White Development Area, Blocks 813, 814, 857, and 858, Alaminos Canyon Area, Gulf of Mexico. Report for Shell Offshore, Inc. Project No. 0105-945d.

Georgi, A. 1993. The status of Kootenai River white sturgeon. Report of Don Chapman Consultants, Inc. to Pacific Northwest Utilities Conference Committee, Portland, OR.

Geraci, J.R. and D.J. St. Aubin. 1980. Offshore petroleum resource development and marine mammals: A review and research recommendations. Marine Fisheries Review 42:1-12.

Geraci, J.R. and D.J. St. Aubin, eds. 1990. Sea mammals and oil: Confronting the risks. San Diego, CA: Academic Press, Inc. 282 pp.

Getter, C.D., G. Cintron, B. Kicks, R.R. Lewis III, and E.D. Seneca. 1984. The recovery and restoration of salt marshes and mangroves following an oil spill. In: Cairn, J., Jr. and A.L. Buikema, Jr., eds. Restoration of habitats impacted by oil spills. Boston, MA: Butterworth Publishers, Ann Arbor Science Book. Pp. 65-104.

Gibson, D.J., and P.B. Looney. 1994. Vegetation colonization of dredge spoil on Perdido Key, Florida. Journal of Coastal Research 10:133-134.

Gilbert, D. 2011. New scrutiny slams near shore exploration. *The Wall Street Journal*. Internet website: http://online.wsj.com/article/SB10001424052970204204004576050442684314836.html?KEYWORDS=new+scrutiny+slams+near-shore+exploration. Posted January 3, 2011. Accessed January 4, 2011.

Gill, J.A., K. Norris, and W.J. Sutherland. 2001. Why behavioural responses may not reflect the population consequences of human disturbance. Biological Conservation 97:265-268.

Gitschlag, G.R., J.S. Schrripa, and J.E. Powers. 2000. Estimation of fisheries impacts due to underwater explosives used to sever and salvage oil and gas platforms in the U.S. Gulf of Mexico. U.S. Dept. of the Interior, Minerals Management Service, Gulf of Mexico OCS Region, New Orleans, LA. OCS Study MMS 2000-087. 80 pp.

Gittings, S.R., comp. 2006. Conservation science in NOAA's National Marine Sanctuaries: Description and recent accomplishments. U.S. Dept. of Commerce, National Oceanic and Atmospheric Administration, Office of National Marine Sanctuaries, Silver Spring, MD. Marine Sanctuaries Conservation Series ONMS-06-04. 30 pp. Internet website: http://sanctuaries.noaa.gov/science/conservation/pdfs/accomplishments.pdf.

Gittings, S.R., T.J. Bright, W.W. Schroeder, W.W. Sager, J.S. Laswell, and R. Rezak. 1992a. Invertebrate assemblages and ecological controls on topographic features in the northeast Gulf of Mexico. Bulletin of Marine Science 50(3):435-455.

Gittings, S.R., G.S. Boland, K.J.P. Deslarzes, C.L. Combs, B.S. Holland, and T.J. Bright. 1992b. Mass spawning and reproductive viability of reef corals at the East Flower Garden Bank, northwest Gulf of Mexico. Bulletin of Marine Science 51(3):420-428.

Gittings, S.R., G.S. Boland, K.J.P. Deslarzes, D.K. Hagman, and B.S. Holland. 1992c. Long-term monitoring at the East and West Flower Garden Banks. U.S. Dept. of the Interior, Minerals Management Service, Gulf of Mexico OCS Region, New Orleans, LA. OCS Study MMS 92-0006. 206 pp.

Gittings, S.R., G.S. Boland, C.R.B. Merritt, J.J. Kendall, K.J.P. Deslarzes, and J. Hart. 1994. Mass spawning by reef corals in the Gulf of Mexico and Caribbean Sea. A Report on Project Reef Spawn '94. Flower Gardens Fund Technical Series Report Number 94-03.

Gobert, A. 2010. OCS pipelines (DOT jurisdiction) that terminate onshore Louisiana. Excel spreadsheet provided by Angie Gobert, Field Operations, to Perry Boudreaux, Leasing and Environment, Gulf of Mexico Region, Bureau of Ocean Energy Management, Regulation and Enforcement by e-mail on April 2, 2010.

Godish, T. 1991. Air quality. 2nd ed. Michigan: Lewis Publishers, Inc. 422 pp.

Goh, B.P.L. and C.S. Lee. 2008. A study of the effect of sediment accumulation on the settlement of coral larvae using conditioned tiles. In: Proceedings of the 11th International Reef Symposium. July 7-11, 2008. Session No. 24. Fort Lauderdale, FL.

Gómez Gesteira, J.L. and J.C. Dauvin. 2000. Amphipods are good bioindicators of the impact of oil spills on soft-bottom macrobenthic communities. Marine Pollution Bulletin 40(11):1017-1027.

Gonzalez, A. 2010. U.S. gas boom orphans LNG. *The Wall Street Journal*. October 22, 2010. Internet website: http://online.wsj.com/article/SB10001424052702304023804575566570816389914.html. Accessed March 1, 2011.

Good, B., J. Buchtel, D. Meffert, J. Radford, K. Rhinehart, and R. Wilson. 1995. Louisiana's major coastal navigation channels. Louisiana Dept. of Natural Resources, Baton Rouge, LA. 35 pp. Internet website: http://dnr.louisiana.gov/crm/D%20R%20S%20Reports/General/La.%20Navigation%20Channels/Channels_1.pdf.

Gordon, J.C.D., D. Gillespie, L.E. Rendell, and R. Leaper. 1996. Draft report on playback of ATOC like sounds to sperm whales (*Pheseter macrocephalus*) off the Azores. Wildlife Conservation Research Unit, Dept. of Zoology, Oxford, UK.

Gordon, S. 2011. Official communication. Email with slide presentation to the Mississippi Commission on Marine Resources (Mississippi Oyster Mortality), July 19, 2011.

Gore, R.H. 1992. The Gulf of Mexico. Pineapple Press, Florida.

Gosselink, J.G., C.L. Cordes, and J.W. Parsons. 1979. An ecological characterization study of the Chenier Plain coastal ecosystem of Louisiana and Texas. 3 vols. U.S. Dept. of the Interior, Fish and Wildlife Services. FWS/OBS-78/9 through 78/11.

Gower, J. and S. King. 2008. Satellite images show the movement of floating Sargassum in the Gulf of Mexico and Atlantic Ocean. Nature Precedings: hdl:10101/npre.2008.1894.1.

Gower, J., C. Hu, G. Borstad, and S. King. 2006. Ocean color satellites show extensive lines of floating Sargassum in the Gulf of Mexico. IEEE Trans. Deosci. Rem. Sens. 44(12):3619-3625.

Graham, P. 1981. Status of white sturgeon in the Kootenai River. Montana Dept. of Fish, Wildlife, and Parks, Kalispell, MT.

Gramling, R. 1984a. Housing in the coastal zone parishes. In: Gramling, R.B. and S. Brabant, eds. The role of outer continental shelf oil and gas activities in the growth and modification of Louisiana's coastal zone. U.S. Dept. of Commerce, National Oceanic and Atmospheric Administration and Louisiana Dept. of Natural Resources, Lafayette, LA. Interagency Agreement NA-83-AA-D-CZ025; 21920-84-02. Pp. 127-134.

Gramling, R. 1984b. Offshore oil and gas activity and its socioeconomic and environmental influences. United States House of Representatives Subcommittee on Panama Canal/Outer Continental Shelf. Serial No. 98 37, p. 302. Washington, DC: U.S. Government Printing Office.

Greater New Orleans, Inc. 2011. A study of the economic impact of the *Deepwater Horizon* oil spill.

Green, A. 2008. Facing the facts: A literacy forecast for Texas. Texas Workforce Commission. 4 pp. Internet website: http://www.twc.state.tx.us/svcs/adultlit/facing_facts.pdf.

Green, M.M., 2006. Coastal restoration annual project reviews, December 2006. Louisiana Dept. of Natural Resources, Baton Rouge, LA. 116 pp. Internet website: http://lacoast.gov/reports/apr/2006%20Coastal%20Restoration%20Annual%20Project%20Reviews.pdf.

Greenberg, J. 2011. OSV day rates. Workboat. May 2011, 68(5).

Greene, C.R. 1986. Underwater sounds from the semisubmersible drill rig SEDCO 708 drilling in the Aleutian Islands. Section 1. Washington, DC: American Petroleum Institute. API Publication 4438. 69 pp.

Greene, G., C. Moss, and T. Spreen. 1997. Demand for recreational fishing in Tampa Bay, Florida: A random utility approach. Marine Resource Economics 12:293-305.

Grey, E.K., C. Taylor, S. Chiasson, L. Koplitz, D.A. Grimm, and J. Sinski. 2011a. Assessing the effects of the *Deepwater Horizon* oil spill on blue crab, *Callinectes sapidus*, megalope: Abstract. In: Proceedings of the 40th Benthic Ecology Meeting, Mobile, AL, March 16-20, 2011.

Grey, E.K., C. Taylor, S. Chiasson, L. Koplitz, D.A. Grimm, and J. Sinski. 2011b. Assessing the effects of the *Deepwater Horizon* oil spill on blue crab, *Callinectes sapidus*, Megalope. Presentation given at the 40th Benthic Ecology Meeting, Mobile, AL, March 16-20, 2011.

Grigg, R.W. 1977. Population dynamics of two gorgonian corals. Ecology 58:278-290.

Grimm, D.E. and T.S. Hopkins. 1977. Preliminary characterization of the octocorallian and scleractinian diversity at the Florida Middle Ground. Proceedings, Third International Coral Reef Symposium, Miami, FL. 1:135-141.

Guillen, G., G. Boland, D. Breeding, K. Deslarzes, A. Lugo-Fernandez, and B. Rogers. 1999. Proposed MMS oil spill mitigation policy dealing with the Flower Garden Bank (FGB). Flower Garden Oil Spill Mitigation Work Group, December 16, 1999 Submitted to Dennis Chew, LE Mitigation Team Member and NEPA Unit Chief.

Gulf Coast Claims Facility. 2010a. Program statistics & overall summary, and state status reports. Internet website: http://www.gulfcoastclaimsfacility.com/reports. Accessed November 27, 2010.

Gulf Coast Claims Facility. 2010b. Program frequently asked questions. Internet website: http://gulfcoastclaimsfacility.com/faq#Q11. Accessed November 2010.

Gulf of Mexico Alliance. 2009a. Gulf of Mexico Alliance water quality. Internet website: http://gulfofmexicoalliance.org/issues/welcome.html. Last updated June 2, 2009. Accessed March 15, 2010.

Gulf of Mexico Alliance. 2009b. Gulf of Mexico Alliance priority issues. Internet website: http://gulfofmexicoalliance.org/issues/welcome.html. Last updated June 2, 2009. Accessed March 15, 2010.

Gulf of Mexico Fishery Management Council (GMFMC). 2005. Generic amendment number 3 for addressing essential fish habitat requirements, habitat areas of particular concern, and adverse effects of fishing in the following fishery management plans of the Gulf of Mexico: shrimp fishery of the Gulf of Mexico, United States waters red drum fishery of the Gulf of Mexico, reef fish fishery of the Gulf of Mexico coastal migratory pelagic resources (mackerels) in the Gulf of Mexico and South Atlantic, stone crab fishery of the Gulf of Mexico, spiny lobster in the Gulf of Mexico and South Atlantic, coral and coral reefs of the Gulf of Mexico. Gulf of Mexico Fishery Management Council, Tampa, FL.

Gulf of Mexico Fishery Management Council (GMFMC). 2010a. Federal fishing rules for the Gulf of Mexico. Internet website: http://www.gulfcouncil.org/fishrules.htm. Accessed August 5, 2010.

Gulf of Mexico Fishery Management Council (GMFMC). 2010b. Supplemental recreational red snapper season to open October 1, 2010. Internet website: http://www.gulfcouncil.org/news_resources/Press%20Releases/2010RedSnapperReopening.pdf.

Gulf of Mexico Fishery Management Council (GMFMC). 2011a. Memo to Gulf Coast Ecosystem Restoration Task Force: Guidance for future restoration efforts. 6 pp. Internet website: http://www.gulfcouncil.org/docs/Gulf%20Council%20oil%20spill%20restoration%20research%20priorities.pdf. Accessed October 18, 2011.

Gulf of Mexico Fishery Management Council (GMFMC). 2011b. Recreational fishing regulations for Gulf of Mexico federal waters. Internet website: http://www.gulfcouncil.org/Beta/GMFMCWeb/downloads/rec_brochure_2010.pdf.

Gulf of Mexico Fishery Management Council and South Atlantic Fishery Management Council. 1982. Fishery management plan for coral and coral reefs of the Gulf of Mexico and South Atlantic, April 1982. Internet website: http://www.gulfcouncil.org/Beta/GMFMCWeb/downloads/Coral%20FMP.pdf. Accessed June 1, 2011.

Gulf of Mexico Oil Spill Blog. 2010. Gulf Coast winners and losers. Internet website: http://gulfofmexicooilspillblog.com/2010/11/14/gulf-of-mexico-oil-spill-blog-gulf-coast-economic-winners-and-losers/. Posted November 14, 2010. Accessed December 15, 2010.

Guo, J., D.W. Hughes, and W.R. Keithly. 1998. An analysis of Louisiana Highway 1 in relation to expanding oil and gas activities in the Central Gulf of Mexico. In: Lafourche Parish and Port Fourchon, Louisiana: Effects of the Outer Continental Shelf Petroleum Industry on the Economy and Public Services, Part 1. U.S. Dept. of the Interior, Minerals Management Service, Gulf of Mexico OCS Region, New Orleans, LA. OCS Study MMS 2001-019. 42 pp.

Guzmán, H.M. and I. Holst. 1993. Effects of chronic oil-sediment pollution on the reproduction of the Caribbean reef coral *Siderastrea siderea*. Marine Pollution Bulletin 26(5):276-282.

Guzmán, H.M., J.B.C. Jackson, and E. Weil. 1991. Short-term ecological consequences of a major oil spill on Panamanian subtidal reef corals. Coral Reefs 10:1-12.

Guzmán, H.M., K.A. Burns, and J.B.C. Jackson. 1994. Injury, regeneration, and growth of Caribbean reef corals after a major oil spill in Panama. Marine Ecology Progress Series 105:231-241.

Haab, T.C., J.C. Whitehead, and T. McConnell. 2000. The economic value of marine recreational fishing in the southeast United States: 1997 southeast economic data analysis; final report, July 2000. 105 pp. Internet website: http://www.st.nmfs.noaa.gov/st5/RecEcon/Publications/SE_vol2.pdf. Accessed April 4, 2011.

Haab, T.C., R. Hicks, K. Schnier, and J.C. Whitehead. 2010. Angler heterogeneity and the species-specific demand for marine recreational fishing. Appalachian State University, Department of Economics Working Paper. Number 10-02. 43 pp. Internet website: http://econ.appstate.edu/RePEc/pdf/wp1002.pdf.

Haag, W.G. 1992. The Monte Sano site. In: Jeter, M.D., ed. Southeastern Archaeological Conference: Abstracts of the Forty-ninth Annual Meeting, Arkansas' Excelsior Hotel, October 21-24, 1992. Little Rock, AR. 18 pp.

Haby, M.G., R.J. Miget, and L.L. Falconet. 2009. Hurricane damage sustained by the oyster industry and the oyster reefs across the Galveston Bay system with recovery recommendations. A Texas AgriLife Extension Service/SeaGrant Extension Program Staff Paper. The Texas A&M University System, College Station, TX. TAMU-SG-09-201. 51 pp.

Haddad, R. and S. Murawski. 2010. Analysis of hydrocarbons in samples provided from the cruise of the R/V *Weatherbird II*, May 23-26, 2010. U.S. Dept. of Commerce, National Oceanographic and Atmospheric Administration, Silver Spring, MD. 14 pp.

Hagerty, C.L. and J.L. Ramseur, coordinators. 2010. *Deepwater Horizon* oil spill: Selected issues for Congress. Congressional Research Service. 49 pp. Internet website: http://www.fas.org/sgp/crs/misc/R41262.pdf.

Haig, S.H. and C.L. Ferland. 2002. 2001 international piping plover census. U.S. Dept. of the Interior, Geological Survey, Forest and Rangeland Ecosystem Science Center, Corvallis, OR. 293 pp.

Hale, L.F. and J.K. Carlson. 2007. Characterization of the shark bottom longline fishery, 2005-2006. NOAA Technical Memorandum NMFS-SEFSC-554. 28 pp.

Hale, L.F., L.D. Hollinsead, and J.K. Carlson. 2007. Characterization of the shark bottom longline fishery, 2007. NOAA Technical Memorandum NMFS-SEFSC-564. 25 pp.

Hale, L.F., S.J.B. Gulak, and J.K. Carlson. 2009. Characterization of the shark bottom longline fishery, 2008. NOAA Technical Memorandum NMFS-SEFSC-586. 23 pp.

Hall, E.R. 1981. The mammals of North America: Volume II. New York, NY: John Wiley and Sons. Pp. 667-670.

Hall, R.J., A.A. Belisle, and L. Sileo. 1983. Residues of petroleum hydrocarbons in tissues of sea turtles exposed to the *Ixtoc I* oil spill. Journal of Wildlife Diseases 19(2):106-109.

Halley, R.B., A.C. Hine, B.D. Jarrett, D.C. Twichell, D.F. Naar, G.D. Dennis, and K. Ciembronowicz. 2004. Pulley Ridge: The US's deepest hermatypic coral reef? A poster by the U.S. Dept. of the Interior, Geological Survey and University of South Florida, College of Marine Science, St. Petersburg, FL. Internet website: http://coastal.er.usgs.gov/pulley-ridge/Pulley_Ridge.pdf.

Hamdan, L.J. and P.A. Fulmer. 2011. Effects of COREXIT® EC9500A on bacteria from a beach oiled by the *Deepwater Horizon* spill. Aquatic Microbial Ecology 63:101-109, doi:10.3354/ame01482.

Hamilton, P. and A. Lugo-Fernandez. 2001. Observations of high speed deep currents in the northern Gulf of Mexico. Geophysical Research Letters 28:2767-2870.

Hamilton, P., J.J. Singer, E. Waddell, and K. Donuhue. 2003. Deepwater observations in the northern Gulf of Mexico from in-situ current meters and PIES: Final report. Volume II. Technical report. U.S. Dept. of the Interior, Minerals Management Service, Gulf of Mexico OCS Region, New Orleans, LA. OCS Study MMS-2003-049. 95 pp.

Hammer, D. 2011. Ken Feinberg reaches deal to pay subsistence claims for commercial fishermen who consume a portion of their catch. *The Times Picayune*. Internet website: http://www.nola.com/news/gulf-oil-spill/index.ssf/2011/04/post_31.html. Accessed April 28, 2011.

Handley, D.A., D. Altsman, and R. DeMay, eds. 2007. Seagrass status and trends in the northern Gulf of Mexico: 1940-2002. U.S. Dept. of the Interior, Geological Survey Scientific Investigations Report 2006-5287 and U.S. Environmental Protection Agency 855-R-04-003. Internet website: http://pubs.usgs.gov/sir/2006/5287/. Accessed May 13, 2011.

Haney, J.L, Y. Wei, and S.G. Douglas. 2004. A preliminary assessment of on-shore air quality impacts for the eastern Gulf Coast (Louisiana to Florida) using the 2000 Gulfwide Emissions Inventory: Draft report. Prepared for the U.S. Dept. of the Interior, Minerals Management Service, Gulf of Mexico OCS Region, New Orleans, LA, by ICF Consulting, San Rafael, CA.

Hanski, I. 1999. Metapopulation ecology. Oxford: Oxford University Press. 328 pp.

Harbison, R.N. 1968. Geology of De Soto Canyon. Journal of Geophysical Research 73:5175-5185.

Hardin, D.K., K.D. Spring, S.T. Viada, A.D. Hart, B.D. Graham, and M.B. Peccini. 2001. Chapter 7: Hard bottom communities. In: Continental Shelf Associates, Inc. and Texas A&M University, Geochemical and Environmental Research Group. 2001. Mississippi/Alabama pinnacle trend ecosystem monitoring: Final synthesis report. U.S. Dept. of the Interior, Geological Survey, Biological Resources Division, USGS BSR 2001-0007 and Minerals Management Service, Gulf of Mexico OCS Region, New Orleans, LA, OCS Study MMS 2001-080. 415 pp. + apps.

Hargreaves, S. 2010. Drilling ban: Jobs at stake. Internet website: http://money.cnn.com/2010/06/24/news/economy/drilling_jobs_at_stake/index.htm?postversion=2010062410. Accessed June 30, 2010.

Harper, D.E., Jr. 1991. Macroinfauna and macroepifauna. In: Brooks, J.M., ed. 1991. Mississippi-Alabama continental shelf ecosystem study: Data summary and synthesis. Volume II: Technical narrative. U.S. Dept. of the Interior, Minerals Management Service, Gulf of Mexico OCS Region, New Orleans, LA. OCS Study MMS 91-0063. 862 pp.

Harper, D.E., Jr., L.D. McKinney, J.M. Nance, and R.R. Salzer. 1991. Recovery responses of two benthic assemblages following an acute hypoxic event on the Texas continental shelf, northwestern Gulf of Mexico. Geological Society, London, Special Publications 58:49-64.

Harrington, B. 1996. The flight of the red knot. New York, NY: W.W. Norton & Company

Harris, R. 2010. Scientists find thick layer of oil on seafloor. National Public Radio (online). September 10, 2010. Internet website: http://www.npr.org/templates/story/story.php?storyId=129782098. Accessed January 13, 2011.

Harrison, P. 1983. Seabirds: An identification guide. Boston, MA: Houghton Mifflin Co. 448 pp.

Harrison, P. 1996. Seabirds of the world. Princeton, NJ: Princeton University Press. 317 pp.

Hart, A.D., K.D. Spring, J.M. Brooks, B.J. Presley, and B.A. Vittor. 1989. Fate and effects of drilling fluid and cutting discharges in shallow, nearshore waters. Washington, DC: American Petroleum Institute.

Hartung, R. 1995. Assessment of the potential for long-term toxicological effects of the *Exxon Valdez* oil spill on birds and mammals. ASTM (American Society for Testing Materials) Special Technical Publication.

Harvey, J.T. and M.E. Dahlheim. 1994. Cetaceans in oil. In: Loughlin, T.R., ed. Marine Mammals and the *Exxon Valdez*. San Diego, CA: Academic Press. Pp. 257-264.

Havrylkoff, J. 2010. Official communication. Email from Pascagoula Sturgeon Team. Post Katrina Gulf sturgeon opdate for Pascagoula sampling area. University of Southern Mississippi Gulf Coast Research Laboratory. October 1, 2010.

Hayes, M.O., D.D. Domeracki, C.D. Getter, T.W. Kana, and G.I. Scott. 1980. Sensitivity of coastal environments to spilled oil, south Texas coast. Research Planning Institute, Inc. Report No. RPI/R/80/4/11-12. Prepared for the U.S. Dept. of Commerce, National Oceanic and Atmospheric Administration, Office of Marine Pollution Assessment, Columbia, SC. 89 pp.

Hayman, P., J. Marchant, and T. Prater. 1986. Shorebirds: An identification guide to the waders of the world. Boston, MA: Houghton Mifflin Co. 412 pp.

Hazen, T.C., E.A. Dubinsky, T.Z. DeSantis, G.L. Andersen, Y.M. Picento, N. Singh, J.K. Jansson, A. Probst, S.E. Borglin, J.L. Fortney, W.T. Stringfellow, M. Bill, M.S. Conrad, L.M. Tom, K.L. Chavarria, T.R. Alusi, R. Lamendella, D.C. Joyner, C. Spier, J. Baelum, M. Auer, M.L. Zelma, R. Chakraborty, E.L. Sonnenthal, P. D'haeseleer, H.N. Holman, S. Osman, Z. Lu, J.D. Van Nostrand, Y. Deng, J. Zhou, and O.U. Mason. 2010. Deep-sea oil plume enriches indigenous oil-degrading bacteria. Published online: Science Express August 24, 2010. Science 330:6001(204-208).

Heath, A.G. 1995. Water pollution and fish physiology. 2nd edition. Boca Raton, FL: CRC Press, Inc. 359 pp.

Heck, K.L., G. Hays, and R.J. Orth. 2003. Critical evaluation of the nursery role hypothesis for seagrass meadows. Marine Ecology Progress Series 253:123-136.

Helicopter Safety Advisory Conference. 2009. HSCA 2009 safety statistics. Internet website: http://www.hsac.org/Minutes/may2010/2009SAFETYSTAT.pdf. Accessed December 17, 2010.

Helix Well Containment Group (HWCG). 2011. Capabilities. Internet website: http://www.hwcg.org/. Accessed October 20, 2011.

Hell, J.W. and M.D. Ehlers, eds. 2008. Structural and functional organization of the synapse. New York, NY: Springer. 801 pp.

Hemmerling, S.A. and C.E. Colten. 2003. Environmental justice considerations in Lafourche Parish, Louisiana. U.S. Dept. of the Interior, Minerals Management Service, Gulf of Mexico OCS Region, New Orleans, LA. OCS Study MMS 2003-038. 348 pp.

Hemmerling, S.A. and C.E. Colten. In preparation. Environmental justice: A comparative perspective in Louisiana. U.S. Dept. of the Interior, Bureau of Ocean Energy Management, Regulation and Enforcement, Gulf of Mexico OCS Region, New Orleans, LA. Prepared under Contract No. 30951-72404.

Hemming, J.M., P.V. Winger, S.J. Herrington, W. Gierhart, H. Herod, and J. Ziewitz. 2006. Water and sediment quality integrity survey of threatened and endangered freshwater mussel habitat in the Ochlockonee River basin. Endangered Species Research 6:1-13.

Heneman, B. and the Center for Environmental Education. 1988. Persistent marine debris in the North Sea, northwest Atlantic Ocean, wider Caribbean area, and the west coast of Baja California. Final report for the Marine Mammal Commission. Contract MM3309598-5. Washington, DC. Available from NTIS, Springfield, VA: PB89-109938. 161 pp.

Henfer, L.M., B.O. Wilen, T.E. Dahl, and W.E. Frayer. 1994. Southeast wetlands: Status and trends, mid-1970's to mid-1980's. U.S. Dept. of the Interior, Fish and Wildlife Service, Atlanta, GA. 32 pp.

Henningsson, S.S. and T. Alerstam. 2005. Barriers and distances as determinants for the evolution of bird migration links: The Arctic shorebird system. In: Proceedings; Biological Sciences, 2005. London: Royal Society of London 272(1578):2251-2258.

Henriet, J.P. and J. Mienert. 1998. Gas hydrates; relevance to world marginal stability and climate change. Geological Society of London, England. Geological Society Special Publication No. 137. 338 pp.

Hernandez, F., S. Powers, and W. Graham. 2010. Seasonal variability in ichthyoplankton abundance and assemblage composition in the northern Gulf of Mexico off Alabama. Fishery Bulletin 108(2):193-207.

Hickerson, E.L., G.P. Schmahl, M. Robbart, W.F. Precht, and C. Caldow. 2008. The state of coral reef ecosystems of the Flower Garden Banks, Stetson Bank, and other banks in the northwestern Gulf of Mexico. In: Waddell, J.E. and A.M. Clarke, eds. The state of coral reef ecosystems of the United States and Pacific freely associated states: 2008. Center for Coastal Monitoring and Assessment's Biogeography Team, Silver Spring, MD. NOAA Technical Memorandum NOS NCCOS 73. NOAA/NCCOS. 569 pp.

Hiett, R.L. and J.W. Milon. 2002. Economic impact of recreational fishing and diving associated with offshore oil and gas structures in the Gulf of Mexico: Final report. U.S. Dept. of the Interior, Minerals Management Service, Gulf of Mexico OCS Region, New Orleans, LA. OCS Study MMS 2002-010. 98 pp.

Hobaugh, W.C., C.D. Stutzenbaker, and E.L. Flickinger. 1989. The rice prairies. In: Smith, L.M., R.L. Pederson, and R.M. Kaminski, eds. Habitat management for migrating and wintering waterfowl in North America. Texas Tech University Press, Lubbock.

Hogan, J.L. 2003. Occurrence of the diamondback terrapin (*Malaclemys terrapin littoralis*) at South Deer Island in Galveston Bay, Texas, April 2001–May 2002. U.S. Dept. of the Interior, Geological Survey, Austin, TX. USGS Open-File Report 03-022. 30 pp.

Holand, P. 1999. Reliability of subsea BOP systems for deepwater application, phase II DW. SINTEF Report prepared for the U.S. Dept. of the Interior, Minerals Management Service. TA&R Project 319. 118 pp. + apps. Internet website: http://www.boemre.gov/tarprojects/319/319AA.pdf.

Holand, P. and P. Skalle. 2001. Deepwater kicks and BOP performance. SINTEF Report prepared for U.S. Dept. of the Interior, Minerals Management Service. TA&R Project 383. 108 pp. + apps.

Internet website: http://www.boemre.gov/tarprojects/383/383%20AB%20Final%20report%20Deepwater%20Kicks%20and%20BOP%20Performance.pdf.

Holder, Jr., S.W. and A. Lugo-Fernandez. 1993. Relationships between the Barataria Basin tidal prism and the basin's barrier islands. In: Clipp, A., ed. Louisiana shoreline erosion: Emphasis on Grand Isle. Proceedings of a symposium held at Grand Isle, LA, March 3-5, 1993. Pp. 31-42.

Holdway, D.A. 2002. The acute and chronic effects of wastes associated with offshore oil and gas production on temperate and tropical marine ecological processes. Marine Pollution Bulletin 44:185-203.

Holliman, D.C. 1983. Status and habitat of Alabama Gulf Coast beach mice *Peromyscus polionotus ammobates* and *P.p. trissyllepsis*. Northeast Gulf Science 6(2):121-129.

Hopkins, T.S., D.R. Blizzard, S.A. Brawley, S.A. Earle, D.E. Grimm, D.K. Gilbert, P.G. Johnson, E.H. Livingston, C.H. Lutz, J.K. Shaw, and B.B. Shaw. 1977. A preliminary characterization of the biotic components of composite strip transects on the Florida Middle Ground, northeastern Gulf of Mexico. Proceedings, Third International Coral Reef Symposium, Miami, FL. 1:32-37.

Howard, R.K. and F.T. Short. 1986. Seagrass growth and survivorship under the influence of epiphyte grazers. Aquatic Botany 24(3):287-302.

Hsu, S.A. 1979. An operational forecasting model for the variation of mean maximum mixing heights across the coastal zone. Boundary-Layer Meteorology 16:93-98.

Hu, C. and F.E. Muller-Karger. 2007. Response of sea surface properties to Hurricane Dennis in the eastern Gulf of Mexico. Geophysical Research Letters Vol. 34, L07606, doi:10.1029/2006GL028935.

Hua, J. 1999. Behavior of chemically dispersed oil in marine sediment. Journal of Marine Science and Technology 7(1):35-42.

Hudson, J.H. and D.M. Robbin. 1980a. Effects of drilling mud on the growth rate of reef-building coral, *Montastraea annularis*. The R&D Program for OCS Oil and Gas Operations. U.S. Dept. of the Interior, Geological Survey, Fisher Island Station, Miami Beach, FL.

Hudson, J.H. and D.M. Robbin. 1980b. Effects of drilling mud on the growth rate of the reef-building coral, *Montastraea annularis*. In: Proceedings, Volume 2. Research on the Environmental Fate and Effects of Drilling Fluids and Cuttings, January 21-24, 1980, Lake Buena Vista, FL.

Hudson, J.H. and D.M. Robbin. 1980c. Effects of drilling mud on the growth rate of the reef-building coral, *Montastraea annularis*. In: Geyer, R.A., ed. Marine Environmental Pollution. Elsevier Oceanography Series, 27A. Amsterdam: Elsevier Scientific Publishing Company. Pp. 455-470.

Hudson, J.H., E.A. Shinn, and D.M. Robbin. 1982. Effects of offshore oil drilling on Philippine reef corals. Bulletin of Marine Science 32(4):890-908.

Huff, J.A. 1975. Life history of the Gulf of Mexico sturgeon, *Acipenser oxyrhynchus desotoi*, in the Suwannee River, Florida. Marine Resources Publication No. 16. 32 pp.

Hughes, D.W., J.M. Fannin, W. Keithly, W. Olatubi, and J. Guo. 2001. Lafourche Parish and Port Fourchon, Louisiana: Effects of the outer continental shelf petroleum industry on the economy and public services, part 2. U.S. Dept. of the Interior, Minerals Management Service, Gulf of Mexico OCS Region, New Orleans, LA. OCS Study MMS 2001-020. 51 pp.

Hummell, R.L. 1990. Main Pass and the ebb-tidal delta of Mobile Bay, Alabama. Geological Survey of Alabama, Energy and Coastal Geology Division. Circular 146.

Hunt D. 2006. Official communication. Impacts of Hurricanes Rita and Katrina on bird habitat. U.S. Dept. of the Interior, Fish and Wildlife Service, Southeastern Louisiana Wildlife Refuges, Lacombe, LA. September 2006.

Hyland, J.L. and E.D. Schneider. 1976. Petroleum hydrocarbons and their effects on marine organisms, populations, communities, and ecosystems. In: Sources, effects and sinks of hydrocarbons in the aquatic environment. Proceedings of the Symposium, Washington, DC. August 9-11, 1976. Arlington, VA: American Institute of Biological Sciences. Pp. 465-506.

Hyland, J., D. Hardin, M. Steinhauer, D. Coats, R. Green, and J. Neff. 1994. Environmental impact of offshore oil development on the outer continental shelf and slope off Point Arguello, California. Marine Environmental Research 37:195-229.

IEM. 2010. A study of the economic impact of the *Deepwater Horizon* oil spill. Part 1: Fisheries. Prepared for the Greater New Orleans Inc. Regional Economic Alliance. 55 pp. Internet website: http://www.uflib.ufl.edu/docs/Economic%20Impact%20Study,%20Part%20I%20-%20Full%20Report.pdf.

Iledare, O.O. and M.J. Kaiser. 2007. Competition and performance in oil and gas lease sales and development in the U.S. Gulf of Mexico OCS region, 1983-1999. U.S. Dept. of the Interior, Minerals Management Service, Gulf of Mexico OCS Region, New Orleans, LA. OCS Study MMS 2007-034. 106 pp.

Inoue, M., S.E. Welsh, L.J. Rouse, Jr., and E. Weeks. 2008. Deepwater currents in the eastern Gulf of Mexico: Observations at 25.5ºN and 87ºW. U.S. Dept. of the Interior, Minerals Management Service, Gulf of Mexico OCS Region, New Orleans, LA. OCS Study MMS 2008-001. 95 pp.

Intergovernmental Panel on Climate Change. 2007a. Summary for policymakers. In: Climate change 2007: The physical science basis. Contribution of Working Group I to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change (Solomon, S., D. Qin, M. Manning, Z. Chen, M. Marquis, K.B. Averyt, M. Tignor and H.L. Miller, eds.). Cambridge University Press, Cambridge, United Kingdom and New York, NY. 24 pp. Internet website: http://www.ipcc.ch/pdf/assessment-report/ar4/syr/ar4_syr_spm.pdf.

International Tanker Owners Pollution Federation Limited (ITOPF). 2002. Fate of marine oil spills. Technical Information Paper. London, United Kingdom. 8 pp. Internet website: http://www.itopf.com/_assets/documents/tip2.pdf. Accessed December 2, 2010.

International Tanker Owners Pollution Federation Limited (ITOPF). 2010a. Weathering process. Internet website: http://www.itopf.com/marine-spills/fate/weathering-process/. Accessed January 4, 2011.

International Tanker Owners Pollution Federation Limited (ITOPF). 2010b. Containment & recovery. Internet website: http://www.itopf.com/spill-response/clean-up-and-response/containment-and-recovery/. Accessed December 23, 2010.

Irion, J.B. and R.J. Anuskiewicz. 1999. MMS seafloor monitoring project: First annual technical report, 1997 field season. U.S. Dept. of the Interior, Minerals Management Service, Gulf of Mexico Region, New Orleans, LA. OCS Report MMS 99-0014. 63 pp.

Irion, J.B. and D.A. Ball. 2001. The *New York* and the *Josephine*: Two steamships of the Charles Morgan Line. International Journal of Nautical Archaeology 30(1):48-56.

Irvine, G. 2000. Persistence of spilled oil on shores and its effects on biota. In: Seas at the millennium: An environmental evaluation. Volume III: Global issues and processes. Elsevier Science Ltd.

Isphording, W.C. and G.C. Flowers. 1990. Geological and geochemical characterization. In: Stout, J. and L. Bryant, eds. Mobile Bay: Issues, resources, status, and management. U.S. Dept. of Commerce, National Oceanic and Atmospheric Administration. Estuary-of-the-Month Seminar Series No. 15. Pp. 9-25.

Israel, B. 2010. 5 years after Katrina, Gulf ecosystems on the ropes. Live Science. Internet website: http://www.livescience.com/environment/hurricane-katrina-gulf-coast-ecological-damage-100827.html. Accessed August 27, 2010.

Izon, D., E.P. Danenberger, and M. Mayes. 2007. Absence of fatalities in blowouts encouraging in MMS study of OCS incidents 1992-2006. Drilling Contractor, July/August. Pp. 84-90. Internet website: http://drillingcontractor.org/dcpi/dc-julyaug07/DC_July07_MMSBlowouts.pdf.

Jaap, W.C. and R. Halley. 2008. Pulley Ridge. In: Ritchie, K.B. and B.D. Keller, eds. A scientific forum on the Gulf of Mexico: The islands in the stream concept. U.S. Dept. of Commerce, National Oceanic and Atmospheric Administration, National Marine Sanctuary Program, Silver Spring, MD. Marine Sanctuaries Conservation Series NMSP-08-04. Pp. 45-48. Internet website: http://sanctuaries.noaa.gov/science/conservation/pdfs/gom.pdf.

Jaap, W.C. and P. Hallock. 1991. Coral reefs. In: Myers, R.L. and J.J. Ewel, eds. Ecosystems of Florida. Orlando, FL: University of Central Florida Press. Pp. 574-616.

Jackson, J.B.C., J.D. Cubit, B.D. Keller, V. Batista, K. Burns, H.M. Caffey, R.L. Caldwell, S.D. Garrity, C.D. Getter, C. Gonzalez, H.M. Guzman, K.W. Kaufmann, A.H. Knap, S.C. Levings, M.J. Marshall, R. Steger, R.C. Thompson, and E. Weil. 1989. Ecological effects of a major oil spill on Panamanian coastal marine communities. Science 243:37-44.

Jackson, L.E., J.C. Kurtz, and W.S. Fisher. 2000. Evaluation guidelines for ecological indicators. U.S. Environmental Protection Agency, Research Triangle Park, NC. EPA/620/R-99/005. Internet website: http://www.epa.gov/emap/html/pubs/docs/resdocs/ecol_ind.pdf.

Jarrett, B.D., A.C. Hine, A.C. Neumann, D. Naar, S. Locker, D. Mallinson, and W. Jaap. 2002. Deep biostromes at Pulley Ridge, southwest Florida carbonate platform. University of South Florida, St. Petersburg, FL. Internet website: http://rubicon-foundation.org/dspace/bitstream/123456789/8968/1/AAUS_2000_8.pdf.

Jefferson, T.A., S. Leatherwood, L.K.M. Shoda, and R.L. Pitman. 1992. Marine mammals of the Gulf of Mexico: A field guide for aerial and shipboard observers. Texas A&M University Printing Center, College Station, TX. 92 pp.

Jenssen, B.M. 1994. Review article: Effects of oil pollution, chemically treated oil, and cleaning on the thermal balance of birds. Environmental Pollution 86:207-215.

Jenssen, B.M. and M. Ekker. 1991. Effects of plumage contamination with crude oil disperant mixtures on thermoregulation in common eiders and mallards. Archives of Environmental Contamination and Toxicology 20:398-403.

Jernelöv, A. and O. Lindén. 1981. *Ixtoc I*: A case study of the world’s largest oil spill. Ambio 10(6):299-306.

Ji, Z.-G., W.R. Johnson, C.F. Marshall, and E.M. Lear. 2007. Oil spill risk analysis: Gulf of Mexico outer continental shelf (OCS) lease sales, Central Planning Area and Western Planning Area, 2007-2012, and Gulfwide OCS Program, 2007-2046. U.S. Dept. of the Interior, Minerals Management Service, Environmental Division, Herndon, VA. OCS Report MMS 2007-040. 59 pp.

Jindal, B. 2010. Governor Jindal letter to President Obama and Secretary Salazar: Severe impacts of moratorium on deepwater drilling. Press Release, June 3, 2010. Internet website: http://emergency.louisiana.gov/Releases/06032010-letter.html. Accessed January 13, 2011.

Jochens, A.E., L.C. Bender, S.F. Di Marco, J.W. Morse, M.C. Kennicutt II, M.K. Howard, and W.D. Nowlin, Jr. 2005. Understanding the processes that maintain the oxygen levels in the deep Gulf of Mexico. U.S. Dept. of the Interior, Minerals Management Service, Gulf of Mexico OCS Region, New Orleans, LA. OCS Study MMS 2005-032. 129 pp.

Jochens, A., D. Biggs, K. Benoit-Bird, D. Engelhaupt, J. Gordon, C. Hu, N. Jaquet, M. Johnson, R. Leben, B. Mate, P. Miller, J. Ortega-Ortiz, A. Thode, P. Tyack, and B. Würsig. 2008. Sperm whale seismic study in the Gulf of Mexico: Synthesis report. U.S. Dept. of the Interior, Minerals Management Service, Gulf of Mexico OCS Region, New Orleans, LA. OCS Study MMS 2008-006. 341 pp.

Johansen, O., H. Rye, and C. Cooper. 2001. DeepSpill JIP—field study of simulated oil and gas blowouts in deep water. In: Proceedings from the Fifth International Marine Environment Modeling Seminar, October 9-11, 2001, New Orleans, LA. 377 pp.

Johnsgard, P.A. 1975. Waterfowl of North America. Bloomington, IN: Indiana University Press. 624 pp.

Johnson, W.B. and J.G. Gosselink. 1982. Wetland loss directly associated with canal dredging in the Louisiana coastal zone. In: Boesch, D.F., ed. Proceedings of the Conference on Coastal Erosion and Wetland Modification in Louisiana: Causes, Consequences, and Options, Baton Rouge, LA. U.S. Dept. of the Interior, Fish and Wildlife Service. FWS/OBS-82/59. Pp. 60-72.

Johnson, G.C., R.E. Kidd, C.A. Journey, H. Zappia, and J.B. Atkins. 2002. Environmental setting and water-quality issues of the Mobile River Basin, Alabama, Georgia, Mississippi, and Tennessee. U.S. Dept. of the Interior, Geological Survey Water-Resources Investigations Report 02-4162. 61 pp.

Johnston, J.B., D.R. Cahoon, and M.K. La Peyre. 2009. Outer continental shelf (OCS)-related pipelines and navigation canals in the Western and Central Gulf of Mexico: Relative impacts on wetland habitats and effectiveness of mitigation. U.S. Dept. of the Interior, Minerals Management Service, Gulf of Mexico OCS Region, New Orleans, LA. OCS Study MMS 2009-048. 200 pp.

Joint Analysis Group. 2010a. Review of R/V *Brooks McCall* data to examine subsurface oil. Internet website: http://www.noaa.gov/sciencemissions/PDFs/JAG_Report_1_BrooksMcCall_Final_June20.pdf. Accessed October 14, 2010.

Joint Analysis Group. 2010b. Review of preliminary data to examine oxygen levels in the vicinity of MC525#1. May 8 to August 9, 2010. Internet website: http://www.noaa.gov/sciencemissions/PDFs/JAG_Oxygen_Report%20(FINAL%20090410).pdf. Accessed October 19, 2010.

Jones, R.J. and A.J. Heyward. 2003. The effects of produced formation water (PFW) on coral and isolated symbiotic dinoflagellates of coral. Marine and Freshwater Research 54:153-162.

Joye, S. 2010. Focusing in on oil, scientist' log from September 5, 2010, aboard the R/V *Oceanus* in the northern Gulf of Mexico. Gulf Oil Blog, University of Georgia, Dept. of Marine Sciences. Internet website: http://gulfblog.uga.edu/2010/09/focusing-in-on-oil. Accessed September 15, 2010.

Joye,S. I Leifer, I.R. MacDonald, J.P. Chanton, C.D. Meile, A.P. Teske, J.E. Kostka, L. Chistoserdova, R. Coffin, D. Hollander, M. Kastner, J.P. Montoya, G. Rehder, E. Solomon, T. Treude, and T.A. Villareal. 2011. Comment on "A persistent oxygen anomaly reveals the rate of spilled methane in the deep Gulf of Mexico." Science 27 May 2011, 332(6033):1033. doi:10.1126/science.1203307. Internet website: http://www.sciencemag.org/content/332/6033/1033.3.full. Accessed November 18, 2011.

Kaplan, M.F. and C. Whitman. Unpublished. Measuring the economic impact of tourism and recreation industries on Gulf Coast communities—Relationship between OCS development and coastal resources (2008). U.S. Dept. of the Interior, Minerals Management Service, Gulf of Mexico OCS Region, New Orleans, LA. Contract No. 1435-01-99-CA-30951-18261. x + 164 pp.

Kaplan, M.F., A. Laughland, and J. Mott. In preparation. OCS-related infrastructure fact book. Volume II: Communities in the Gulf of Mexico. U.S. Dept. of the Interior, Bureau of Ocean Energy Management, Gulf of Mexico OCS Region, New Orleans, LA. OCS Study BOEMRE 2011-044.

Karl, T.R., J.M. Melillo, and T.C. Peterson, eds. 2009. Global climate change impacts in the United States. New York, NY: Cambridge University Press. 180 pp. Internet website: http://downloads.globalchange.gov/usimpacts/pdfs/climate-impacts-report.pdf.

Keim, B. and R.A. Muller. 2009. Hurricanes of the Gulf of Mexico. Louisiana State University Press, Baton Rouge, LA.

Kemp, G.P. 1986. Mud deposition at the shoreface: Wave and sediment dynamics on the Chenier Plain of Louisiana. Ph.D. dissertation. Louisiana State University, Baton Rouge, LA. 148 pp.

Kemp, W.M. 1989. Estuarine seagrasses. In: Day, J.W., Jr., C.A.S. Hall, W.M. Kemp, and A. Yanez-Arancibia, eds. Estuarine ecology. New York, NY: John Wiley & Sons. 558 pp.

Kendall, J.J. and G. Rainey. 1991. Produced waters: Findings of recent studies in the coastal waters of Louisiana; session introduction. In: Geo-Marine, Inc., comp. Proceedings: Eleventh Annual Gulf of Mexico Information Transfer Meeting, November 1990. U.S. Dept. of the Interior, Minerals Management Service, Gul of Mexico OCS Region, New Orleans, LA. OCS Study MMS 91-0040. 524 pp.

Kendall, J.J., E.N. Powell, S.J. Connor, and T.J. Bright. 1983. The effects of drilling fluids (muds) and turbidity on the growth and metabolic state of the coral *Acropora cervicornic*, with comments on methods of normalization for coral data. Bulletin of Marine Science 33(2):336-352.

Kennedy, C.J., N.J. Gassman, and P.J. Walsh. 1992. The fate of benzo[a]pyrene in the Scleractinian corals *Favia fragrum* and *Montastrea annularis*. Marine Biology 113:313-318.

Kennet, J.P. 1982. Marine geology. Englewood Cliff, NJ: Prentice-Hall. 752 pp.

Kennicutt II, M.C., ed. 1995. Gulf of Mexico offshore operations monitoring experiment, Phase I: Sublethal responses to contaminant exposure, final report. U.S. Dept. of the Interior, Minerals Management Service, Gulf of Mexico OCS Region, New Orleans, LA. OCS Study MMS 95-0045. 709 pp.

Kennicutt II, M.C., J.M. Brooks, R.R. Bidigare, R.A. Fay, T.L. Wade and T.J. McDonald. 1985. Vent type taxa in a hydrocarbon seep region on the Louisiana slope. Nature (London) 317:351-353.

Kennicutt II, M.C., J. Sericano, T. Wade, F. Alcazar, and J.M. Brooks. 1987. High-molecular weight hydrocarbons in the Gulf of Mexico continental slope sediment. Deep-Sea Research 34:403-424.

Kennicutt II, M.C., P.N. Boothe, T.L. Wade, S.T. Sweet, R. Rezak, F.J. Kelly, J.M. Brooks, B.J. Presley, and D.A. Wiesenburg. 1996. Geochemical patterns in sediments near offshore production platforms. Canadian Journal of Fisheries and Aquatic Science 53: 2554-2566.

Kenworthy, W.J. and M.S. Fonseca. 1996. Light requirements of seagrasses *Halodule wrightii* and *Syringodium filiforme* derived from the relationship between diffuse light attenuation and maximum depth distribution. Estuaries 19(3):740-750.

Kenworthy, W.J., M.J. Durako, S.M.R. Fatemy, H. Valavis, and G.W. Thayer. 1993. Ecology of seagrasses in northeastern Saudi Arabia one year after the Gulf War spill. Marine Pollution Bulletin 27:213-222.

Kessler, J.D., D.L Valentine, M.C. Redmond, M. Du., E.W. Chan, S.D. Mendes, E.W. Quiroz, C.J. Villanueva, S.S. Shusta, L.M. Werra, S.A. Yvon-Lewis, and T.C. Weber. 2011a. A persistent oxygen anomaly reveals the fate of spilled methane in the deep Gulf of Mexico. Science Express. Internet website: http://www.sciencemag.org/content/early/2011/01/05/science.1199697. Posted January 6, 2011. Accessed May 20, 2011.

Kessler, J.D., D.L. Valentine, M.C. Redmond, and M. Du. 2011b. Response to comment on "A persistent oxygen anomaly reveals the fate of spilled methane in the deep Gulf of Mexico." Science 27 May 2011, 332(6033):1033. doi:10.1126/science.1203428. Internet website: http://www.sciencemag.org/content/332/6033/1033.4.full. Accessed November 18, 2011.

Khan, R.A. and P. Ryan. 1991. Long-term effects of crude oil on common murres (*Uria aalge*) following rehabilitation. Bulletin of Environmental Contamination and Toxicology 46:216-218.

Khodorevskaya, R.P., O.L. Zhravleva, and A.D. Vlasenko. 1997. Present status of commercial stocks of sturgeons in the Caspian Sea basin. Environ. Biol. Fish. 48:209-219.

Kilpatrick, A.M., S.L. LaDeau, and P.P. Marra. 2007. Ecology of West Nile virus transmission and its impact on birds in the Western Hemisphere. Auk 124:1121-1136.

King, W.E. 2007. Energy alternatives and the environment. U.S. Dept. of the Interior, Minerals Management Service, Herndon, VA. OCS Report MMS 2007-016. 46 pp.

King, B.A. and F.A McAllister. 1998. Modelling the dispersion of produced water discharges. The APPEA Journal 38(Part I):681-691.

Kingston, P.F. 1995. The *Exxon Valdez* and *Braer* oil spills; a comparison of their impacts on the marine environment. Deutsche Hydrographische Zeitschrift Supplement 5:59-72.

Kingston, P.F., I.M.T. Dixon, S. Hamilton, and D.C. Moore. 1995. The impact of the *Braer* oil spill on the macrobenthic infauna of the sediments off the Shetland Isles. Marine Pollution Bulletin 189:159-170.

Kirk, J.P. 2007. Official communication. Information describing the latest unpublished sturgeon population estimates for Gulf sturgeon in the Pearl River. U.S. Dept. of the Army, Corps of Engineers, Engineering Research and Development Center. January 2007.

Kirk, J.P. 2008. Gulf sturgeon movements in and near the Mississippi River Gulf Outlet. U.S. Dept. of the Army, Corps of Engineers, Engineering Research Development Center, Environmental Lab. ERDC/EL TR-08-18.

Kirk, J.P. and H.R. Rogillio. 2007. Official communication. Information describing the latest unpublished sturgeon population estimates for Gulf sturgeon in the Pearl River. J.P. Kirk, U.S. Dept. of the Army, Corps of Engineers, Research and Development Center, Vicksburg, MS; and H.R. Rogillio, Louisiana Dept. of Wildlife and Fisheries, Lacombe, LA.

Klasing, K., R. Donohoe, and J. Yamamoto. 2007. Dietary exposure to naphthalene in the Japanese quail (*Coturnix coturnix japonica*). In: Massey, J.G., ed. Proceedings of the Ninth International Effects of Oil on Wildlife Conference, Monterey, California, 2007, University of California at Davis Wildlife Health Center.

Klein, M.L., S.R. Humphrey, and H.F. Percival. 1995. Effects of ecotourism on distribution of waterbirds in a wildlife refuge. Conservation Biology 9:1454-1465.

Kleypas, J.A., J.W. McManus, and L.A.B. Meñtz. 1999a. Environmental limits to coral reef development: Where do we draw the line? American Zoologist 39:146-159.

Knap, A.H. 1987. Effects of chemically dispersed oil on the brain coral, *Diploria strigosa*. Marine Pollution Bulletin 18(3):119-122.

Knap, A.H., J.E. Solbakken, R.E. Dodge, T.D. Sleeter, S.J. Wyers, and K.H. Palmork. 1982. Accumulation and elimination of (9-^{14}C) phenanthrene in the reef-building coral (*Diploria strigosa*). Bulletin of Environmental Contamination and Toxicology 28:281-284.

Knap, A.H., T.D. Sleeter, R.E. Dodge, S.C. Wyers, H.R. Frith, and S.R. Smith. 1983. The effects of oil spills and dispersant use on corals: A review and multidisciplinary experimental approach. Oil and Petrochemical Pollution 1(3):157-169.

Ko, J-Y. and J.W. Day. 2004a. A review of ecological impacts of oil and gas development on coastal ecosystems in the Mississippi delta. Ocean and Coastal Management 47(11-12):597-623.

Ko, J-Y. and J.W. Day. 2004b. Wetlands: Impacts of energy development in the Mississippi Delta. Encyclopedia of Energy, Volume 6. Elsevier Inc. Pp. 397-408. Internet website: http://www.lsu.edu/cei/research_projects/Wetlands_final.pdf.

Kokaly, R.F., D. Heckman, J. Holloway, S. Piazza, B. Couvillion, G.D. Steyer, C. Mills, and T.M. Hoefen. 2011. Shoreline surveys of oil impacted marsh in southern Louisiana, July to August 2010. U.S. Dept. of the Interior, Geological Survey Open File Report 2011-1022. 124 pp.

Korschgen, C.E., L.S. George, and W.L. Green. 1985. Disturbance of diving ducks by boaters on a migrational staging area. Wildlife Society Bulletin 13:290-296.

Kou, W.W. 2010. Direct seismic indicators of gas hydrates in the Walker Ridge and Green Canyon Areas, deepwater Gulf of Mexico. American Association of Petroleum Geologists, Search and Discovery Article #80112. Internet website: http://www.searchanddiscovery.com/documents/2010/80112kou/ndx_kou.pdf. Posted October 22, 2010.

Krapu, G.L., J.L. Eldridge, C.L. Gratto-Trevor, and D.A. Buhl. 2006. Fat dynamics of Arctic-nesting sandpipers during spring in mid-continental North America. Auk 123:323-334.

Kraus, R.T., R.L. Hill, J.R. Rooker, and T.M. Dellapenna. 2006. Preliminary characterization of a mid-shelf bank in the northwestern Gulf of Mexico as essential habitat of reef fishes. In: Proceedings of the 57th Gulf and Caribbean Fisheries Institute, November 8-12, 2004, St. Petersburg, FL. Pp. 621-632.

Kraus, R.T., C. Friess, R.L. Hill, and J.R. Rooker. 2007. Characteristics of the snapper-grouper-grunt complex, benthic habitat description, and patterns of reef fish recruitment at Sonnier Bank in the northwestern Gulf of Mexico. In: Proceedings of the 59th Gulf and Caribbean Fisheries Institute, November 6-11, 2006, Belize City, Belize. Pp. 165-170.

Krivor, M.C., J. de Bry, N.J. Linville, and D.J. Wells. In press. Archival investigations for potential colonial-era shipwrecks in ultra-deep water in the Gulf of Mexico. U.S. Department of the Interior, Bureau of Ocean Energy Management, Regulation and Enforcement, Gulf of Mexico OCS Region, New Orleans, LA. OCS Study BOEMRE 2011-004. 158 pp.

Krone, M.A. and D.C. Biggs. 1980. Sublethal metabolic responses to the hermatypic coral *Madracis decactis* exposed to drilling mud enriched with ferrochrome lignosulfonate. In: Proceedings, Volume 2. Research on the Environmental Fate and Effects of Drilling Fluids and Cuttings, January 21-24, 1980, Lake Buena Vista, FL. Pp. 1097-1100. (ERL,GB X167).

Kruse, G.O. and D.L. Scarnecchia. 2002. Assessment of bioaccumulated metal and organochlorine compounds in relation to physiological biomarkers in Kootenai River white sturgeon. J. App. Ichthyol. 18:430-438.

Kuhn, N.L., I.A. Mendelssohn, and D.J. Reed. 1999. Altered hydrology effects on Louisiana salt marsh function. Wetlands 19:3.

Kushmaro, A., G. Henning, D.K. Hofmann, and Y. Benayahu. 1997. Metamorphosis of *Heteroxenia fuscescens* Plaunlae (Cnidaria: Octocorallia) is inhibited by crude oil: A novel short term toxicity bioassay. Marine Environmental Research 43(4):295-302.

LA 1 Coalition. 2010a. LA 1 Coalition continues aggressive efforts to fund phase 2 of highway project in the wake of Tiger 2 grant results. Press Release. Internet website: http://la1coalition.org/images/Oct21_10LA1NewsRelease.pdf. Accessed December 3, 2010.

LA 1 Coalition. 2010b. One to One. Fall 2010 Newsletter. Internet website: http://www.la1coalition.org/images/Fall2010webLA1news.pdf.

LaCoast.gov. 2010a. CWPPRA projects. Internet website. http://www.lacoast.gov/projects/list.asp. Accessed January 13, 2011.

LaCoast.gov. 2010b. Coastal Wetlands Planning, Protection, and Restoration Act: Summary of wetland benefit for priority list projects. Internet website: http://www.lacoast.gov/reports/wva/CWPPRA%20project%20benefits%202010-03-22.pdf. Posted March 22, 2010. Accessed May 24, 2010.

LaCoast.gov. 2010c. The Calcasieu/Sabine Basin. Internet website: http://lacoast.gov/new/About/Basin_data/cs/Default.aspx. Accessed September 29, 2010.

LaCoast.gov. 2011. Atchafalaya Basin: Summary of basin plan. Internet website: http://lacoast.gov/new/About/Basin_data/at/Default.aspx. Accessed January 28, 2011.

Lack, D.L. 1968. Ecological adaptations for breeding in birds. London: Methuen. 409 pp.

LaDeau, S.L., A.M. Kilpatrick, and P.P. Marra. 2007. West Nile virus emergence and large-scale declines of North American bird populations. Nature 447:710-714 and Supplementary Information, 10 pp.

Lambert, G., D.B. Peakall, B.J.R. Philogene, and F.R. Engelhardt. 1982. Effect of oil and oil dispersant mixtures on the basal metabolic rate of ducks. Bulletin of Environmental Contamination and Toxicology 29:520-524.

Lange, R. 1985. A 100-ton experimental oil spill at Halten Bank, off Norway. In: Proceedings, 1985 Oil Spill Conference, February 25-28, 1985, Los Angeles, CA. Washington, DC: American Petroleum Institute.

Lange, J.L., D.A. Schwartz, B.N. Doebbeling, J.M. Heller, and P.S. Thorne. 2002. Exposures to the Kuwait oil fires and their association with asthma and bronchitis among Gulf War veterans. Environmental Health Perspectives 110(11):1141-1146.

Lassuy, D.R. 1983. Species profiles: Life histories and environmental requirements (Gulf of Mexico)—brown Shrimp. U.S. Dept. of the Interior, Fish and Wildlife Service, Division of Biological Services, FWS/OBS-82/11.1. U.S. Dept. of the Army, Corps of Engineers, TR EL-82-4. 15 pp.

Lavoie, D., J.G., Flocks, J.L. Kindinger, A.H. Sallengaer, and D.C. Twichell. 2010. Effects of building a sand barrier berm to mitigate the effects of the *Deepwater Horizon* oil spill on Louisiana marshes. U.S. Dept. of the Interior, Geological Survey. Open-File Report 2010-1108. 7 pp. Internet website: http://pubs.usgs.gov/of/2010/1108/pdf/of2010-1108.pdf.

Leahy, J.G. and R.R. Colwell. 1990. Microbial degradation of hydrocarbons in the environment. Microbiological Reviews 54(3):305-315.

LeBlanc, D.J. 1985. Environmental and construction techniques involved with the installation of a gas pipeline across Timbalier Island, Louisiana. In: Proceedings, Sixth Annual Gulf of Mexico Information Transfer Meeting, October 22-24, 1985. U.S. Dept. of the Interior, Minerals Management Service, Gulf of Mexico OCS Region, New Orleans, LA. OCS Study MMS 86-0073. Pp. 203-205.

Leblanc, D. 2010. Official communication. Lack of ecological change in the beach mouse after the *Deepwater Horizon* event. Wildlife Biologist, U.S. Dept. of the Interior, Fish and Wildlife Service, Ecological Services Office, Daphne, AL. July 6, 2010.

Lee, M.R. and T.C. Blanchard. 2010. Health impacts of *Deepwater Horizon* oil disaster on coastal Louisiana residents. Louisiana State University, Department of Sociology, Baton Rouge, LA.

Lee, D.S. and M.L. Moser. 1998. Importance des Sargasses pelagiques pour la recherché alimentaire des oiseaux marins. El Pitirre 11(3):111-112.

Leighton, F.A. 1993. The toxicity of petroleum oils to birds. Environmental Reviews 1:92-103.

Lewis, J.B. 1971. Effect of crude oil and an oil-spill dispersant on reef corals. Marine Pollution Bulletin 2:59-62.

Lewis, A. and D. Aurand. 1997. Putting dispersants to work: Overcoming obstacles. 1997 International Oil Spill Conference. API 4652A. Technical Report IOSC-004.

LGL Ecological Research Associates Inc. 1990. Characterization of the chemosynthetic fauna at Viosca Knoll Block 826. Report for Oryx Energy. 35 pp. + plates.

LGL Ecological Research Associates, Inc. and Texas A&M University. 1986. Gulf of Mexico continental slope study: Annual report, year 2. Volume II: Primary volume. U.S. Dept. of the Interior, Minerals Management Service, Gulf of Mexico OCS Office, Metairie, LA. OCS Study MMS 86-0090. 220 pp.

Lin, Q. and I.A. Mendelssohn. 1996. A comparative investigation of the effects of South Louisiana Crude on the vegetation of fresh, brackish and salt marshes. Marine Pollution Bulletin 32:202-209.

Lindstrom, J.E. and J.F. Braddock. 2002. Biodegradation of petroleum hydrocarbons at low temperature in the presence of the dispersant Corexit 9500. Marine Pollution Bulletin 44 (8):739-747. Internet website: http://www.sciencedirect.com/science/journal/0025326X Accessed January 28, 2011.

Lirman, D., G. Deangelo, J. Serafy, A. Hazra, D. Smith Hazra, J. Herlan, J. Lou, S. Bellmund, J. Wang, and R. Clausing. 2008. Seasonal changes in the abundance and distribution of submerged aquatic vegetation in a highly managed coastal lagoon. Hydrobiologia 596:105-120.

Lissner, A.L., G.L. Taghon, D.R. Diener, S.C. Schroeter, and J.D. Dixon. 1991. Recolonization of deep-water hard-substrate communities: Potential impacts from oil and gas development. Ecological Implications 1(3):258-267.

Littler, D.S. and M.M. Littler. 2000. Caribbean reef plants; an identification guide to the reef plants of the Caribbean, Bahamas, Florida and Gulf of Mexico. Offshore Graphics Inc., FL. Pp. 280-290.

Liu, K-B. and M.L. Fearn. 2000. Holocene history of catastrophic hurricane landfalls along the Gulf of Mexico coast reconstructed from coastal lake and marsh sediments. In: Nig, Z.H. and K.K. Abdollahi, eds. Current stresses and potential vulnerabilities: Implications of global change for the Gulf Coast region of the United States. Baton Rouge, LA: Franklin Press.

Liu, A. and A. Plyer. 2010. The New Orleans Index at Five: An overview of greater New Orleans—from recovery to transformation. Washington: Brookings Institution and Greater New Orleans Community Data Center. 20 pp. Internet website: https://gnocdc.s3.amazonaws.com/NOIat5/Overview.pdf.

Llacuna, S., A. Gorriz, M. Durfort, and J. Nadal. 1993. Effects of air pollution on passerine birds and small mammals. Archives of Environmental Contamination and Toxicology 24:59-66.

Locker, S. 2008. Official communication. Information concerning the Sticky Mounds 185 km west of Tampa Bay, Florida. Unpublished cruise plan of the Florida Institute of Oceanography, R/V *Bellows*, for October 27-29, 2008. University of South Florida, Dept. of Marine Sciences, St. Petersburg, FL.

Lohoefener, R., W. Hoggard, K. Mullin, C. Roden, and C. Rogers. 1990. Association of sea turtles with petroleum platforms in the north-central Gulf of Mexico. U.S. Dept. of the Interior, Minerals Management Service, Gulf of Mexico OCS Region, New Orleans, Louisiana. OCS Study MMS 90-0025. 90 pp.

Lohr, K. 2010. Louisiana Gulf Coast businesses lament losses. National Public Radio. October 13, 2010. Internet website: http://www.npr.org/templates/story/story.php?storyId=130537922. Accessed November 12, 2010.

Long, B.F. and J.H. Vandermuelen. 1983. Geomorphological impact of cleanup of an oiled salt marsh (Ile Grande, France). In: Proceedings, 1983 Oil Spill Conference, February 28-March 3, 1983, San Antonio, TX. Washington, DC: American Petroleum Institute. Pp. 501-505.

Longley, W.L., ed. 1994. Freshwater inflows to Texas bays and estuaries: Ecological relationships and methods for determination of needs. Texas Water Development Board and Texas Parks and Wildlife Department, Austin, TX. 386 pp.

Longwell, A.C. 1977. A genetic look at fish eggs and oil. Oceanus 20(4):46-58.

Loren C. Scott & Associates. 2008. The economic impacts of Port Fourchon on the national and Houma MSA economies. 31 pp. Internet website: http://www.portfourchon.com/site100-01/1001757/docs/port_fourchon_economic_impact_study.pdf.

Louisiana Bucket Brigade. 2010. Self-reported health and economic impact survey: An analysis of the *Deepwater Horizon* spill disaster in four coastal Louisiana parishes. March 3, 2011. Internet website: http://www.labucketbrigade.org/article.php?id=718. Accessed December 6, 2011.

Louisiana Coastal Wetlands Conservation and Restoration Task Force. 1993. Coastal Wetland Planning, Protection, and Restoration Act: Louisiana coastal wetlands restoration plan; main report and environmental impact statement. Louisiana Coastal Wetlands Conservation and Restoration Task Force, Baton Rouge, LA.

Louisiana Coastal Wetlands Conservation and Restoration Task Force. 2006. The 2006 evaluation report to the U.S. Congress on the effectiveness of Coastal Wetlands Planning, Protection and Restoration Act projects. Submitted by the Chairman of the Louisiana Coastal Wetlands Conservation and Restoration Task Force, U.S. Dept. of the Army, Corps of Engineers, New Orleans District, New Orleans, LA. 73 pp.

Louisiana Dept. of Culture, Recreation, and Tourism. 2010. Louisiana's State parks, historic sites and preservation area. Internet website: http://www.crt.state.la.us/parks/iparkmap.aspx. Accessed April 14, 2011.

Louisiana Dept. of Environmental Quality. 2004. Louisiana environmental inventory report, 2nd annual edition, April 2004. Baton Rouge, LA. 92 pp.

Louisiana Dept. of Environmental Quality. 2010. Louisiana Administrative Code. Title 33: Environmental quality; Part III. Air. Chapter 21: Control of emission of organic compounds. Section 2108: Marine vapor recovery. Pp. 144-146. Internet website: http://www.deq.louisiana.gov/portal/LinkClick.aspx?fileticket=wEHlil1kyQ8%3d&tabid=1674. Accessed April 17, 2011.

Louisiana Dept. of Health & Hospitals. 2008. Disease Cluster Investigation Program: Fact sheet. Louisiana Dept. of Health & Hospitals, Center for Environmental Health, Baton Rouge, LA. Internet website: http://new.dhh.louisiana.gov/index.cfm/page/563. Accessed in July 2011.

Louisiana Dept. of Natural Resources. 1998. Coast 2050: Toward a sustainable coastal Louisiana. Report of the Louisiana Coastal Wetlands Conservation and Restoration Task Force and the Wetlands Conservation and Restoration Authority. Baton Rouge, LA. 173 pp. Internet website: http://www.coast2050.gov/products/docs/orig/2050report.pdf.

Louisiana Dept. of Natural Resources. 2009. Louisiana is proud to be a hub of industry. 6 pp. Internet website: http://dnr.louisiana.gov/assets/docs/hub-of-business_brochure.pdf. Accessed January 23, 2011.

Louisiana Dept. of Natural Resources. 2010. Production information. SONRIS lite. Internet website: http://sonris-www.dnr.state.la.us/www_root/sonris_portal_1.htm. Accessed October 6, 2010.

Louisiana Dept. of Wildlife and Fisheries. 2008a. The impact of Hurricane Gustav on the fisheries resources of Louisiana: Preliminary report. September 8, 2008. 4 pp.

Louisiana Dept. of Wildlife and Fisheries. 2008b. The impact of Hurricane Ike on the fisheries resources of Louisiana: Preliminary report. October 2, 2008. 5 pp.

Louisiana Dept. of Wildlife and Fisheries. 2009. L.D.W.F. fisheries recovery assessment will benefit commercial fishermen and seafood dealers. News Release, April 17, 2009. Internet website: http://wlf.louisiana.gov/news/30198. Accessed May 18, 2011.

Louisiana Dept. of Wildlife and Fisheries. 2010a. Oyster stock assessment report of the public oyster areas in Louisiana. Oyster Data Report Series No. 16. July, 2010.

Louisiana Dept. of Wildlife and Fisheries. 2010b. Artificial reef program (maps). Internet website: http://www.wlf.louisiana.gov/fishing/artificial-reef-program. Accessed April 15, 2011.

Louisiana Dept. of Wildlife and Fisheries. 2010c. Louisiana fishing regulations 2010—recreational. 48 pp. Internet website: http://www.wlf.louisiana.gov/sites/default/files/pdf/publication/31743-recreational-fishing-regulations/2011_rec_fish.pdf.

Louisiana Dept. of Wildlife and Fisheries. 2011. Frequently asked questions (FAQ). Whooping crane reintroduction in Louisiana; questions and answers about the environmental assessment and nonessential, experimental designation history and background. http://www.wlf.louisiana.gov/wildlife/faq

Louisiana Mid-Continent Oil and Gas Association. 2010. Impact of President Obama's order halting work on 33 exploratory wells in the deepwater Gulf of Mexico. Internet website: http://www.lmoga.com/Economic%20Impacts%20of%20Gulf%20Moratorium.pdf. Accessed July 7, 2010.

Louisiana Sea Grant. 2006. Louisiana hurricane resources, barrier islands & wetlands. Internet website: http://www.laseagrant.org/hurricane/archive/wetlands.htm. Accessed September 29, 2010.

Louisiana Universities Marine Consortium (LUMCON). 2008. Dead zone again rivals record size. Press Release, July 28, 2008. Internet website: http://www.gulfhypoxia.net/. Accessed May 4, 2009.

Louisiana Universities Marine Consortium (LUMCON). 2009. Gulf of Mexico dead zone surprisingly small in area, but severe. Press Release, July 24, 2009. Internet website: http://www.gulfhypoxia.net/Research/Shelfwide%20Cruises/2009/Files/Press_Release.pdf/. Accessed August 24, 2009.

Louisiana Universities Marine Consortium (LUMCON). 2010. 2010 Dead zone—one of the largest ever. LUMCON News. Internet website: http://www.lumcon.edu/Information/news/default.asp?XMLFilename=201008021451.xml. Accessed August 10, 2010.

Loya, Y. 1975. Possible effects of water pollution on the community structure of Red Sea corals. Marine Biology 29:177-185.

Loya, Y. 1976a. Recolonization of Red Sea corals affected by natural catastrophes and man-made perturbations. Ecology 57:278-289.

Loya, Y. 1976b. Effects of water turbidity and sedimentation on the community structure of Puerto Rican corals. Bulletin of Marine Science 26(4):450-466.

Loya, Y. and B. Rinkevich. 1979. Abortion effect in corals induced by oil pollution. Marine Ecology Progress Series 1:77-80.

Lu, L. and R.S.S. Wu. 2006. A field experimental study on recolonization and succession of macrobenthic infauna in defaunated sediment contaminated with petroleum hydrocarbons. Estuarine, Coastal and Shelf Science 68:627-634.

Lubchenco, J.L., M. McNutt, B. Lehr, M. Sogge, M. Miller, S. Hammond, and W. Conner. 2010. BP *Deepwater Horizon* oil budget: What happened to the oil? Internet website: http://www.noaanews.noaa.gov/stories2010/PDFs/OilBudget_description_%2083final.pdf. Accessed September 8, 2010.

Ludwick, J.C. and W.R. Walton. 1957. Shelf-edge, calcareous prominences in the northeastern Gulf of Mexico. Bulletin of the American Association of Petroleum Geologists 41(9):2054-2101.

Lugo-Fernandez, A., D.A. Ball, M. Gravois, C. Horrell, and J.B. Irion. 2007. Analysis of the Gulf of Mexico's Veracruz-Havana route of La Flota de la Nueva España. Journal of Maritime Archaeology 2(1):24-47.

Lutcavage, M.E., P. Plotkin, B. Witherington, and P.L. Lutz. 1997. Human impacts on sea turtle survival. In: Lutz, P.L. and J.A. Musick, eds. The biology of sea turtles. Boca Raton, FL: CRC Press, Inc. Pp. 387-409.

Luton, H.H. and R.E. Cluck. 2004. Social impact assessment and offshore oil and gas in the Gulf of Mexico. In: Proceedings, 24th Annual Conference, International Association for Impact Assessment, 24-30 April 2004, Vancouver, Canada.

Lyons, T.J. and W.D. Scott. 1990. Principles of air pollution meteorology. Boca Raton, FL: CRC Press, Inc. 225 pp.

Lytle, J.S. 1975. Fate and effects of crude oil on an estuarine pond. In: Proceedings, Conference on Prevention and Control of Oil Pollution, San Francisco, CA. Pp. 595-600.

Mac, M.J., P.A. Opler, C.E. Puckett Haecker, and P.D. Doran. 1998. Status and trends of the Nation's biological resources: Volume 1 (pp. 1-436). U.S. Dept. of the Interior, Geological Survey, Reston, VA. P. 391. Internet website: http://www.nwrc.usgs.gov/sandt/SNT.pdf. Accessed September 29, 2010.

MacDonald, I.R., ed. 1992. Chemosynthetic ecosystems study literature review and data synthesis, northern Gulf of Mexico: Volumes I-III. U.S. Dept. of the Interior, Minerals Management Service, Gulf of Mexico OCS Region, New Orleans, LA. OCS Study MMS 92-0033, 92-0034, and 92-0035. 25, 218, and 263 pp., respectively.

MacDonald, I.R., ed. 1998. Stability and change in Gulf of Mexico chemosynthetic communities: Interim report. U.S. Dept. of the Interior, Minerals Management Service, Gulf of Mexico OCS Region, New Orleans, LA. OCS Study MMS 98-0034. 114 pp.

MacDonald, I.R., ed. 2002. Stability and change in Gulf of Mexico chemosynthetic communities. Volume II: Technical report. U.S. Dept. of the Interior, Minerals Management Service, Gulf of Mexico OCS Region, New Orleans, LA. OCS Study MMS 2002-036. 465 pp.

MacDonald, I.R., G.S. Boland, J.S. Baker, J.M. Brooks, M.C. Kennicutt II, and R.R. Bidigare. 1989. Gulf of Mexico hydrocarbon seep communities. II. Spatial distribution of seep organisms and hydrocarbons at Bush Hill. Marine Biology 101:235-247.

MacDonald, I.R., N.L. Guinasso, Jr., J.F. Reilly, J.M. Brooks, W.R. Callender, and S.G. Gabrielle. 1990. Gulf of Mexico hydrocarbon seep communities. VI. Patterns in community structure and habitat. Geo-Marine Letters 10:244-252.

MacDonald, I.R., N.L. Guinasso Jr., S.G. Ackleson, J.F. Amos, R. Duckworth, R. Sassen, and J.M. Brooks. 1993. Natural oil slicks in the Gulf of Mexico visible from space. Journal of Geophysical Research 98(C9):16,351-16,364.

MacDonald, I.R., N.L. Guinasso, R. Sassen, J.M. Brooks, S. Lee, and K.T. Scott. 1994. Gas hydrates that breach the sea-floor and intersect with the water column on the continental slope of the Gulf of Mexico. Geology 22:699-702.

MacDonald, I.R., W.W. Schroeder, and J.M. Brooks, eds. 1995. Chemosynthetic ecosystems study: Final report. Volume 2: Technical report. U.S. Dept. of the Interior, Minerals Management Service, Gulf of Mexico OCS Region, New Orleans, LA. OCS Study MMS 95-0022. 319 pp.

MacDonald, I.R., J.F. Reilly Jr., W.E. Best, R. Vnkataramaiah, R. Sassen, N.S. Guinasso Jr., and J. Amos. 1996. Remote sensing inventory of active oil seeps and chemosynthetic communities in the northern Gulf of Mexico. In: Schumacher, D. and M.A. Abrams, eds. Hydrocarbon migration and its near-surface expression. American Association of Petroleum Geologists Memoir 66:27-37.

Mackar, R. 2010. NIH to launch Gulf oil spill health study. Environmental Factor: Your online source for NIEHS news. Internet website: http://www.niehs.nih.gov/news/newsletter/2010/october/spotlight-launch.cfm. Accessed October 2010.

Mackin, J.G. and A.K. Sparks. 1961. A study of the effect on oysters of crude oil loss from a wild well. Publications of the Institute of Marine Science 7:230-261.

Macreadie, P.I., A.M. Fowler, and D.J. Booth. 2011. Rigs-to-reefs: Will the deep sea benefit from artificial habitat? Frontiers in Ecology and the Environment (e-view). doi:10.1890/100112. Internet website: http://www.esajournals.org/doi/pdf/10.1890/100112. Accessed September 22, 2011.

Madge, S. and H. Burn. 1988. Waterfowl: An identification guide to the ducks, geese, and swans of the world. Boston, MA: Houghton Mifflin. 298 pp.

Magill, K. 2010. Local jobless rate remains lowest in La. Internet website: http://www.houmatoday.com/article/20101123/ARTICLES/101129790. Accessed December 8, 2010.

Maiaro, J.L. 2007. Disturbance effects on nekton communities of seagrasses and bare substrates in Biloxi Marsh, Louisiana. Master's thesis, Louisiana State University, Baton Rouge, LA. 78 pp. Internet website: http://etd.lsu.edu/docs/available/etd-07032007-101237/unrestricted/Maiaro_thesis.pdf.

Malins, D.C., S. Chan, H.O. Hodgins, U. Varanasi, D.D. Weber, and D.W. Brown. 1982. The nature and biological effects of weathered petroleum. U.S. Dept. of Commerce, National Marine Fisheries Service, Northwest and Alaska Fisheries Center, Environmental Conservation Division, Seattle, WA. 43 pp.

Malins, D.C., M.M. Krahn, M.S. Myers, L.D. Rhodes, D.W. Brown, C.A. Krone, B.B. McCain, and S-L. Chan. 1985. Toxic chemicals in sediments and biota from a creosote-polluted harbor:

relationships with hepatic neoplasms and other hepatic lesions in English sole (*Parophrys vetulus*). Carcinogenesis 6:1463-469.

Mallinson, D.J., A.C. Hine, S.D. Locker, and M.R. Hafen. 1998. The Florida Middle Ground: A complex product of geological, physical, and biological interactions. U.S. Dept. of the Interior, Geological Survey, Center for Coastal Geology. Internet website: http://coastal.er.usgs.gov/wfla/HTML/framework/ofr_f9.htm.

Mallinson, D., B. Donahue, D. Naar, A. Hine, and S. Locker. 2006. Pleistocene and Holocene geologic controls on the Florida Middle Ground relict reef complex: A diverse benthic environment on the West Florida Shelf. 3th Ocean Sciences Meeting, February 2006, Honolulu HI. Internet website: http://www.agu.org/meetings/os06/os06-sessions/os06_OS26I.html. Accessed May 18, 2011.

Mallman, E.P. and M.D. Zoback. 2007. Subsidence in the Louisiana coastal zone due to hydrocarbon production. Proceedings of the 9th International Coastal Symposium, Journal of Coastal Research SI 50:443–449. Gold Coast, Australia. Internet website: http://www.griffith.edu.au/conference/ics2007/pdf/ICS085.pdf.

Malme, C.I., P.W. Smith, and P.R. Miles. 1986. Characterization of geophysical acoustic survey sounds. U.S. Dept. of the Interior, Minerals Management Service, Pacific OCS Region, Los Angeles, CA. OCS Study 86-0032. 92 pp.

Manville II, A.M. 2005. Bird strikes and electrocutions at power lines, communication towers, and wind turbines: State of the art and state of the science—next steps toward mitigation. In: Ralph, C.J. and T.D. Rich, eds. Bird conservation implementation in the Americas: Proceedings of the 3rd International Partners in Flight Conference, 2002. U.S. Dept. of Agriculture, Forest Service, Pacific Southwest Research Station, Albany, CA. Forest Service General Technical Report PSW-GTR-191. Pp. 1051-1064.

Manzella, S., J. Williams, B. Schroeder, and W. Teas. 2001. Juvenile head-started Kemp's ridleys found in floating grass mats. Marine Turtle Newsletter 52:5-6.

Marchent, S.R. and M.K. Shutters. 1996. Artificial substrates collect Gulf sturgeon eggs. North American Journal of Fisheries Management 16:445-447.

Marine Resources Research Institute (MRRI). 1984. South Atlantic OCS area living marine resources study: Phase III; final report. Volume 1. Prepared for the U.S. Dept. of the Interior, Minerals Management Service, Washington, DC. Contract No. 14-12-0001-29185. Internet website: http://www.gomr.boemre.gov/PI/PDFImages/ESPIS/4/4622.pdf. 239 pp.

Marine Well Containment Company (MWCC). 2010. New oil spill containment system to protect Gulf of Mexico planned by major oil companies. Press Release, July 21, 2010. Internet website: http://marinewellcontainment.com/press.php?pressid=1. Accessed December 27, 2010.

Marine Well Containment Company (MWCC). 2011. Marine Well Containment Company interim system capping stack now usable in 10,000 feet of water. Press Release, June 14, 2011. Internet website: http://marinewellcontainment.com/pdfs/MWCC-10,000-Feet-Approval_061411.pdf. Accessed October 11, 2011.

Market Dynamics Research Group. 2011. Oil spill research report: April 7, 2011. 55 pp. Internet website: http://www.crt.state.la.us/tourism/research/Documents/2010-11/OilSpillReport_regional_nationwide20110407.pdf.

Marshall, P.A. 2000. Skeletal damage in reef corals: Relating resistance to colony morphology. Marine Ecology Progress Series 200:177-189.

Marszalek, D.S. 1981. Impact of dredging on a subtropical reef community, southeast Florida, USA. In: Proceedings of the Fourth International Coral Reef Symposium. Vol 1. May 18-22, 1981. Manila, Philippines.

Martin, R.P. 1991. Regional overview of wading birds in Louisiana, Mississippi, and Alabama. In: Proceedings of the Coastal Nongame Workshop. U.S. Dept. of the Interior, Fish and Wildlife Service, Region 4, and Florida Game and Fresh Water Fish Commission. Pp. 22-33.

Martin, R.P. and G.D. Lester. 1991. Atlas and census of wading bird and seabird nesting colonies in Louisiana: 1990. Louisiana Dept. of Wildlife and Fisheries, Louisiana Natural Heritage Program. Special Publication No. 3.

Mascarelli, A. 2010. *Deepwater Horizon*: After the oil. Scientific American. Internet website: http://www.scientificamerican.com/article.cfm?id=deepwater-horizon-after-the-oil. Posted September 1, 2010. Accessed December 27, 2010.

Mason, J. 2010. The economic cost of a moratorium on offshore oil and gas exploration to the Gulf region. Louisiana State University, Baton Rouge, LA.

Mason, W.T. and J.P. Clugston. 1993. Foods of the Gulf sturgeon in the Suwannee River, Florida. Transactions of the American Fisheries Society 122(3):378-385.

Massachusetts Technology Collaborative. 2005. A framework for offshore wind energy development in the United States. With the U.S. Dept. of Energy, National Renewable Energy Laboratory, and GE Energy. 30 pp. Internet website: http://www.masstech.org/offshore/final_09_20.pdf.

Matkin, C.O., E.L. Saulitis, G.M. Ellis, P. Olesiuk, and S.D. Rice. 2008. Ongoing population-level impacts on killer whales *Orcinus orca* following the "Exxon Valdez" oil spill in Prince William Sound, Alaska. Marine Ecology Progress Series 356:269-281.

Matthews, J.R. and C.J. Moseley. 1990. The official world wildlife fund guide to endangered species of North America. Volume 2: Birds, reptiles, amphibians, fishes, mussels, crustaceans, snails, insects, and arachnids. Mississippi sandhill crane. Washington, DC: Beacham Publishing, Inc.

Matthews, T. and B. Cameron, Jr. 2010. OCS regulatory framework for the Gulf of Mexico region. U.S. Dept. of the Interior, Minerals Management Service, Gulf of Mexico OCS Region, New Orleans, LA. OCS Report MMS 2010-019. 24 pp. Internet website: http://www.gomr.boemre.gov/PDFs/2010/2010-019.pdf.

Matthiessen, P. and J. P. Sumpter. 1998. Effects of estrogenic substances in the aquatic environment. In: Braunbeck, T., D.E. Hinton, and B. Streit, eds. Fish ecotoxicology. Birkhauser Verlag: Basel, Switzerland.

Maze-Foley, K. and K.D. Mullin. 2006. Cetaceans of the oceanic northern Gulf of Mexico: Distributions, group sizes and interspecific associations. J. Cetacean Res. Manage. 8(2):203-213.

McAuliffe, C.D. 1987. Organism exposure to volatile soluble hydrocarbons from crude oil spills—a field and laboratory comparison. In: Proceedings, 1987 Oil Spill Conference . . . April 6-9, 1988, Baltimore, MD. Washington, DC: American Petroleum Institute. Pp. 275-288.

McAuliffe, C.D., A.E. Smalley, R.D. Groover, W.M. Welsh, W.S. Pickle, and G.E. Jones. 1975. Chevron Main Pass Block 41 oil spill: Chemical and biological investigation. In: Proceedings, 1975 Conference on Prevention and Control of Oil Pollution, March 25-27, 1975, San Francisco, CA. Washington, DC: American Petroleum Institute.

McAuliffe, C.D., B.L. Steelman, W.L. Leek, D.E. Fitzgerald, J.P. Ray, and C.D. Baker. 1981a. The 1979 southern California dispersant treated research oil spills. In: Proceedings 1981 Oil Spill Conference . . . March 2-5, 1981, Atlanta, GA. Washington DC: American Petroleum Institute. Pp. 269-282.

McAuliffe, C.D., G.P. Canevari, T.D. Searl, J.C. Johnson, and S.H. Greene. 1981b. The dispersion and weathering of chemically treated crude oils on the sea surface. In: Petroleum and the Marine Environment. Proceedings of Petromar '80. London: Graham and Trotman Ltd.

McBride, R.A., S. Penland, M.W. Hiland, S.J. Williams, K.A. Westphal, B.J. Jaffe, and A.H. Sallenger. 1992. Analysis of barrier shoreline change in Louisiana from 1853 to1989. In: Williams, S.J., S.

Penland, and A.H. Sallenger, eds. Atlas of shoreline changes in Louisiana from 1853 to 1989. U.S. Dept. of the Interior, Geological Survey. Miscellaneous Investigation Series I-2150-A. Pp. 36-97.

McCauley, R.D. and R.C. Harrel. 1981. Effects of oil spill cleanup techniques on a salt marsh. In: Proceedings, 1981 Oil Spill Conference . . . March 2-5, 1981, Atlanta, GA. Washington, DC: American Petroleum Institute. Pp. 401-407.

McConnaughey, R.A., K.L. Mier, and C.B. Dew. 2000. An examination of chronic trawling effects on soft-bottom benthos of the eastern Bering Sea. ICES Journal of Marine Science 57:1377-1388.

McCoy, M. and J. Salerno. 2010. Assessing the effects of the Gulf of Mexico oil spill on human health—workshop summary. Institute of Medicine of the National Academies. Pp. 43-74.

McDonald, T.J., J.M. Brooks, and M.C. Kennicutt II. 1984. The effects of dispersant on incorporation of volatile liquid hydrocarbons into the water column. In: Allen. T.E, ed. Oil spill chemical dispersants: Research, experience, and recommendations. ASTM Committee F-20 on Hazardous Substances and Oil Spill Response. ASTM STP 840.

McDonald, S.J., K.L. Willett, J. Thomsen, K.B. Beatty, K. Connor, T.R. Narasimhan, C.M. Erikson, and S.H. Safe. 1996. Sublethal detoxification responses to contaminant exposure associated with offshore production platforms. Canadian Journal of Fisheries and Aquatic Science 53:2606-2617.

McGinnis, M.V., L. Fernandez, C. Pomeroy, S. Hitz, and C. Navarro. 2001. The politics, economics, and ecology of decommissioning offshore oil and gas structures. U.S. Dept. of the Interior, Minerals Management Service, Pacific OCS Region, Camarillo, CA. OCS Study MMS 2001-006. 98 pp.

McGrattan, K.B., W.D. Walton, A.D. Putorti Jr., W.H. Twilley, J.A. McElroy, and D.D. Evans. 1995. Smoke plume trajectory from in situ burning of crude oil in Alaska—field experiments. In: Proceedings of the Eighteenth Arctic and Marine Oil spill Program (AMOP) Technical Seminar, Vol. 2, June 14-16, 1995, Edmonton, Alberta, Canada.

McGrail, D. 1982. Water and sediment dynamics at the Flower Garden Banks. In: Norman, R., ed. Environmental studies at the Flower Gardens and selected banks: Northwestern Gulf of Mexico, 1979-1981. Executive summary. Technical Report No. 82-8-T. Pp. 27-29.

McIlgorm, A., H.F. Campbell, and M.J. Rule. 2009. Understanding the economic benefits and costs of controlling marine debris in the APEC region (MRC 02/2007). A report to the Asia-Pacific Economic Cooperation, Marine Resource Conservation Working Group by the National Marine Science Centre (University of New England and Southern Cross University). Coffs Harbour, NSW, Australia. APEC#209-MR-01.3. 95 pp.

McKeithen, M.A. 2007. Testimony to the Committee on Energy and Natural Resources: Hearing on oil and gas resources on the outer continental shelf and areas available for leasing in the Gulf of Mexico, January 25, 2007. Louisiana Dept. of Natural Resources, Office of Mineral Resources. Internet website: http://energy.senate.gov/public/_files/MarjoriesTestimonyFinal2.doc. Accessed February 16, 2011.

McLaughlin, S.L. 1995. Roots, relics, and recovery: What went wrong with the Abandoned Shipwreck Act of 1987. Columbia-VLA Journal of Law & the Arts 19(3):149-198.

McLelland, J.A. and R.W. Heard. 2004. Analysis of benthic macro-invertebrates from northern Florida shallow coastal area where Gulf sturgeon, *Acipenser oxyrinchus desotoi*, are believed to forage. Final report to the U.S. Dept. of the Interior, Fish and Wildlife Service. 27 pp.

McLelland, J.A. and R.W. Heard. 2005. Analysis of benthic macro-invertebrates collected from Gulf sturgeon foraging grounds in northern Florida shallow coastal areas: Year 2. Final report to the U.S. Dept. of the Interior, Fish and Wildlife Service. 26 pp.

MCS Advanced Subsea Engineering. 2010. Risk analysis of using a surface BOP. Prepared for the U.S. Dept. of the Interior, Minerals Management Service. TA&R Project 640. 113 pp. + apps. Internet website: http://www.boemre.gov/tarprojects/640/aa.pdf.

McTigue, T.A. and R.J. Zimmerman. 1998. Use of infauna by juvenile *Panaeus aztecus* Ives and *Panaeus setiferus* (Linnaeus). Estuaries 21(1):160-175.

Mechalas, B.J. 1974. Pathways and environmental requirements for biogenic gas production in the ocean. In: Kaplan, I.R., ed. Natural gases in marine sediments. Marine Science, Volume 3. New York, NY: Plenum Press.

Meckel, T.A., U.S. tenBrink, and S.J. Williams. 2006. Current subsidence rates due to compaction of Holocene sediments in southern Louisiana. Geophysical Research Letters Volume 33, L11403. Internet website: http://www.agu.org/pubs/crossref/2006/2006GL026300.shtml.

Melendez, J., J.J. Schubert, and M. Amani. 2006. Risk assessment of surface vs. subsurface BOPs on mobile offshore drilling units. Final project report prepared for the U.S. Dept. of the Interior, Minerals Management Service under the MMS/OTRC Cooperative Research Agreement 1435-01-04-CA-35515. TA&R Project 540. 103 pp. Internet website: http://www.boemre.gov/tarprojects/540/aa.pdf.

Memphis State University. 1971. Effects of noise on wildlife and other animals. Prepared for the U.S. Environmental Protection Agency, Office of Noise Abatement and Control, Washington, DC, under contract number 68-04-0024.

Mendelssohn, I.A. and M.W. Hester. 1988. Texaco USA: Coastal vegetation project, Timbalier Island. New Orleans, LA: Texaco USA. 207 pp.

Mendelssohn, I.A., M.W. Hester, C. Sausser, and M. Fishel. 1990. The effect of a Louisiana crude oil discharge from a pipeline break on the vegetation of a southeast Louisiana brackish marsh. Oil and Chemical Pollution 7:1-15.

Mendelssohn, I.A., M.W. Hester, and J.M. Hill. 1993. Effects of oil spills on coastal wetlands and their recovery. U.S. Dept. of the Interior, Minerals Management Service, Gulf of Mexico OCS Region, New Orleans, LA. OCS Study MMS 93-0045. 46 pp.

Menzies, R.J., R.Y. George, and G.T. Rowe. 1973. Abyssal environment and ecology of the world oceans. Wiley-Interscience. 488 pp.

Meo, S.A. 2009. Effect of duration of exposure to polluted air environment on lung function in subjects exposed to crude oil spill into sea water. International Journal of Occupational Medicine and Environmental Health 22(1):35-41.

Mettee, M.F., T.E. Shepard, J.B. Smith, S.W. McGregor, C.C. Johnson and P.E. O'Neil. 2009. A survey for the Gulf sturgeon in the Mobile and Perdido Basins, Alabama. Geological Survey of Alabama. Open-File Report 0903. 94 pp. Internet website: http://www.gsa.state.al.us/gsa/eco/pdf/OFR_0903.pdf.

Meylan, A.B. and M. Donnelly. 1999. Status justification for listing the hawksbill turtle (*Eretmochelys imbricata*) as critically endangered on the 1996 IUCN Red List of threatened animals. Chelonian Conservation and Biology 3(2):200-204.

Meylan, A. and D. Ehrenfeld. 2000. Conservation of marine turtles. In: Klemens, M.K., ed. Turtle conservation. Washington, DC: Smithsonian Institution Press. Pp. 96-125.

Michel, J. 1992. Chapter 2. Oil behavior and toxicity. In: Hayes, M.O., R. Hoff, J. Michel, D. Scholz, and G. Shigenaka. An introduction to coastal habitats and biological resources for oil spill response. U.S. Dept. of Commerce, National Oceanic and Atmospheric Administration, Office of Response and Restoration. NOAA Report No. HMRAD 92-4. Pp. 2-1 through 2-9. Internet website: http://response.restoration.noaa.gov/book_shelf/678_Chapter2.pdf.

Michot, T.C., C.W. Jeske, J.C. Mazourek, W.G. Vermillion, R.S. Kemmerer, and D. Baker. 2003. Atlas and census of wading bird and seabird nesting colonies in South Louisiana, 2001. Barataria-Terrebonne National Estuary Program Report No. 32. Thibodaux, LA. 93 pp.

Mikuska, T., J.A. Kushlan, and S. Hartley. 1998. Key areas for wintering North American herons. Colonial Waterbirds 21:125-134.

Miller, B.K. and W.R. Fontenot. 2001. Birds of the Gulf Coast. Louisiana University Press, Baton Rouge. 132 pp.

Mississippi Coalition of Vietnamese American Fisherfolk and Families. 2010. Mississippi Coalition preliminary report: Impact of BP oil spill on Vietnamese American communities and seafood industry. Internet website: http://www.mscenterforjustice.org/glomer/upload_repo/docs/MS%20Coalition%20PrelimReport_FINAL_06%2004%2010.pdf. 20 pp. Accessed March 28, 2011.

Mississippi Dept. of Marine Resources. 1999. Mississippi's coastal wetlands. Distributed by Eric Clark, Secretary of State.

Mississippi Dept. of Marine Resources. 2006. Coastal preserves. Internet website: http://www.dmr.state.ms.us/coastal-ecology/preserves/cp-home.htm. Accessed September 29, 2010.

Mississippi Dept. of Marine Resources. 2010a. Rigs-to-reef: Marine fisheries (artificial reef maps). Internet website: http://www.dmr.state.ms.us/Fisheries/Reefs/rigs-to-reef.htm. Accessed April 15, 2011.

Mississippi Dept. of Marine Resources. 2010b. Guide to Mississippi saltwater fishing: Rules and regulations; 2010-2011. 38 pp. Internet website: http://www.dmr.state.ms.us/publications/2010-2011-reg-book.pdf.

Mississippi Development Authority. Tourism Division. 2010. Fiscal year 2009 economic contribution of travel and tourism in Mississippi. 50 pp. Internet website: http://www.visitmississippi.org/resources/FY2009_Economic_Contribution_Report_and_Cover.pdf.

Mississippi Press. 2007. Sees salt dome as worst disaster since Katrina. News article. Internet website: http://www.gulflive.com/opinion/mississippipress/index.ssf?/base/opinion/119538457290590.xml. Accessed November 19, 2007.

Mitchell, H. 2010. Official communication. Vulnerability of beach mice to damage of burrows by cleanup personnel. Wildlife Biologist, U.S. Dept. of the Interior, Fish and Wildlife Service, Ecological Services Office, Panama City, FL.

Mitchell, R. and I. Chet. 1975. Bacterial attack of corals in polluted seawater. Microbial Ecology 2:227-233.

Mitchell, R., I.R. MacDonald, and K.A. Kvenvolden. 1999. Estimation of total hydrocarbon seepage into the Gulf of Mexico based on satellite remote sensing images. Transactions, American Geophysical Union 80(49), Ocean Sciences Meeting, OS242.

Mitsch, W.J. and J.G. Gosselink. 2007. Wetlands. Hoboken, NY: John Wiley and Sons.

Monaghan, P.H., C.D. McAuliffe, and F.T. Weiss. 1977. Environmental aspects of drilling muds and cuttings from oil and gas extraction operations in offshore and coastal waters. Presented at the Offshore Technology Conference, May 2-5, 1977, Houston, TX. Paper No. 2755-MS.

Monaghan, P.H., C.D. McAuliffe, and F.T. Weiss. 1980. Chapter 15: Environmental aspects of drilling muds and cuttings from oil and gas operations in offshore and coastal waters. In: Geyer, R.A., ed. Marine Environmental Pollution, 1. Hydrocarbons. Elsevier Oceanography Series, 27A. Amsterdam. Pp. 412-432.

Moncreiff, C.A. 2007. Statewide summary for Mississippi. In: Handley, D.A, D. Altsman, and R. DeMay, eds. Seagrass status and trends in the northern Gulf of Mexico: 1940-2002. U.S. Dept. of the Interior, Geological Survey Scientific Investigations Report 2006-5287 and U.S. Environmental Protection Agency 855-R-04-003. Pp. 73-76. Internet website: http://pubs.usgs.gov/sir/2006/5287/. Accessed May 13, 2011.

Montagna, P.A. and D.E. Harper, Jr. 1996. Benthic infaunal long-term response to offshore production platforms in the Gulf of Mexico. Canadian Journal of Fisheries and Aquatic Science 53:2567-2588.

Montagna, P. and T. Holmberg. 2000. Epibiont recruitment. In: McKay, M. and J. Nides. 2000. Proceedings: Eighteenth Annual Gulf of Mexico Information Transfer Meeting. December 1998. U.S. Dept. of the Interior, Minerals Management Service, Gulf of Mexico OCS Region, New Orleans, LA. OCS Study MMS 2000-030. Pp. 347-352.

Montagna, P.A. and J. Li. 1997. Modeling contaminant effects on deposit feeding nematodes near Gulf of Mexico production platforms. Ecological Modeling 98:151-162.

Monterrey Bay Aquarium Research Institute. 2008. Florida's ocean and coastal economies report: Phase II; facts and figures. 30 pp.

Moody, R., S. Kerner, L. Biermann, J. Howard, and J. Cebrian. 2011. Temporal dynamics of nekton abundance in coastal fringing marshes: Impact of the oil spill? In: Proceedings of the 40th Benthic Ecology Meeting, March 16-20, 2011, Mobile, AL.

Moore, J.J. 2006. State of the marine environment in SW Wales, 10 years after the *Sea Empress* oil spill. Prepared for Countryside Council for Wales. Marine Monitoring Report No. 21.

Moore, D.R. and H.R. Bullis, Jr. 1960. A deep-water coral reef in the Gulf of Mexico. Bulletin of Marine Science 10(1):125-128.

Moore, S.F. and R.L. Dwyer. 1974. Effects of oil on marine organisms: A critical assessment of published data. Water Research 8:819-827.

Moridis, G.J., T.S. Collett, R. Boswell, M. Kurihara, M.T. Reagan, C. Koh, and E.D. Sloan. 2008. Toward production from gas hydrates: Current status, assessment of resources, and simulation-based evaluation of technology and potential. Society of Petroleum Engineers. Unconventional Reservoirs Conference, Keystone, CO, February 10-12, 2008. 43 pp. Internet website: http://www.netl.doe.gov/technologies/oil-gas/publications/Hydrates/reports/G308_SPE114163_Feb08.pdf.

Morita A., Y. Kusaka, Y. Deguchi, A. Moriuchi, Y. Nakanaga, M. Iki, S. Miyazaki, and K. Kawahara. 1999. Acute health problems among the people engaged in the cleanup of the Nakhodka oil spill. Environmental Research 91:185-194.

Morrison, R.I.G. 1984. Migration systems of some New World shorebirds. In: Burger, J. and B.L. Olla, eds. Shorebirds: Migration and foraging behavior. Behavior of marine animals. Current Perspectives in Research 6:125-206.

Morrison, R.I.G., R.E. Gill, Jr., B.A. Harrington, S. Skagen, G.W. Page, C.L. Gratto-Trevor, and S.M. Haig. 2000. Population estimates of Nearctic shorebirds. Waterbirds 23:337-352.

Morrison, R.I.G., R.E. Gill, Jr., B.A. Harrington, S. Skagen, G.W. Page, C.L. Gratto-Trevor, and S.M. Haig. 2001. Estimates of shorebird populations in North America. Canadian Wildlife Service Occasional Paper No. 104, Ottawa, Ontario.

Morrison, R.I.G., B.J. McCaffery, R.E. Gill, S.K. Skagen, S.L. Jones, G.W. Page, C.L. Gratto-Trevor, and B.A. Andres. 2006. Population estimates of North American shorebirds. Wader Study Group Bulletin 111:67-85.

Morton, R.A. 1982. Effects of coastal structures on shoreline stabilization and land loss—the Texas experience. In: Boesch, D.F., ed. Proceedings of the Conference on Coastal Erosion and Wetland Modification in Louisiana: Causes, Consequences, and Options. Washington, DC: U.S. Dept. of the Interior, Fish and Wildlife Service, Biological Services Program. FWS/OBS-82/59.

Morton, R.A. 2003. An overview of coastal land loss: With emphasis on the southeastern United States. U.S. Dept. of the Interior, Geological Survey. USGS Open File Report 03-337. Internet website: http://pubs.usgs.gov/of/2003/of03-337/intro.html. Accessed May 11, 2010.

Morton, R.A. 2008. Historical changes in the Mississippi-Alabama barrier-island chain and the roles of extreme storms, sea level, and human activities. Journal of Coastal Research 24(6):1587-1600. West Palm Beach (Florida), ISSN 0749-0208.

Morton, R.A., N. Buster, and M. Krohn. 2002. Subsurface controls on historical subsidence rates and associated wetland loss in south-central Louisiana. Transactions Gulf Coast Association of Geological Societies 52:767-778.

Morton, R.A., J.C. Bernier, J.A. Barras, and N.F. Ferina. 2005. Rapid subsidence and historical wetland loss in the Mississippi Delta plain: Likely causes and future implications. U.S. Dept. of the Interior, Geological Survey. Open-File Report 2005-1216. 116 pp. Internet website: http://pubs.usgs.gov/of/2005/1216/ofr-2005-1216.pdf.

Mosier, A.E. 1998. The impact of coastal armoring structures on sea turtle nesting behavior at three beaches on the East Coast of Florida. Unpublished Masters thesis, University of South Florida, St. Petersburg, FL. 112 pp.

Moyers, J.E. 1996. Food habits of Gulf Coast subspecies of beach mice (*Peromyscus polionotus* spp.). M.S. Thesis, Auburn University, AL. 84 pp.

Muller-Karger, F.E., F. Vukovich, R. Leben, B. Nababan, C. Hu, and D. Myhre. 2001. Surface circulation and the transport of the Loop Current into the northeastern Gulf of Mexico: Final report. U.S. Dept. of the Interior, Minerals Management Service, Gulf of Mexico OCS Region, New Orleans, LA. OCS Study MMS 2001-102. 39 pp.

Mullin, K.D. and W. Hoggard. 2000. Visual surveys of cetaceans and sea turtles from aircraft and ships; Chapter 4. In: Davis, R.W., W.E. Evans, and B. Würsig, eds. Cetaceans, sea turtles and birds in the northern Gulf of Mexico: Distribution, abundance and habitat associations. Volume II: Technical report. U.S. Dept. of the Interior, Geologic Survey, Biological Resources Division, USGS/BRD/CR-1999-005 and Minerals Management Service, Gulf of Mexico OCS Region, New Orleans, LA. OCS Study MMS 2000-003. 364 pp.

Mullin, K.D. and G.L. Fulling. 2004. Abundance of cetaceans in the oceanic northern Gulf of Mexico, 1996-2001. Marine Mammal Science 20:787-807.

Muncy, R.J. 1984. Species Profiles: Life histories and environmental requirements of coastal fishes and invertebrates (Gulf of Mexico)—white shrimp. U.S. Dept. of the Interior, Fish and Wildlife Service, FWS/OBS-82/11.20. U.S. Dept. of the Army, Corps of Engineers, TR EL-82-4. 19 pp.

Murray, S.P. 1998. An observational study of the Mississippi/Atchafalaya coastal plume: Final report. U.S. Dept. of the Interior, Minerals Management Service, Gulf of Mexico OCS Region, New Orleans, LA. OCS Study MMS 98-0040. 513 pp.

Murray, S.P. and J. Donley. 1996. Mississippi River plume hydrography: Second annual report. U.S. Dept. of the Interior, Minerals Management Service, Gulf of Mexico OCS Region, New Orleans, LA. OCS Study MMS 96-0022. 175 pp.

Musick, J.A. and C.J. Limpus. 1997. Habitat utilization and migration in juvenile sea turtles. In: Lutz, P.L. and J.A. Musick, eds. The biology of sea turtles. Boca Raton, FL: CRC Press. Pp. 137-163.

Nalco. 2010. Oil dispersant expert testimony. Internet website. http://www.nalco.com/news-and-events/4259.htm. Accessed December 27, 2010.

National Association of Corrosion Engineers (NACE). 2003. Standard material requirements—methods for sulfide stress cracking and stress corrosion cracking resistance in sour oilfield environments. National Association of Corrosion Engineers. ANSI/NACE MR1075-2003. 44 pp. Internet website: http://www.techstreet.com/cgi-bin/detail?doc_no=NACE%7CMR0175_2003&product_id=1082002.

National Geographic Society. 1999. Field guide to the birds of North America, third edition. Washington, DC: National Geographic. 480 pp.

National Public Radio. 2011. A year after oil spill, tourism bounces back at some Florida beach towns. Internet website: http://www.npr.org/2011/04/18/135326540/a-year-after-deepwater-florida-sees-a-comeback. Accessed September 8, 2011.

National Research Council (NRC). 1983. Drilling discharges in the marine environment. Panel on Assessment of Fates and Effects of Drilling Fluids and Cuttings in the Marine Environment. Marine Board, Commission on Engineering and Technical Systems, National Research Council. Washington, DC: National Academy Press. Pp. 18-21.

National Research Council (NRC). 1985. Oil in the sea—inputs, fates and effects. Washington, DC: National Academy Press. 601 pp.

National Research Council (NRC). 1989. Using oil spill dispersants on the sea. Washington, DC: National Academy Press. 335 pp.

National Research Council (NRC). 1990. Decline of the sea turtles: Causes and prevention. Committee on Sea Turtle Conservation. Washington, DC: National Academy Press. 280 pp.

National Research Council (NRC). 2002. Effects of trawling & dredging on seafloor habitat. Washington, DC: National Academy Press. 136 pp.

National Research Council (NRC). 2003. Oil in the sea III: Inputs, fates, and effects (Committee on Oil in the Sea: J.N. Coleman, J. Baker, C. Cooper, M. Fingas, G. Hunt, K. Kvenvolden, J. McDowell, J. Michel, K. Michel, J. Phinney, N. Rabalais, L. Roesner, and R.B. Spies). Washington, DC: National Academy Press. 265 pp.

National Research Council (NRC). 2005. Oil spill dispersants: Efficacy and effects. Washington, DC: National Academy Press. 377 pp.

National Research Council (NRC). 2006. Review of recreational fisheries survey methods. Washington, DC: National Academy Press. 202 pp.

National Response Team. 2010. Oil spill response strategies for coastal marshes during the *Deepwater Horizon* MC252 spill. 10 pp. Internet website: http://www.nrt.org/Production/NRT/NRTWeb.nsf/AllAttachmentsByTitle/SA-1061NRT_Marsh_Cleanup_Options_DWH.06032010.pdf/$File/NRT_marsh_cleanup_overview_6-15.pdf?OpenElement. Accessed December 23, 2010.

National Wetlands Inventory Group. 1985. Status and trends of wetlands and deepwater habitats in the conterminous United States, 1950's to 1970's. Trans. N. Am. Wildl. Nat. Resour. Conf. 50:440-448.

Natural Resources Defense Council. 2010a. Disaster in the Gulf: Tracking oil washing ashore on beaches. Internet website: http://www.nrdc.org/energy/gulfspill/beaches.asp. Accessed April 18, 2011.

Natural Resources Defense Council. 2010b. Gulf Coast seafood consumption survey. Internet website: http://docs.nrdc.org/health/files/hea_10120702a.pdf. 7 pp.

Natural Resource Defense Council and National Disease Clusters Alliance. 2011. Health alert: Disease clusters spotlight the need to protect people from toxic chemicals. Internet website: http://www.nrdc.org/health/diseaseclusters/files/diseaseclusters_issuepaper.pdf.

NaturalGas.org. 2010a. Offshore drilling. Internet website. http://www.naturalgas.org/naturalgas/extraction_offshore.asp. Accessed December 21, 2010.

NaturalGas.org. 2010b. Background. Internet website: http://www.naturalgas.org/overview/background.asp. Accessed August 25, 2010.

Neal Adams Firefighters Inc. 1991. Joint industry program for floating vessel blowout control. Prepared for the U.S. Dept. of the Interior, Minerals Management Service. TA&R Project 150. Internet website: http://www.boemre.gov/tarprojects/150/150AA.pdf.

Neff, J.M. 1987. Biological effects of drilling fluids, drill cuttings and produced waters. In: Boesch, D.F. and N.N. Rabalais, eds. Long-term environmental effects of offshore oil and gas development. London: Elsevier Applied Science. Pp. 469-538.

Neff, J.M. 1990. Composition and fate of petroleum and spill-treating agents in the marine environment. In: Geraci, J.R. and D.J. St. Aubin, eds. Sea mammals and oil: Confronting the risks. San Diego, CA: Academic Press, Inc. Pp. 1-33.

Neff, J.M. 2002. Bioaccumulation in marine organisms: Effect of contaminants from oil well produced water. Kidlington, Oxford, UK: Elsevier Science Ltd.

Neff, J.M. 2005. Composition, environmental fates, and biological effects of water based drilling muds and cuttings discharged to the marine environment: A synthesis and annotated bibliography. Prepared for the Petroleum Environmental Research Forum and American Petroleum Institute. Duxbury, MA: Battelle. 83 pp. Internet website: http://www.perf.org/pdf/APIPERFreport.pdf.

Neff, J.M., T.C. Sauer, and N. Maciolek. 1989. Fate and effects of produced water discharges in nearshore marine waters. Prepared for the American Petroleum Institute, Washington, DC.

Neff, J.M. and T.C. Sauer, Jr. 1991. Review: Findings of the American Petroleum Institute study on produced waters. In: Geo-Marine, Inc. Proceedings: Eleventh Annual Gulf of Mexico Information Transfer Meeting. November, 1990. U.S. Dept. of the Interior, Minerals Management Service, Gulf of Mexico OCS Region, New Orleans, LA. OCS Study MMS 91-0040. 524 pp.

Neff, J.M., S. McKelvie, and R.C. Ayers, Jr. 2000. Environmental impacts of synthetic-based drilling fluids. U.S. Dept. of the Interior, Minerals Management Service, Gulf of Mexico OCS Region, New Orleans, LA. OCS Study MMS 2000-064. 118 pp.

Negri, A.P. and A.J. Heyward. 2000. Inhibition of fertilization and larval metamorphisis of the coral *Acropora milepora* (Ehrenberg, 1834) by petroleum products. Marine Pollution Bulletin 41(7-12):420-427.

Nelson, H.F. and E.E. Bray. 1970. Stratigraphy and history of the Holocene sediments in the Sabine-High Island Area, Gulf of Mexico. In: Morgam, J.P., ed. Deltaic sedimentation; modern and ancient. Special Publn. No. 15. Tulsa, OK: SEPM.

Nelson, D.L. and M.M. Cox. 2008. Lehringer principles of biochemistry, fifth edition. W.H. Freeman. 1,100 pp.

Nelson, M. 2011. Gulf Coast tourism rebounds after BP oil spill. Associated Press article. Internet website: http://travel.usatoday.com/destinations/story/2011-09-10/Gulf-Coast-tourism-rebounds-after-BP-oil-spill/50317906/1. Accessed October 6, 2011.

Netto, S.A., F. Gallucci, and G. Fonseca. 2009. Deep-sea meiofauna response to synthetic-based drilling mud discharge off SE Brazil. Deep-Sea Research II 56:41-49.

Neumann, C.J., B.R. Jarvinen, and J.D. Elms. 1993. Tropical cyclones of the north Atlantic Ocean, 1871-1992. U.S. Dept. of Commerce, National Oceanic and Atmospheric Administration, Asheville, NC. 193 pp..

Newell, R.C., L.J. Seiderer, and D.R. Hitchcock. 1998. The impact of dredging works in coastal waters: A review of the sensitivity to disturbance and subsequent recovery of biological resources on the seabed. Oceanography and Marine Biology: An Annual Review 36:127-178.

Newman, J.R. 1977. Sensitivity of the hose martin (*Delichon urbica*) to fluoride emissions. Fluoride 10:73-76.

Newman, J.R. 1980. Effects of air emissions on wildlife resources. U.S. Dept. of the Interior, Fish and Wildlife Service, Biological Services Program, National Power Plant Team. FWS/OBS-80/40.1. 32 pp.

Newman, S.H., A. Chmura, K. Converse, A.M. Kilpatrick, N. Patel, E. Lammers, and P. Daszak. 2007. Aquatic bird disease and mortality as an indicator of changing ecosystem health. Marine Ecology Progress Series 352:299-309.

Nicholls, J.L. and G.A. Baldassarre. 1990. Habitat associations of piping plovers wintering in the United States. Wilson Bulletin 102:581-590.

Nicol, J.A.C., W.H. Donahue, R.T. Wang, and K. Winters. 1977. Chemical composition and effects of water extracts of petroleum and eggs of the sand dollar *Melitta quinquiesperforata*. Marine Biology 40:309-316.

Nisbet, I.C.T. 2000. Disturbance, habituation, and management of waterbird colonies. Waterbirds 23:312-332.

Nolan, B. 2010. Family business knocked to its knees by oil spill, moratorium. Internet website: http://www.nola.com/news/gulf-oil-spill/index.ssf/2010/09/family_business_knocked_to_its.html. Accessed December 12, 2010.

Nolan, B. and A. Good. 2010. Moratorium in wake of Gulf oil spill idles much more than rigs, workers. Internet website: http://www.nola.com/news/gulf-oil-spill/index.ssf/2010/07/moratorium_in_wake_of_gulf_oil.html. Accessed July 6, 2010.

Norris, F.H., S.P. Stevens, B. Pfefferbaum, K.F. Wyche, and R. L. Pfefferbaum. 2008. Community resilience as a metaphor, theory, set of capacities, and strategy for disaster readiness. American Journal of Community Psychology 41:127-150.

Nowlin, W.D., Jr. 1972. Winter circulation patterns and property distributions. In: Capurro, L.R.A. and J.L. Reid, eds. Contributions on the physical oceanography of the Gulf of Mexico. Texas A&M University Oceanographic Studies, Vol. 2. Houston, TX: Gulf Publishing Co. Pp. 3-51.

Nowlin, W.D., Jr., A.E. Jochens, R.O. Reid, and S.F. DiMarco. 1998. Texas-Louisiana shelf circulation and transport processes study: Synthesis report. Volume I: Technical report. U.S. Dept. of the Interior, Minerals Management Service, Gulf of Mexico OCS Region, New Orleans, LA. OCS Study MMS 98-0035. 502 pp.

Nudds, T.D. 1983. Niche dynamics and organization of waterfowl guilds in variable environments. Ecology 64:319-330.

Nudds, T.D. 1992. Patterns in breeding waterfowl communities. In: Afton, A.D., M.G. Anderson, C.D. Ankney, D.H. Johnson, J.A. Kadlec, and G.L. Krapu, eds. Ecology and management of breeding waterfowl. University of Minnesota Press, Minneapolis. Pp. 540-547.

Nunley, M.J. 2010. Gulf sturgeon annual workshop meeting. Presentation: VR2W receiver deployment in the Gulf of Mexico. Science Applications International Corporation.

Nyman, J.A. and W.H. Patrick, Jr. 1996. Effects of oil and chemical responses on fresh marsh function and oil degradation: Response implications. Office of the Governor, Louisiana Oil Spill Coordinators Office, Louisiana Applied Oil Spill Research and Development Program, Baton Rouge, LA. OSRADP Technical Report Series 95-11.

Ocean Conservancy. 2011. Tracking trash: 25 years of action for the ocean. 43 pp. Internet website: http://act.oceanconservancy.org/pdf/Marine_Debris_2011_Report_OC.pdf.

O'Conner, J.M. and R.J. Huggett. 1998. Aquatic pollution problems, North Atlantic coast, including Chesapeake Bay. Aquat. Toxicol. 11:163-190.

Odenkirk, J.S. 1989. Movements of Gulf of Mexico sturgeon in the Apalachicola River, Florida. In: Proceedings of the Annual Conference of the Southeastern Association of Fish and Wildlife Agencies. 43:230-238.

Odess, D. 2010. Official communication. Teleconference regarding Section 106 in relation to response to the oil spill.

OffshoreEnergyToday.com. 2010. USA: Coast Guard responds to wellhead allision. Oil no longer spewing in Barataria Bay. Offshore Energy Today.com, August 3, 2010. Internet website: http://www.offshoreenergytoday.com/usa-coast-guard-responds-to-wellhead-allision-oil-no-longer-spewing-in-bataria-bay/. Accessed July 27, 2011.

offshoreWIND.biz. 2010. Japan plans to build 1,000MW offshore wind power by 2020. Internet website: http://www.offshorewind.biz/2010/05/10/japan-plans-to-build-1000mw-offshore-wind-power-by-2020/. Posted May 10, 2010. Accessed March 24, 2011.

Ogden, J.C., D.A. McCrimmon, Jr., G.T. Bancroft, and B.W. Patty. 1987. Breeding populations of the wood stork in the southeastern United States. Condor 89:752-759.

Ogren, L.H. 1989. Distribution of juvenile and sub-adult Kemp's ridley sea turtle: Preliminary results from 1984-1987 surveys. In: Caillouet, C.W. and A.M. Landry, eds. First International Symposium on Kemp's Ridley Sea Turtle Biology, Conservation and Management, Texas A&M University; Galveston, TX, October 1-4, 1985. TAMU-SG-89-105. Pp. 116-123.

O'Hara, P.D. and L.A. Morandin. 2010. Effects of sheens associated with offshore oil and gas development on the feather microstructure of pelagic seabirds. Marine Pollution Bulletin 60:672-678.

Oil and Gas Journal. 2009. BP finds oil in multiple Lower Tertiary reservoirs. Internet website: http://www.ogfj.com/index/article-display/5015598529/articles/oil-gas-financial-journal/volume-6/Issue_10/Upstream_News/BP_finds_oil_in_multiple_Lower_Tertiary_reservoirs.html. Posted October 1, 2009. Accessed January 11, 2011.

Oil Spill Commission. 2011a. Stopping the spill: The five-month effort to kill the Macondo well. Staff Working Paper No. 6. National Commission on the BP Deepwater Horizon Oil Spill and Offshore Drilling. Internet website: http://www.oilspillcommission.gov/sites/default/files/documents/Updated%20Containment%20Working%20Paper.pdf. Posted November 22, 2010. Updated January 11, 2011.

Oil Spill Commission. 2011b. Response/clean-up technology research & development and the BP *Deepwater Horizon* oil spill. Staff Working Paper No. 7. National Commission on the BP Deepwater Horizon Oil Spill and Offshore Drilling. Originally released November 22, 2010; updated January 11, 2011. 28 pp. Internet website: http://www.oilspillcommission.gov/sites/default/files/documents/Updated%20Response%20RD%20Working%20Paper.pdf. Accessed February 11, 2011.

O'Keefe, D.J. and G.A. Young. 1984. Handbook on the environmental effects of underwater explosives. U.S. Dept. of the Navy, Naval Surface Warfare Center, Dahlgren, VA, and Silver Spring, MD. NSWC TR 83-240.

Okuyama, H., Y. Majima, A.M. Dannenberg, Jr., M. Suga, B.G. Bang, and F.B. Bang. 1979. Qualitative histological changes produced in the tracheal mucosa of young chickens by the inhalation of sulfur dioxide in low concentrations. Journal of Environmental Science and Health Part C: Environmental Health Sciences 13(4):267-300.

Olsen, K.M. and H. Larsson. 1995. Terns of Europe and North America. Princeton, NJ: Princeton University Press. 175 pp.

Olsen, K.M. and H. Larsson. 1997. Skuas and jaegers. New Haven, CT: Yale University Press. 190 pp.

Onuf, C.P. 1994. Seagrasses, dredging and light in Laguna Madre, Texas, U.S.A. Estuarine Coastal Shelf Science 39:75-91.

Onuf, C.P. 1996. Biomass patterns in seagrass meadows of the Laguna Madre, Texas. Bulletin of Marine Science 58(2):404-420.

Opaluch, J.J., T.A. Grigalunas, C.M. Anderson, S.C. Trandafir, and D. Jin. 2011a. Policies to affect the pace of leasing and revenues in the Gulf of Mexico. Part 2: Technical report, August 2009. In: Economic Analysis, Inc. and Marine Policy Center. Policies to affect the pace of leasing and revenues in the Gulf of Mexico: Final report, August 2009. U.S. Dept. of the Interior, Bureau of Ocean Energy Management, Regulation and Enforcement, Herndon, VA. OCS Study BOEMRE 2011-013. 191 pp. Internet website: http://www.boemre.gov/econ/PDFs/ExternalStudies/2011_013/Part2.pdf.

Opaluch, J.J., T.A. Grigalunas, C.M. Anderson, S.C. Trandafir, and D. Jin. 2011b. Policies to affect the pace of leasing and revenues in the Gulf of Mexico. Part 2: Technical report, December 2010. In:

Economic Analysis, Inc. and Marine Policy Center. Policies to affect the pace of leasing and revenues in the Gulf of Mexico: Final report, December 2010. U.S. Dept. of the Interior, Bureau of Ocean Energy Management, Regulation and Enforcement, Herndon, VA. OCS Study BOEMRE 2011-014. 199 pp. Internet website: http://www.boemre.gov/econ/PDFs/ExternalStudies/2011_014/Part2.pdf.

Operational Science Advisory Team (OSAT). 2010. Summary report for sub-sea and sub-surface oil and dispersant detection: Sampling and monitoring. Unified Area Command, New Orleans, LA. Released December 17, 2010. Internet website: http://www.restorethegulf.gov/release/2010/12/16/data-analysis-and-findings. Accessed March 14, 2011.

Operational Science Advisory Team (OSAT-2). 2011. Summary report for fate and effects of remnant oil in the beach environment. Gulf Coast Incident Management Team, New Orleans, LA. Released February 10, 2011. Internet website: http://www.restorethegulf.gov/release/2011/03/01/osat-2-fate-and-effects-oil-beaches. Accessed March 14, 2011.

Orth, R.J., T.J.B. Carruthers, W.C. Dennison, C.M. Duarte, J.W. Fourqurean, K.L. Heck, Jr., A.R. Hughes, G.A. Kendrick, W.J. Kenworthy, S. Olyarnik, F.T. Short, M. Waycott, and S.L. Williams. 2006. A global crisis for seagrass ecosystems. BioScience 56(12):987-996.

Osenberg, C.W., R.J. Schmitt, S.J. Holbrook, and D. Canestro. 1992. Spatial scale of ecological effects associated with and open coast discharge of produced water. In: Ray, J.P. and F.R. Englehardt, eds. Produced water: Technological/environmental issues and solutions. New York, NY: Plenum Press. Pp. 387-402.

Otvos, E.G. 1979. Barrier island evolution and history of migration: North central Gulf Coast. In: Leatherman, S., ed. Barrier islands from the Gulf of St. Lawrence to the Gulf of Mexico. New York, NY: Academic Press. Pp. 219-319.

Oxford Economics. 2010. Potential impact of the Gulf oil spill on tourism. Prepared for the U.S. Travel Association. 27 pp. Internet website: http://www.ustravel.org/sites/default/files/page/2009/11/Gulf_Oil_Spill_Analysis_Oxford_Economics_710.pdf.

Oynes, C. 2006. Deepwater expansion continues in the Gulf of Mexico. Pipeline & Gas Journal 231(6):58.

Palinkas, L.A., A.J. Russell, M.A. Downs, and J.S. Petterson. 1992. Ethnic-differences in stress, coping, and depressive symptoms after the *Exxon Valdez* oil-spill. Journal of Nervous and Mental Disease 180:287-295.

Palka, D. and M. Johnson, eds. 2007. Cooperative research to study dive patterns of sperm whales in the Atlantic Ocean. U.S. Dept. of the Interior, Minerals Management Service, Gulf of Mexico OCS Region, New Orleans, LA. OCS Study MMS 2007-033. 49 pp.

Parauka, F. 2007a. Official communication. Post-Katrina recovery of Gulf sturgeon habitat. U.S. Dept. of the Interior, Fish and Wildlife Service, Ecological Services, Fisheries Resource Office, Panama City FL.

Parauka, F. 2007b. Official communication. Information concerning the critical habitat, sampling programs, and damage assessments of the Gulf sturgeon. U.S. Dept. of the Interior, Fish and Wildlife Service, Ecological Services, Fisheries Resource Office, Panama City FL. May 29, 2007.

Parauka, F. 2008. Official communication. Gulf sturgeon population survey in the Escambia River, Florida. AFA News, Newsletter of the Alabama Fisheries Association, January 2007.

Parker, P.L., G.P. Pfeiffer, R.E. Casey, C.S. Giam, J.S. Holland, E.T. Park, B.J. Presley, W.M. Sackett, N.P. Smith, C. Van Baalen, and D.E. Wohlschlang. 1975. Environmental assessment of the south Texas outer continental shelf. Chemical and biological survey component. Report to the U.S. Dept. of the Interior, Bureau of Land Management. Contract no. 08550-CT5-17.

Parker, R.O., Jr., D.R. Colby, and T.P. Willis. 1983. Estimated amount of reef habitat on a portion of the U.S. South Atlantic and Gulf of Mexico continental shelf. Bulletin of Marine Science 33:935-940.

Parnell, J.F., D.G. Ainley, H. Blokpoel, G. Cain, T.W. Custer, J.L. Dusi, S. Kress, J.A. Kushlan, W.E. Southern, L.E. Stenzel, and B.C. Thompson. 1988. Colonial waterbird management in North America. Journal of the Colonial Waterbird Society 11:129-169.

Parr, A.E. 1939. Quantitative observations on pelagic Sargassum vegetation of the western North Atlantic. Bull. Bingham Oceanog. Coll. 6:1-94

Parsons, J.J. 1972. The hawksbill turtle and the tortoise shell trade. In: Études de géographie tropicale offertes a Pierre Gourou. Paris, France: Mouton. Pp. 45-60.

Parsons, K.C. 1994. The Arthur Kill oil spills: Biological effects in birds. In: Burger, J., ed. Before and after an oil spill: The Arthur Kill. New Brunswick, NJ: Rutgers University Press. Pp. 215-237.

Parsons, G. and A. Kang. 2007. Valuing beach closures on the Padre Island National Seashore. University of Delaware, Graduate College of Marine Studies. U.S. Dept. of Commerce, NOAA Grant Number NA04NOS4190063. Project Number 06-090. 31 pp.

Pashley, D.N. 1991. Shorebirds, gulls, and terns: Louisiana, Mississippi, Alabama. In: Proceedings of the Coastal Nongame Workshop. U.S. Dept. of the Interior, Fish and Wildlife Service, Region 4, and Florida Game and Fresh Water Fish Commission. Pp. 79-83.

Patin, S.A. 1999. Environmental impact of the offshore oil and gas industry. East Northpoint, NY: EcoMonitor Publishing. Pp. 425.

Patrick, S.R., D.R. Patrick, and S.W. Fardo. 1993. Energy conservation guidebook. Lilburn, GA: The Fairmont Press, Inc. 471 pp. Internet website: http://books.google.com/books?id=f45IIzt4DCIC&pg=PA143&lpg=PA143&dq=ship,+%22discharge+water+temperature%22&source=bl&ots=CEHy0wpaMz&sig=BZam0pB-2mDwo4vO5zGM9jBsQWY&hl=en&ei=nMEpTYnqJsSBlAf_-7joAQ&sa=X&oi=book_result&ct=result&resnum=5&ved=0CC0Q6AEwBA#v=onepage&q&f=false. Accessed January 10, 2011.

Pattengill, C.V. 1998. The structure and persistence of reef fish assemblages of the Flower Garden Banks National Marine Sanctuary. Ph.D. Thesis, Texas A&M University, College Station, TX.

Paull, C.K., B. Hecker, R. Commeau, R.P Freeman-Lynde, C. Neumann, W.P. Corso, S. Golubic, J.E. Hook, E. Sikes, and J. Curry. 1984. Biological communities at the Florida Escarpment resemble hydrothermal vent taxa. Science 226:965-967.

PCCI Marine and Environmental Engineering. 1999. Oil spill containment, remote sensing and tracking for deepwater blowouts: status of existing and emerging technologies. Report prepared for the U.S. Dept. of the Interior, Minerals Management Service. TA&R Project 311. 66 pp. + apps. Internet website: http://www.boemre.gov/tarprojects/311/311AA.pdf.

Peakall, D.B., P.G. Wells, and D. Mackay. 1987. A hazard assessment of chemically dispersed oil spills and seabirds. Marine Environmental Research 22:91-106.

Peakall, D.B., R.J. Norstrom, D.A. Jeffrey, and F.A. Leighton. 1989. Induction of hepatic mixed function oxidases in the herring gull (*Larus argentatus*) by Pruhoe Bay crude oil and its fractions. Comparative Biochemistry and Physiology 94C:461-463.

Peake, D., G. Fargion, K. Mullen, and R. Pitman. 1995. Seabirds of the northwestern and central Gulf of Mexico. In: Abstracts of the Joint Meeting of the Wilson Ornithological Society and Virginia Society of Ornithology, Virginia, 4-7 May, 1995.

Pearson, C.E., D.B. Kelley, R.A. Weinstein, and S.W. Gagliano. 1986. Archaeological investigations on the outer continental shelf: A study within the Sabine River valley, offshore Louisiana and Texas. U.S. Dept. of the Interior, Minerals Management Service, Reston, VA. OCS Study MMS 86-0119. 314 pp.

Pearson, C.E., S.R. James, Jr., M.C. Krivor, S.D. El Darragi, and L. Cunningham. 2003. Refining and revising the Gulf of Mexico outer continental shelf region high-probability model for historic shipwrecks: Final report. Volumes I-III. U.S. Dept. of the Interior, Minerals Management Service, Gulf of Mexico OCS Region, New Orleans, LA. OCS Study MMS 2003-060, 2003-061, and 2003-062. 13, 338, and 138 pp., respectively.

Peele, R.H., J.I. Snead, and W. Feng. 2002. Outer continental shelf pipelines crossing the Louisiana coastal zone: A geographic information system approach. U.S. Dept. of the Interior, Minerals Management Service, Gulf of Mexico Region OCS Study, New Orleans LA. MMS 2002-038. 24 pp.

Penland, S., L. Wayne, L.D. Britsch, S.J. Williams, A.D. Beall, and V. Caridas Butterworth. 2001a. Geomorphic classification of coastal land loss between 1932 and 1990 in the Mississippi River Delta Plain, southeastern Louisiana. U.S. Dept. of the Interior, Geological Survey, Coastal and Marine Geology Program, Woods Hole Field Center, Woods Hole, MA. Open-File Report 00-417.

Penland, S., L. Wayne, L.D. Britsch, S.J. Williams, A.D. Beall, and V. Caridas Butterworth. 2001b. Process classification of coastal land loss between 1932 and 1990 in the Mississippi River Delta Plain, southeastern Louisiana. U.S. Dept. of the Interior, Geological Survey, Coastal and Marine Geology Program, Woods Hole Field Center, Woods Hole, MA. Open-File Report 00-418.

Pequegnat, W.E. 1983. The ecological communities of the continental slope and adjacent regimes of the northern Gulf of Mexico. Prepared by TerEco Corp. for the U.S. Dept. of the Interior, Minerals Management Service, Gulf of Mexico OCS Region, New Orleans, LA. 398 pp.

Pequegnat, W.E., B.J. Gallaway, and L. Pequegnat. 1990. Aspects of the ecology of the deepwater fauna of the Gulf of Mexico. American Zoologist 30:45-64.

Perez, C., A. Velando, I. Munilla, M. Lopez-Alonzo, and D. Oro. 2008. Monitoring polycyclic aromatic hydrocarbon pollution in the marine environment after the *Prestige* oil spill by means of seabird blood analysis. Environmental Science and Technology 42:707-713.

Perez, C., I. Munilla, M. Lopez-Alonso, and A. Velando. 2010. Sublethal effects on seabirds after the *Prestige* oil-spill are mirrored in sexual signals. Biological Letters 6:33-35.

Perry, H.M. and T.D MaIlwain. 1986. Species profiles: Life histories and environmental requirements of coastal fishes and invertebrates (Gulf of Mexico)—blue crab. U.S. Dept. of the Interior, Fish and Wildlife Service, Biological Report 82(11.55). U.S. Dept. of the Army, Corps of Engineers, TR EL-82-4. 21 pp.

Peters, E.C., P.A. Meyers, P.P. Yevich, and N.J. Blake. 1981. Bioaccumulation and histopathological effects of oil on a stony coral. Marine Pollution Bulletin 12(0):333-339.

Peters, E.C., N.J. Gassman, J.C. Firman, R.H. Richmond, and E.A. Power. 1997. Ecotoxicology of tropical marine ecosystems. Environmental Toxicology and Chemistry 16(1):12-40.

Peterson, C.H., M.C. Kennicutt II., R.H. Green, P. Montagna, D.E. Harper, Jr., E.N. Powell, and P.F. Roscigno. 1996. Ecological consequences of environmental perturbations associated with offshore hydrocarbon production: A perspective on long-term exposures in the Gulf of Mexico. Canadian Journal of Fisheries and Aquatic Science 53:2637-2654.

Pezeshki, S.R., R.D. Delaune, J.A. Nyman, R.R. Lessard, and G.P. Canevari. 1995. Removing oil and saving oiled marsh grass using shoreline cleaner (Publication No. 4620). International Oil Spill Conference. Washington, DC: American Petroleum Institute. Pp. 203-209.

Pezeshki, S.R., M.W. Hester, Q. Lin, and J.A. Nyman. 2000. The effects of oil spill and cleanup on dominant U.S. Gulf Coast marsh macrophytes: A review. Environmental Pollution 108:129-139.

Piatt, J.F. and P. Anderson, 1996. Response of common murres to the *Exxon Valdez* oil spill and long-term changes in the Gulf of Alaska marine ecosystem. American Fisheries Society Symposium 18:720-737.

Pine, W.E. and S. Martell. 2009. Status of Gulf sturgeon in Florida waters: A reconstruction of historical population trends to provide guidance on conservation targets. March 31, 2009, draft final report, project number NG06-004, University of Florida project number 00065323, contract number 06108. 47 pp.

Pipelines International. 2010. Getting the job done in swamp, marsh and wetland terrain. December 2010. Vol. 006, pp. 34-35. Internet website: http://pipelinesinternational.com/pdfs/PIN_Dec10_web.pdf.

Plyer, A. and R. Campanella. 2010. Coastal employment before the 2010 *Deepwater Horizon* oil disaster.: Employment maps and data from 2008. Greater New Orleans Community Data Center. Internet website: https://gnocdc.s3.amazonaws.com/reports/GNOCDC_CoastalEmployment.pdf. Released July 20, 2010. 12 pp.

Poirier, O.A. and G.A. Thiel. 1941. Deposition of free oil by sediments settling in sea water. Bulletin of the American Association of Petroleum Geologists 25(12):2170-2180.

Poirrier, M.A. 2007. Statewide summary for Louisiana. In: Handley, D.A, D. Altsman, and R. DeMay, eds. Seagrass status and trends in the northern Gulf of Mexico: 1940-2002. U.S. Dept. of the Interior, Geological Survey Scientific Investigations Report 2006-5287 and U.S. Environmental Protection Agency 855-R-04-003. 61 pp. Internet website: http://pubs.usgs.gov/sir/2006/5287/. Accessed May 13, 2011.

Pond, S. and G.L. Pickard. 1983. Introductory dynamical oceanography, 2nd ed. New York, NY: Pergamon Press. 329 pp.

Powell, E.N. 1995. Evidence for temporal change at seeps. In: MacDonald, I.R., W.W. Schroeder, and J.M. Brooks, eds. Chemosynthetic ecosystems study: Final report. Volume 2: Technical report. U.S. Dept. of the Interior, Minerals Management Service, Gulf of Mexico OCS Region, New Orleans, LA. OCS Study MMS 95-0022. Pp. 8.1-8.65.

Powell II, A. 2010. Barataria Bay oil spill enters cleanup mode. *The Times Picayune*, August 3, 2010. Internet website: http://blog.nola.com/news_impact/print.html?entry=/2010/08/barataria_bay_oil_spill_enters.html. Accessed December 28, 2010.

Poysa, H. 1983. Morphology-mediated niche organization in a guild of dabbling ducks. Ornis Scandinavica 14:317-326.

Precht, W.F., R.B. Aronson, K.J.P. Deslarzes, M.L. Robbart, D.J. Evans, B. Zimmer, and L. Duncan. 2008. Long-term Monitoring at the East and West Flower Garden Banks, 2004-2005: Interim report. Volume I: Technical report. U.S. Dept. of the Interior, Minerals Management Service, Gulf of Mexico OCS Region, New Orleans, Louisiana. OCS Study MMS 2008-027. 123 pp.

Prentki, R.T., C. Smith, O. Johansen, P. Daling, M. Moldestad, K. Skognes, and M. Reed. 2004. The MMS/SINTEF oil weathering model, further development and applications. Review version of paper presented at International Marine Environmental Modeling Seminar (IMEMS), Washington, DC, October 2004. Internet website: http://alaska.boemre.gov/reports/2005rpts/2005_020/Final%20Report/Appendix%20E/prentki_OWM_Alaska.pdf.

Press Register. 2010. Short-term spill impacts leave both winners and losers. Internet website: http://blog.al.com/press-register-business/2010/11/short_term_spill_impacts_leave.html. Published November 14, 2010. Accessed June 14, 2011.

Pritchard, P.C.H. 1997. Evolution, phylogeny, and current status. In: Lutz, P.L. and J.A. Musivk, eds. The biology of sea turtles. Boca Raton, FL: CRC Press. Pp. 1-28.

Puder, M.G. and J.A. Veil. 2006. Offsite commercial disposal of oil and gas exploration and production waste: Availability, options, and costs. Argonne National Laboratory, Environmental Science Division. Internet website: http://www.evs.anl.gov/pub/doc/ANL-EVS-R-06-5.pdf.

Pulsipher, A.G., O.O. Iledare, R.H. Baumann, D.E. Dismukes, and D.V. Mesyanzhinov. 1998. Environmental and safety risks of an expanding role for independents on the Gulf of Mexico OCS. U.S. Dept. of the Interior, Minerals Management Service, Gulf of Mexico OCS Region, New Orleans, LA. OCS Study MMS 98-0021. 39 pp.

Putt, R. 2011. Species composition, distribution, and abundance of planktonic, benthic, and demersal megafauna in the vicinity of MC252 during August 2010. In: Proceedings of the Gulf Oil Spill SETAC Focused Topic Meeting, April 26-28, 2011, Pensacola Beach, FL.

Rabalais, N.N. 1990. Biological communities of the south Texas continental shelf. American Zoologist 30:77-87.

Rabalais, N.N., B.A. McKee, D.J. Reed and J.C. Means. 1991. Fate and effects of nearshore discharges of OCS produced waters. Volume III. Appendices. OCS Study MMS 91-0006. U.S. Dept. of the Interior, Minerals Management Service, Gulf of Mexico OCS Region, New Orleans, LA. 225 pp.

Rabalais, N.N., R.E. Turner, and W.J. Wiseman, Jr. 2002. Gulf of Mexico hypoxia, A.K.A. "The Dead Zone." Annual Review of Ecological Systems 33:235-263.

Raimondi, P.T., A.M Barnett, and P.R. Krause. 1997. The effects of drilling muds on marine invertebrate larvae and adults. Environmental Toxicology and Chemistry 16(6):1218-1228.

Ramseur, J.L. 2010. Oil spill in U.S. coastal waters: Background, governance, and issues for Congress. Congressional Research Service. Report for Congress 7-57, RL33705. April 30, 2010.

Rappole, J.H. 2006. A guide to the birds of the southeastern states: Florida, Georgia, Alabama, and Mississippi. Gainesville, FL: University Press of Florida.

Rasmussen, E. 2008. Distance to the horizon, calculator. Erick's Blog. Internet website. http://www.erik-rasmussen.com/blog/2008/03/25/distance-to-the-horizon/. Posted March 25, 2008. Accessed December 30, 2010.

Ravishankara, A.R. and J. Goldman. 2010. Air chemistry in the Gulf of Mexico oil spill area, NOAA WP-3D Airborne Chemical Laboratory Flights of 8 and 10 June 2010. Internet website: http://www.esrl.noaa.gov/csd/tropchem/2010gulf/NOAA_P3_Gulf_Mission_Report_final.pdf.

Ray, J.P. 1998. Findings of the Offshore Operators Committee produced water bioaccumulation study. In: SPE International Conference on Health, Safety, and Environment in Oil and Gas Exploration and Production. June 7-10, 1998. Caracas, Venezuela. Society of Petroleum Engineers, Inc.

Redden, J. 2009. Port Fourchon thrives despite the economy. Offshore Magazine. March 1, 2009. Internet website: http://www.offshore-mag.com/index/article-display/357201/articles/offshore/supplements/port-of-fourchon/articles/port-fourchon-thrives-despite-the-economy.html. Accessed December 3, 2010.

Reed, D.H. and K.R. Traylor-Holzer. 2006. Revised population viability analysis III for the Alabama beach mouse (*Peromyscus polionotus ammobates*). Report to the U.S. Dept. of the Interior, Fish and Wildlife Service. June 2006. 24 pp.

Reed, J. and S. Rogers. 2011. Final cruise report. Florida Shelf Edge Expedition (FLoSEE) *Deepwater Horizon* oil spill response: Survey of deepwater and mesophotic reef ecosystems in the eastern Gulf of Mexico and southeastern Florida. R/V *Seaward Johnson* and *Johnson-Sea-Link* Submersible. July 9 – August 9, 2010. Conducted by Harbor Branch Oceanographic Institute, Florida Atlantic University and NOAA Cooperative Institute for Ocean Exploration, Research, and Technology.

Rees, M.A. 2010. Paleoindian and early archaic. In: Rees, Mark A., ed. Archaeology of Louisiana. Baton Rouge, LA: LSU University Press. Pp. 34-62.

Regg, J.B., S. Atkins, B. Hauser, J. Hennessey, B. Kruse, J. Lowenhaupt, B. Smith, and A. White. 2000. Deepwater development: A reference document for the deepwater environmental assessment, Gulf of Mexico OCS (1998 through 2007). U.S. Dept. of the Interior, Minerals Management Service, Gulf of Mexico OCS Region, New Orleans, LA. OCS Report MMS 2000-015. 94 pp.

Reible, D. 2010. After the oil is no longer leaking. The University of Texas, Austin. Environ. Sci. Technol. 44(15):5685–5686.

Reimer, A.A. 1975. Effects of crude oil on corals. Marine Pollution Bulletin 6(3):39-43.

RestoreTheGulf.gov. 2010a. Update: Rear Admiral Landry approves top kill procedure. Internet website: http://www.restorethegulf.gov/release/2010/05/26/update-rear-admiral-landry-approves-top-kill-procedure. Accessed October 5, 2010.

RestoreTheGulf.gov. 2010b. Grand Isle shoreline treatment recommendation report. Internet website: http://www.restorethegulf.gov/sites/default/files/imported_pdfs/external/content/document/2931/737627/1/9JUN%20LAJF01-008-003-STR%20for%20Jeff%20Par-Grand%20Isle%20Beach.pdf. Accessed October 28, 2011.

RestoreTheGulf.gov. 2011a. The ongoing administration-wide response to the deepwater BP oil spill. Reports from April 22, 2010, through January 13, 2011. Internet website: http://www.restorethegulf.gov/release/2010/09/17/ongoing-administration-wide-response-deepwater-bp-oil-spill. Accessed December 6, 2011.

RestoreTheGulf.gov. 2011b. Fish and wildlife. Internet website: http://www.restorethegulf.gov/fish-wildlife. Accessed on June 28, 2011

RestoreTheGulf.gov. 2011c. Translations into the following languages: Cambodian, Croatian, Spanish, French, Korean, Greek, Laotian, Russian, Thai, and Vietnamese. Internet website: http://www.restorethegulf.gov/. Accessed September 5, 2011.

Reynolds, C.R. 1993. Gulf sturgeon sightings, historic and recent—a summary of public responses. U.S. Dept. of the Interior, Fish and Wildlife Service, Panama City, FL. 40 pp.

Rezak, R. and T.J. Bright. 1979. Northwestern Gulf of Mexico topographic features study. Executive summary of the final report. U.S. Dept. of the Interior, Bureau of Land Management, New Orleans OCS Office, New Orleans, Louisiana. Study no. 1979-14.

Rezak, R. and T.J. Bright. 1981. Northern Gulf of Mexico topographic features study: Final report to the U.S. Dept. of the Interior, Bureau of Land Management, Contract No. AA551-CT8-35. 5 vols.

Rezak, R., T.J. Bright, and D.W. McGrail. 1983. Reefs and banks of the northwestern Gulf of Mexico: Their geological, biological, and physical dynamics. Final Technical Report No. 83-1-T.

Rezak, R., T.J. Bright, and D.W. McGrail. 1985. Reefs and banks of the northwestern Gulf of Mexico: Their geological, biological, and physical dynamics. New York, NY: Wiley and Sons. 259 pp.

Rezak, R., S.R. Gittings, and T.J. Bright. 1990. Biotic assemblages and ecological controls on reefs and banks of the northwest Gulf of Mexico. American Zoologist 30:23-35.

Rhodes, D.C. 1974. Organism-sediment relations on the muddy sea floor. Oceanography and Marine Biology: An Annual Review 12:263-300.

Rhodes, D.C. and J.D. Germano. 1982. Characterization of organism-sediment relations using sediment profile imaging: An efficient method of remote ecological monitoring of the seafloor (Remots™ System). Marine Ecology Progress Series 8:115-128.

Rhodes, R.C., J.D. Thompson, and A.J. Wallcraft. 1989. Buoys-calibrated winds over the Gulf of Mexico. J. Atmos. and Ocean. Technology. 6(4):608-623.

Rice, S.A. and C.L. Hunter. 1992. Effects of suspended sediment and burial on Scleractinian corals from west central Florida patch reefs. Bulletin of Marine Science 51(3):429-442.

Richardson, W.J., C.R. Greene, C.I. Mame, and D.H. Thomson. 1995. Marine mammals and noise. San Diego, CA: Academic Press Inc.

Richmond, E.A. 1962. The fauna and flora of Horn Island, Mississippi. Gulf Research Reports 1(2):59-106.

Ridgway, S.H. and D. Carder. 2001. Assessing hearing and sound production in cetacean species not available for behavioral audiograms: Experience with *Physeter*, *Kogia*, and *Eschrichtius*. Aquatic Mammals 27:267-276.

Rigzone. 2010. Rig report: Offshore rig fleet by region. Internet website: http://www.rigzone.com/data/. Accessed December 20, 2010.

Rinkevich, B. and Y. Loya. 1977. Harmful effects of chronic oil pollution on a Red Sea Scleractinian coral population. In: Taylor, D.L., ed. Proceedings, Third International Coral Reef Symposium. Volume 2: Geology. Miami, FL. May, 1977. Pp. 585-591.

Rinkevich, B. and Y. Loya. 1983. Response of zooxanthellae photosynthesis to low concentrations of petroleum hydrocarbons. Bulletin of the Institute of Oceanography and Fisheries 109-115.

Ripley, S.D. and B.M. Beechler. 1985. Rails of the world, a compilation of new information, 1975-1983, (Aves: Rallidae). Smithsonian Contributions to Zoology, No. 417. Washington, DC: Smithsonian Institute Press.

Robbart, M.L., R.B. Aronson, K.J.P. Deslarzes, W.F. Precht, L. Duncan, B. Zimmer, and T. DeMunda. 2009. Post-hurricane assessment of sensitive habitats of the Flower Garden Banks vicinity. U.S. Dept. of the Interior, Minerals Management Service, Gulf of Mexico OCS Region, New Orleans, LA. OCS Study MMS 2009-032. 160 pp.

Roberts, H.H. and T.W. Neurauter. 1990. Direct observations of a large active mud vent on the Louisiana continental slope. Association of Petroleum Geologists Bulletin 74:1508.

Roberts, H.H., P. Aharon, R. Carney, J. Larkin, and R. Sassen. 1990. Sea floor responses to hydrocarbon seeps, Louisiana continental slope. Geo-Marine Letter 10(4):232-243.

Robydek, A. and M. Nunley. 2008. Determining marine movement and behavior of Gulf sturgeon in the Gulf sturgeon critical habitat of the Eglin Gulf Testing and Training Range (EGTTR) and Santa Rosa Island (SRI) complex. Science Applications International Corporation. Eglin Air Force Base Natural Resources Section. DOD Legacy Resource Management Program.

Robydek, A. and M. Nunley. 2010. Determining marine movement and behavior of Gulf sturgeon in the Gulf of Mexico critical habitat of the Eglin Gulf Testing and Training Range (EGTTR) and Santa Rosa Island Complex. Presentation: 2010 Gulf Sturgeon Workshop meeting at Louisiana State University, Baton Rouge, LA.

Rocke, T.E., T.M. Yuill, and R.D. Hinsdill. 1984. Oil and related toxicant effects on mallard immune defenses. Environmental Research 33:343-352.

Rodgers, J.A., Jr., A.S. Wenner, and S.T. Schwikert. 1987. Population dynamics of wood storks in north and central Florida, USA. Colonial Waterbirds 10:151-156.

Rogers. C.S. 1990. Responses of coral reefs and reef organisms to sedimentation. Marine Ecology Progress Series 62:185-202.

Rogers, C.S. and V.H. Garrison. 2001. Ten years after the crime: Lasting effects of damage from a cruise ship anchor on a coral reef in St. John, U.S. Virgin Islands. Bulletin of Marine Science 69(2):793-803.

Rogillio, H.E. 2007. Official communication. Information describing the latest unpublished sturgeon population estimates for Gulf sturgeon in the Pearl River. Louisiana Dept. of Wildlife and Fisheries. January 2007.

Romano, F. and Landers, S. 2011. Preliminary results of a multiyear meiofauna survey of the northern Gulf of Mexico BP oil spill zone. In: Proceedings of the 40th Benthic Ecology Meeting, March 16-20, 2011, Mobile, AL.

Romanov, A.A. and N.N. Sheveleva. 1993. Disrtuption of gonadogenesis in Caspian sturgeons. J. Ichthyol. 33:127-133.

Rooker, J.R., S.A. Holt, M.A. Soto, and G.J. Holt. 1998. Postsettlement patterns of habitat use by Sciaenid fishes in subtropical seagrass meadows. Estuaries 21(2):318-327.

Roosenburg, W.M. 1994. Nesting habitat requirements of the diamondback terrapin: A geographic comparison. Wetland Journal 6(2):8-11.

Roosenburg, W.M., K.L. Haley, and S. McGuire. 1999. Habitat selection and movements of the diamondback terrapin, *Malaclemys terrapin*, in a Maryland estuary. Chelonian Conservation and Biology 3:425-429.

Rosman, I., G.S. Boland, and J.S. Baker. 1987. Epifaunal aggregations of Vesicomyidae on the continental slope off Louisiana. Deep-Sea Res. 34:1811-1820.

Ross, S.T., R.J. Heise, W.T. Slack, and M. Dugo. 2001. Habitat requirements of Gulf sturgeon (*Acipenser oxyrinchus desotoi*) in the northern Gulf of Mexico. University of Southern Mississippi, Dept. of Biological Sciences and Mississippi Museum of Natural Science. Funded by the Shell Marine Habitat Program, National Fish and Wildlife Foundation. 26 pp.

Roth, A.F. and D.M. Baltz. 2009. Short-term effects of an oil spill on marsh-edge fishes and decapod crustaceans. Estuaries and Coasts 32:565-572.

Rowe, G.T. and M.C. Kennicutt II. 2001. Deepwater program: Northern Gulf of Mexico continental slope benthic habitat and ecology. Year I: Interim report. U.S. Dept. of the Interior, Minerals Management Service, Gulf of Mexico OCS Region, New Orleans, LA. OCS Study MMS 2001-091. 166 pp.

Rowe, G.T. and M.C. Kennicutt II, eds. 2009. Northern Gulf of Mexico continental slope habitats and benthic ecology study: Final report. U.S. Dept. of the Interior, Minerals Management Service, Gulf of Mexico OCS Region, New Orleans, LA. OCS Study MMS 2009-039. 456 pp.

Rowe, G. and D.W. Menzel. 1971. Quantitative benthic samples from the deep Gulf of Mexico with some comments on the measurements of deep-sea biomass. Bulletin of Marine Science 21(2):556-566.

Roy, K.J. and S.V. Smith. 1971. Sedimentation and coral reef development in turbid water: Fanning Lagoon. Pacific Science 25:234-248.

Rozas, L.P. 1992. Comparison of nekton habitats associated with pipeline canals and natural channels in Louisiana salt marshes. Wetlands 12(2):136-146.

Rozas, L.P. and W.E. Odum. 1988. Occupation of submerged aquatic vegetation by fishes: Testing the roles of food and refuge. Oecologia 77:101-106.

Rucker, J.B. and J.O. Snowden. 1989. Relict progradational beach ridge complex on Cat Island in Mississippi Sound. Trans. Gulf Coast Assoc. of Geol. Soc. 39:531-539.

Runcie, J., C. Macinnis-Ng, and P. Ralph. 2004. The toxic effects of petrochemical on seagrasses. Literature review. For Australian Maritime Safety Authority, Institute for Water and Environmental Resource Management, Sydney, Australia. 20 pp. Internet website: http://www.amsa.gov.au/marine_environment_protection/national_plan/Contingency_Plans_and_Management/Research_Development_and_Technology/Toxic_Effects_Seagrasses.pdf.

Russell, R.W. 2005. Interactions between migrating birds and offshore oil and gas platforms in the northern Gulf of Mexico: Final report. U.S. Department of the Interior, Minerals Management Service, Gulf of Mexico OCS Region, New Orleans, LA. OCS Study MMS 2005-009. 327 pp.

Russo, M. 1992. Variations in late archaic subsistence and settlement patterning in peninsular Florida. In: Jeter, M., ed. Southeastern Archaeological Conference: Abstracts of the forty-ninth annual meeting, Little Rock, AR.

Rützler, K. and W. Sterrer. 1970. Oil pollution damage observed in tropical communities along the Atlantic seaboard of Panama. BioScience 20(4):222-224.

Ryan, P.G. 1988. Effects of ingested plastic on seabird feeding: Evidence from chickens. Marine Pollution Bulletin 19(3):125-128.

Ryan, P.G. 1990. The effects of ingested plastic and other marine debris on seabirds. In: Shomura, R.S. and M.L. Godfrey, eds. Proceedings of the Second International Conference on Marine Debris, April 2-7, 1989, Honolulu, HI. U.S. Dept. of Commerce, NOAA Technical Memorandum NMFS-NOAA-TM-NMFS-SWFSC-154. Pp. 623-634.

S.L. Ross Environmental Research Ltd.. 1997. Fate and behavior of deepwater subsea oil well blowouts in the Gulf of Mexico. Prepared for the U.S. Dept. of the Interior, Minerals Management Service. 27 pp. Internet website: http://www.boemre.gov/tarprojects/287/287AA.PDF.

S.L. Ross Environmental Research Ltd. 2000. Technology assessment of the use of dispersants on spills from drilling and production facilities in the Gulf of Mexico outer continental shelf. Prepared for the U.S. Dept. of the Interior, Minerals Management Service, Engineering and Research Branch, Herndon, VA. 19 pp. Internet website: http://www.boemre.gov/tarprojects/349/349AB.pdf.

Sadiq, M. and J.C. McCain. 1993. The Gulf War aftermath: An environmental tragedy. Dordrecht: Kluwer Academic Publishers.

Sager, W. 1997. Geophysical detection and characterization of seep community sites. In: MacDonald, I.R., ed. 1998. Stability and change in Gulf of Mexico chemosynthetic communities: Interim report. U.S. Dept. of the Interior, Minerals Management Service, Gulf of Mexico OCS Region, New Orleans, LA. OCS Study MMS 98-0034. Pp. 49-60.

Sager, W.W., W.W. Schroeder, J.S. Laswell, K.S. Davis, R. Rezak, and S.R. Gittings. 1992. Mississippi-Alabama outer continental shelf topographic features formed during the late Pleistocene-Holocene transgression. Geo-Marine Letters 12:41-48.

Salmon, J., D. Henningsen, and T. McAlpin. 1982. Dune restoration and revegetation manual. Florida Sea Grant College. Report No. 48, September. 49 pp.

Sammarco, P.W., A.D. Atchison, D.A. Brazeau, G.S. Boland, and D.F. Gleason. 2004. Expansion of coral communities within the northern Gulf of Mexico via offshore oil and gas platforms. Marine Ecology Progress Series 280:129-143.

Sanders, H.L., J.F. Grassle, G.R. Hamson, L.S. Morse, S. Garner-Price, and C.C. Jones. 1980. Anatomy of an oil spill: Long-term effects from the grounding of the barge Florida off West Falmouth, Massachusetts. Journal of Marine Research 38:265-380.

Santos, M.F.L., P.C. Lana, J. Silva, J.G. Fachel, and F.H. Pulgati. 2009. Effects of non-aqueous fluids cuttings discharge from exploratory drilling activities on the deep-sea macrobenthic communities. Deep-Sea Research II 56:32-40.

Sapp, C.D. and J. Emplaincourt. 1975. Physiographic regions of Alabama. Geological Survey of Alabama, Tuscaloosa, Alabama. Alabama Geological Survey special map 168.

Sargent, F.J., T.J. Leary, D.W. Crewz, and C.R. Kruer. 1995. Scarring of Florida's seagrasses: Assessment and management options. FRMI TR-1, Florida Marine Research Institute, St. Petersburg, FL. 37 pp. + app.

Sassen, R. 1998. Origins of hydrocarbons and community stability. In: MacDonald, I.R., ed. Stability and change in Gulf of Mexico chemosynthetic communities: Interim report. U.S. Dept. of the Interior, Minerals Management Service, Gulf of Mexico OCS Region, New Orleans, LA. OCS Study MMS 98-00034. Pp. 71-76.

Sassen, R., J.M. Brooks, M.C. Kennicutt II, I.R. MacDonald, and N.L. Guinasso, Jr. 1993a. How oil seeps, discoveries relate in deepwater Gulf of Mexico. Oil and Gas Journal 91(16):64-69.

Sassen, R., H.H. Roberts, P. Aharon, J. Larkin, E.W. Chinn, and R. Carney. 1993b. Chemosynthetic bacterial mats at cold hydrocarbon seeps, Gulf of Mexico continental slope. Organic Geochemistry 20(1):77-89.

Sathiakumar, N. 2010. Short-term physical effects: Oil spills. Presentation, School of Public Health, University of Alabama at Birmingham. Internet website: http://www.iom.edu/~/media/Files/Activity%20Files/PublicHealth/OilSpillHealth/NaliniSathiakumar-6-22-1110am.pdf.

Saunders, J., A. Thurman, and R.T. Saucier. 1992. Preceramic(?) mound complexes in northeastern Louisiana. In: Jeter, M.D., ed. Southeastern Archaeological Conference: Abstracts of the Forty-Ninth Annual Meeting, Little Rock, AR.

Sayre, A. 2010. Forecast: Louisiana will have slow job growth. Internet website: http://www.businessweek.com/ap/financialnews/D9IMCA800.htm. Accessed December 12, 2010.

Scaife, W.W., R.E. Turner, and R. Costanza. 1983. Coastal Louisiana recent land loss and canals impacts. Environmental Management 7(5):433-442.

Schales, S. and D. Soileau. 2001. Official communication with Samuel Holder: Shell Key, Point au Fer ,and their surrounding shell reefs, June 15. Both gentlemen were employed by the Louisiana Dept. of Wildlife and Fisheries at the time.

Schaum, J., M. Cohen, S. Perry, R. Artz, R. Draxler, J.B. Frithsen, D. Heist, M. Lorber, and L. Phillips. 2010. Screening level assessment of risks due to dioxin emissions from burning oil from the BP *Deepwater Horizon* Gulf of Mexico spill. Environ. Sci. Technol. 44(24):9383–9389. Internet website: http://www.epa.gov/research/dioxin/docs/OilScreen25.pdf.

Schiro, A.J., D. Fertl, L.P. May, G.T. Regan, and A. Amos. 1998. West Indian manatee (*Trichechus manatus*) occurrence in U.S. waters west of Florida. Presentation at the World Marine Mammal Conference, 20-24 January, Monaco.

Schlager, W. 1981. The paradox of drowned reefs and carbonate platforms. Geological Society of America Bulletin 92(4):197-211. Internet website: http://bulletin.geoscienceworld.org/cgi/content/abstract/92/4/197.

Schmahl, G.P. and E.L. Hickerson. 2006. McGrail Bank, a deep tropical coral reef community in the northwestern Gulf of Mexico. In: Proceedings of 10th International Coral Reef Symposium. June 28-July 2, 2006, Okinawa, Japan.

Schmahl, G.P., E.L.Hickerson, D.C.Weaver, and J.V.Gardner. 2003. High-resolution multibeam mapping of topographic features in the northwestern Gulf of Mexico. In: Proceedings of the U.S. Hydro Conference, March 24-27, 2003, Biloxi, MS.

Schmidt, K. 2010a. Despite fears following spill, local jobless rate holds steady. Internet website: http://www.reefrelieffounders.com/drilling/2010/09/25/daily-comet-despite-fears-following-spill-local-jobless-rate-holds-steady/. Accessed December 12, 2010.

Schmidt, K. 2010b. Still no employment impact from spill, drilling uncertainty. Internet website: http://www.dailycomet.com/article/20101028/ARTICLES/101029226. Accessed December 10, 2010.

Schofield, P.J. 2009. Geographic extent and chronology of the invasion of the non-native lionfish (*Pterois volitans* [Linneaus 1758] and *P. miles* [Bennett 1828]) in the western North Atlantic and Caribbean Sea. Aquatic Invasions 4(3):473-479.

Scholz, D.K., J.H. Kucklick, R.G. Pond, A.H. Walker, A. Bostrom, and P. Fischbeck. 1999. Fate of spilled oil in marine waters: Where does it go? What does it do? How do dispersants affect it? An information booklet for decision-makers. American Petroleum Institute Publication Number 4691, 43 pp. Internet website: http://www.cleancaribbean.org/ccc_doc/pdf/API_Fate_of_Spilled_Oil.pdf.

Schroeder, W.W. 2000. Shelf hard bottom habitats. In: Schroeder, W.W. and C.F. Wood, eds. Physical/Biological Oceanographic Integration Workshop for DeSoto Canyon and Adjacent Shelf, October 19-21, 1999. U.S. Dept. of the Interior, Minerals Management Service, Gulf of Mexico OCS Region, New Orleans, LA. OCS Study MMS 2000-074. Pp. 67-71.

Schroeder, W.W. 2002. Observations of *Lophelia pertusa* and the surficial geology at a deep-water site in the northeastern Gulf of Mexico. Hydrobiologia 471:29-33.

Schroeder, D.M. and M.S. Love. 2004. Ecological and political issues surrounding decommissioning of offshore oil facilities in the southern California Bight. Ocean and Coastal Management 47:21-48.

Schroeder, W.W., A.W. Shultz, and J.J. Dindo. 1988. Inner-shelf hardbottom areas, northeastern Gulf of Mexico. Trans. Gulf Coast Assoc. Geol. Soc. 38:535-541.

Schroeder, W.W., M.R. Dardeau, J.J. Dindo, P. Fleisher, K.L. Heck Jr., and A.W. Shultz. 1989. Geophysical and biological aspects of hardbottom environments on the MAFLA shelf, northern Gulf of Mexico. Proceedings Oceans '88 Conference. Pp. 17-21.

Schummer, M.L. and W.R. Eddleman. 2003. Effects of disturbance on activity and energy budgets of migrating waterbirds in south-central Oklahoma. Journal of Wildlife Management 67:789-795.

Schwartz, F.J. 1988. Aggregations of young hatchling loggerhead sea turtles in the Sargassum off North Carolina. Marine Turtle Newsletter 42: 9-10

Schwartz, A. 2010. China beats U.S. to first offshore wind farm. Internet website: http://www.fastcompany.com/1687492/china-beats-us-to-first-offshore-wind-farm. Posted September 8, 2010. Accessed March 23, 2011.

Scott-Denton, E. 2009. Official communication. Incidental seabird bycatch in fisheries in the Gulf of Mexico. U.S. Dept. of Commerce, National Oceanic and Atmospheric Administration, National Marine Fisheries Service.

Seni, S.J. and M.P.A. Jackson. 1983. Evolution of salt structures, east Texas diapir province, Part 2: Patterns and rates of halokinesis. The American Association of Petroleum Geologists Bulletin 67(8):1245-1274.

Shaffer, G.P., J.W. Day, S. Mack, G.P. Kemp, I. van Heerden, M.A. Poirrier, K.A.Westphal, D. FitzGerald, A. Milanes, C.A. Morris, R. Bea, and P.S. Penland. 2009. The MRGO navigation project: A massive human-induced environmental, economic, and storm disaster. Journal of Coastal Research 54:206-224.

Shafir, S., J. Van Rijn, and B. Rinkevich. 2007. Short and long term toxicity of crude oil and oil dispersants to two representative coral species. Environmental Science and Technology 41:5571-5574.

Sharp, B.E. 1996. Post-release survival of oiled, cleaned seabirds in North America. Ibis 138:222-228.

Sharp, J.M. and S.G. Appan. 1982. The cumulative ecological effects of normal offshore petroleum operations contrasted with those resulting from continental shelf oil spills. Philosophical Transactions of the Royal Society of London. B: Biological Sciences 297:309-322.

Sheavly, S.B. 2007. National marine debris monitoring program: Final program report, data analysis and summary. Prepared for the U.S. Environmental Protection Agency by Ocean Conservancy. Grant Number X83053401-02. 76 pp.

Shigenaka, G. 2001. Toxicity of oil to reef-building corals: A spill response perspective. U.S. Dept. of Commerce, National Oceanic and Atmospheric Administration, Seattle, WA. NOAA Technical Memorandum NOS OR&R 8. 95 pp. Internet website: http://response.restoration.noaa.gov/book_shelf/1_coral_tox.pdf.

Shinn, E.A., J.H. Hudson, D.M. Robbin, and C.K. Lee. 1980a. Drilling mud plumes from offshore drilling operations: Implications for coral survival. The R&D Program for OCS Oil and Gas Operations. U.S. Dept. of the Interior, Geological Survey, Fisher Island Station, Miami Beach, FL.

Shinn, E.A., J.H. Hudson, D.M. Robbin, and C.K. Lee. 1980b. Drilling mud plumes from offshore drilling operations. Implications for coral survival. In: Geyer, R.A., ed. Marine environmental pollution. Amsterdam: Elsevier Scientific Publishing Company. Elsevier Oceanography Series, 27A. Pp 471-495.

Shinn, E.A., B.H. Lidz, and C.D. Reich. 1993. Habitat impacts of offshore drilling: Eastern Gulf of Mexico. U.S. Dept. of the Interior, Minerals Management Service, Gulf of Mexico OCS Region, New Orleans, LA. OCS Study MMS 93-0021. 73 pp.

Shipp, R.L. and T.L. Hopkins. 1978. Physical and biological observations of the northern rim of the DeSoto Canyon made from a research submersible. N.E. Gulf Sci. 2(2):113-121.

Shoreline Cleanup and Assessment Technique (SCAT). 2011a. Louisiana – SCAT shoreline oiling as of most recent survey, March 8, 2011. U.S. Dept. of Commerce, National Oceanic and Atmospheric Administration, ERMA (Environmental Response Management Application).

Shoreline Cleanup and Assessment Technique (SCAT). 2011b. Mobile – SCAT observation results: SCAT monitor and maintenance segment status and SCAT curring oiling conditions, March 7, 2011. U.S. Dept. of Commerce, National Oceanic and Atmospheric Administration, ERMA (Environmental Response Management Application).

Short, F.T., R.G. Coles, and C. Pergent-Martini. 2001. Global seagrass distribution. In: Short, F.T. and R.G. Coles, eds. 2001. Global seagrass research methods. Amsterdam, The Netherlands: Elsevier Science B.V. Pp 5-6, 20.

Sibley, D.A. 2000. The Sibley guide to birds. National Audubon Society, Knopf, NY. 544 pp.

Singh, T. 2010. China starts construction on world's biggest offshore wind farm. Internet website: http://inhabitat.com/china-starts-construction-on-worlds-biggest-offshore-wind-farm/. Posted October 25, 2010. Accessed March 24, 2011.

Skagen, S.K. and F.L. Knopf. 1993. Toward conservation of midcontinental shorebird migrations. Conservation Biology 7:533-541.

Skagen, S.K., D.A. Granfors, and C.P. Melcher. 2008. On determining the significance of ephemeral continental wetlands to North American migratory shorebirds. Auk 125:20-29.

Slack, T. 2008. Official communication. Information concerning the critical habitat and damage assessments of the Gulf sturgeon. Representing the Mississippi State Museum of Natural Science, Jackson, MS. Meeting held in New Orleans, LA, on January 27, 2008.

Smith, M.F., ed. 1984. Ecological characterization atlas of coastal Alabama: Map narrative. U.S. Dept. of the Interior, Fish and Wildlife Service FWS/OBS-82/46 and Minerals Management Service, Gulf of Mexico OCS Region, New Orleans, LA. OCS Study MMS 84-0052. 189 pp.

Smith, R.C., J.R. Bratten, J. Cozzi, and K. Plasket. n.d. The Emanuel Point ship archaeological investigations 1997-1998. Archaeology Institute, University of West Florida, Pensacola, FL. Report of Investigations No. 68.

Smith, J.P., H.L. Mairs, M.G. Brandsma, R.P. Meek, and R.C. Ayers, Jr. 1994. Field validation of the Offshore Operators Committee (OCC) produced water discharge model. Presented at the Society of Petroleum Engineers 69th Annual Technical Conference and Exhibition, New Orleans, LA, September 25-28, 1994. SPE 28350.

Smultea, M.A. and B. Würsig. 1995. Behavioral reactions of bottlenose dolphins to the *Mega Borg* oil spill, Gulf of Mexico 1990. Aquatic Mammals 21:171-181.

South Alabama Regional Planning Commission. 2001. Fort Morgan Peninsula resource assessment. Alabama Dept. of Conservation and Natural Resources, Mobile, AL. 26 pp.

South Atlantic Fishery Management Council. 2002. Fishery management plan for pelagic Sargassum habitat of the South Atlantic Region, including a final environmental impact statement, initial regulatory flexibility analysis, regulatory impact review, & social impact assessment/fishery impact statement: Second revised final. South Atlantic Fishery Management Council, Charleston, SC.

Southall, B.L., A.E. Bowles, W.T. Ellison, J.J. Finneran, R.L. Gentry, C.R. Greene, Jr., D. Kastak, D.R. Ketten, J.H. Miller, P.E. Nachtigall, W.J. Richardson, J.A. Thomas, and P. Tyack. 2007.

Marine mammal noise exposure criteria: Initial scientific recommendations. Aquatic Mammals 33:411-521.

Southwest Research Institute. 1981. Ecological investigations of petroleum production platforms in the central Gulf of Mexico. Submitted to the U.S. Dept. of the Interior, Bureau of Land Management, New Orleans OCS Office, New Orleans, LA. Contract no. AA551-CT8-17.

Spalding, E.A. and M.W. Hester. 2007. Effects of hydrology and salinity on oligohaline plant species productivity: Implications of relative sea-level rise. Estuaries and Coasts 30(2):214-225.

Spies, R.B., J.S. Felton, and L. Dillard. 1982. Hepatic mixed-function oxidases in California flatfishes are increased in contaminated environments and by oil and PCB ingestion. Marine Biology 70:117-127.

Sports Fishing Institute. 1989. Marine fisheries by catch issues. Sports Fishing Institute, Washington, DC. Bulletin No. 405. 6 pp.

St. Aubin, D.J. and V. Lounsbury. 1990. Chapter 11. Oil effects on manatees: Evaluating the risks. In: Geraci, J.R. and D.J. St. Aubin, eds. Sea mammals and oil: Confronting the risks. San Diego, CA: Academic Press, Inc. Pp. 241-251.

Stabile, J., J.R. Waldman, F. Parauka, and I. Wirgin. 1996. Stock structure and homing fidelity in Gulf of Mexico sturgeon (*Acipenser oxyrinchus desotoi*) based on restriction fragment length polymorphism and sequence analyses of mitochondrial DNA. Genetics 144:767-775.

Stacy, M. 2011. Gulf Coast tourism officials 'cautiously optimistic'. Associated Press article. Internet website: http://www.nola.com/news/gulf-oil-spill/index.ssf/2011/04/gulf_coast_tourism_officials_c.html. Accessed October 6, 2011.

Stadelman, W.J. 1958. The effects of sounds of varying intensity on hatchability of chicken eggs. Poultry Science 37:166-169.

State of Alabama. n.d. Oil & gas industry. Geological Survey of Alabama and State Oil and Gas Board of Alabama. Internet website: http://www.gsa.state.al.us/documents/oginfo/og_industry.pdf. Accessed February 17, 2011.

State of Florida. Division of Historic Resources. 2010. The Emanuel Point shipwreck. Internet website: http://www.flheritage.com/archaeology/projects/shipwrecks/emanuelpoint/. Accessed August 11, 2010.

State of Louisiana. 2007. Integrated ecosystem restoration and hurricane protection: Louisiana's comprehensive master plan for a sustainable coast. Coastal Protection and Restoration Authority of Louisiana, Baton Rouge, LA. Internet website: http://www.lacpra.org/index.cfm?md=pagebuilder&tmp=home&nid=24&pnid=0&pid=28&fmid=0&catid=0&elid=0. Accessed April 7, 2011.

State of Louisiana. 2010. Election 2010: Constitutional amendments results. Internet website: http://www.legis.state.la.us/election2010/amendments.htm. Accessed January 23, 2011.

State University System of Florida Institute of Oceanography (SUSIO). 1977. Baseline monitoring studies: Mississippi, Alabama, Florida outer continental shelf, 1975-1976. Volume I: Executive summary. U.S. Dept. of the Interior, Bureau of Land Management, New Orleans, LA. Contract No. 08550-CT5-30. 55 pp.

Stehn, T. 2007. Official communication. Captive and wild whooping crane population sizes in 2007. Wildlife Biologist, U.S. Dept. of the Interior, Fish and Wildlife Service, Aransas National Wildlife Refuge, Texas.

Stehn, T. 2011. Official communication. Wild and captive population numbers for whooping crane, 2010. Biologist, U.S. Dept. of the Interior, Fish and Wildlife Service, Aransas National Wildlife Refuge, TX.

Steidl, R.J. and B.F. Powell. 2006. Assessing the effects of human activities on wildlife. George Wright Forum 23:50-58.

Stephens, B.P. 2009. Basement controls on subsurface geologic patterns and coastal geomorphology across the northern Gulf of Mexico: Implications for subsidence studies and coastal restoration. Transactions Gulf Coast Association of Geological Societies 59:729-751. Internet website: http://www.searchanddiscovery.net/abstracts/html/2009/gcags/abstracts/stephens.htm.

Stephens, B.P. 2010a. Basement controls on subsurface geologic patterns and near-surface geology across the northern Gulf of Mexico: A deeper perspective on coastal Louisiana. American Association of Petroleum Geologists, Annual Conference and Exhibition, April 11-14, 2010, New Orleans, LA. Search and Discovery Article #30129. Internet website: http://www.searchanddiscovery.net/documents/2010/30129stephens/ndx_stephens.pdf.

Stephens, B.P. 2010b. Basement controls on subsurface geologic patterns and coastal geomorphology across the northern Gulf of Mexico: Implications for subsidence studies and coastal restoration. Adapted from the presentation given to New Orleans Geological Society, July 14, 2010.

Stephenson, R. 1997. Effects of oil and other surface-active organic pollutants on aquatic birds. Environmental Conservation 24:121-129.

Stephenson, R. and C.A. Andrews. 1997. The effect of water surface tension on feather wetability in aquatic birds. Canadian Journal of Zoology 74:288-294.

Steyer, G.D., B.C. Perez, S.P. Piazza, and G. Suir. 2007. Potential consequences of saltwater intrusion associated with Hurricanes Katrina and Rita. In: Farris, G.S., G.J. Smith, M.P. Crane, C.R. Demas, L.L. Robbins, and D.L. Lavoie, eds. Science and the storms—the USGS response to the hurricanes of 2005. U.S. Dept. of the Interior, Geological Survey. Geological Survey Circular 1306. Pp. 137-146. Internet website: http://pubs.usgs.gov/circ/1306/. Accessed April 17, 2011.

Steyer, G.D., C. Sasser, E. Evers, E. Swenson, G. Suir, and S. Sapkota. 2008. Influence of the Houma navigation canal on salinity patterns and landscape configuration in coastal Louisiana: An interagency collaboration: U.S. Dept. of the Interior, Geological Survey. Geological Survey Open-File Report 2008-1127. 190 pp.

Steyn, P. 2010. *Exxon Valdez* oil spill. Answers.com. Internet website: http://www.answers.com/topic/exxon-valdez-oil-spill. Accessed November 23, 2010.

Stone, R.B. 1974. A brief history of artificial reef activities in the United States. In: Proceedings: Artificial Reef Conference, Houston, TX. Pp. 24-27.

Stone, G.W. 2001. Wave climate and bottom boundary layer dynamics with implications for offshore sand mining and barrier island replenishment in south-central Louisiana. U.S. Dept. of the Interior, Minerals Management Service, Gulf of Mexico OCS Region, New Orleans, LA. OCS Study MMS 2000-053. 90 pp.

Stoner, A.W. 1983. Pelagic Sargassum: Evidence for a major decrease in biomass. Deep-Sea Research Part A. Oceanographic Research Papers 30(4):469-474.

Sturges. W., E. Chassignet, and T. Ezer. 2004. Strong mid-depth currents and a deep cyclonic gyre in the Gulf of Mexico: Final report. U.S. Dept. of the Interior, Minerals Management Service, Gulf of Mexico OCS Region, New Orleans, LA. OCS Study MMS-2004-040. 89 pp.

Sturm, D.J., J. Stout, and T. Thibaut. 2007. Statewide summary for Alabama. In. Handley, D.A., D. Altsman, and R. DeMay, eds. Seagrass status and trends in the northern Gulf of Mexico: 1940-2002. Scientific Investigations Report 2006-5287. U.S. Environmental Protection Agency 855-R-04-003. Pp. 87-97. Internet website: http://pubs.usgs.gov/sir/2006/5287/. Accessed May 20, 2011.

Stutzenbaker, C.D. and M.W. Weller. 1989. The Texas coast. In: Smith, L.M., R.L. Pederson, and R.K. Kaminski, eds. Habitat management for migrating and wintering waterfowl in North America. Lubbock, TX: Texas Tech. University Press. Pp. 385-405.

Suchanek, T.H. 1993. Oil impacts on marine invertebrate populations and communities. American Zoologist 33:510-523.

Sulak, K. 1997. Official communication. Conversations regarding recent information and research concerning the Gulf sturgeon at the Seventeenth Annual Information Transfer Meeting held in December 1997 in New Orleans, LA.

Sulak, K.J. and J.P. Clugston. 1998. Early life history stages of Gulf sturgeon in the Suwannee River, Florida. Transactions of American Fisheries Society 127:758-771

Sulak, K.J. and J.P. Clugston. 1999. Recent advance in life history of Gulf of Mexico sturgeon, *Acipenser oxyrinchus desotoi*, in the Suwannee River, Florida, USA: A synopsis. Journal of Applied Ichthyology 15:116-128.

Swann, L. 2010. Alabama and Mississippi estuarine habitats status and trends. Mississippi-Alabama Sea Grant Consortium and Auburn University. Internet website: http://www.masgc.org/ppt/AL_MS_Habitat_Status_Trends_files/frame.htm. Accessed October 13, 2010.

Swanson, C., F.D. McCay, S. Subbayya, J. Rowe, P. Hall, and T. Isaji. 2003. Modeling dredging-induced suspended sediment and the environmental effects in Mt. Hope Bay and the Taunton River for the proposed Weaver's Cove Energy, LLC, Liquefied Natural Gas Import Terminal. Prepared by Applied Science Associates for Weaver's Cove Energy, LLC.

Swenson, E.M. and R.E. Turner. 1987. Spoil banks: Effects on a coastal marsh water-level regime. Estuarine Coastal Shelf Science 24:599-609.

Swift, T.L. and S.J. Hannon. 2010. Critical thresholds associated with habitat loss: A review of the concepts, evidence, and applications. Biological Reviews 85:35-53.

Swilling, W.R., Jr., M.C. Wooten, N.R. Holler, and W.J. Lynn. 1998. Population dynamics of Alabama beach mice (*Peromyscus polionotus ammobates*) following Hurricane Opal. Amer. Midland Nat. 140:287-298.

Systems Applications International, Sonoma Technology, Inc., Earth Tech, Alpine Geophysics, and A.T. Kearney. 1995. Gulf of Mexico air quality study: Final report. Volumes I-III. U.S. Dept. of the Interior, Minerals Management Service, Gulf of Mexico OCS Region, New Orleans, LA. OCS Study MMS 95-0038, 95-0039, and 95-0040. 650, 214, and 190 pp., respectively.

Szaro, R.C., P.H. Albers, and N.C. Coon. 1978a. Petroleum: effects on mallard egg hatchability. Journal of Wildlife Management 42:404-406.

Szaro, R.C., M.P. Dieter, G.H. Heinz, and J.F. Ferrell. 1978b. Effects of chronic ingestion of south Louisiana crude oil on mallard ducklings. Environmental Research 17:426-436.

Szmant-Froelich, A., V. Johnson, T. Hoehn, J. Battey, G.J. Smith, E. Fleischmann, J. Porter, and D. Dallmeyer. 1981. The physical effects of oil-drilling muds on the Caribbean coral *Montastrea annularis*. In: Volume I; Proceedings of the Fourth International Coral Reef Symposium, May 1981, Manilla, Philippines.

Tacha, T.C., S.A. Nesbitt, and P.A. Vohs. 1992. Sandhill crane (*Grus canadensis*). In: Poole, A., ed. The birds of North America online. Ithaca, NY: Cornell Lab of Ornithology. Internet website: http://bna.birds.cornell.edu/bna/species/031. Accessed December 6, 2011.

Tan, L., M. Belanger, and C. Wittnich. 2010. Revisiting the correlation between estimated seabird mortality and oil spill size. Journal of Marine Animals and Their Ecology 3(1):20-26.

Taylor, H.A., M.A. Rasheed, and R. Thomas. 2006. Port Curtis post oil spill seagrass assessment, Gladstone-2006. DPI&F Information Series QI06046 (DPI&F, Cairns). 19 pp. Internet website: http://www.seagrasswatch.org/Info_centre/Publications/pdf/meg/GladstonePostOilSpillReport2006_Final.pdf.

Teal, J.M. and R.W. Howarth. 1984. Oil spill studies: A review of ecological effects. Environmental Management 8:27-44.

Teal, J.M., K. Burns, and J. Farrington. 1978. Analyses of aromatic hydrocarbons in intertidal sediments resulting from two spills of No. 2 fuel oil in Buzzards Bay, Massachusetts. Journal of the Fisheries Research Board of Canada 35:510-520.

Teal, J.M., J.W. Farrington, K.A. Burns, J.J. Stegeman, B.W. Tripp, B. Woodin, and C. Phinney. 1992. The West Falmouth oil spill after 20 years: Fate of fuel oil compounds and effects on animals. Marine Pollution Bulletin 24(12):607-614.

Teas, W.G. 1994. Marine turtle stranding trends, 1986-1993. In: Bjorndal, K.A., A.B. Bolten, D.A. Johnson, and P.J. Eliazar, comps. Proceedings of the Fourteenth Annual Symposium on Sea Turtle Biology and Conservation. NOAA Technical Memorandum NMFS-SEFSC-351. Pp. 293-295.

Telesnicki, G.J. and W.M. Goldberg. 1995. Effects of turbidity on the photosynthesis and respiration of two south Florida reef coral species. Bulletin of Marine Science 57(2):527-539.

Tenaglia, K.M., J.L. Van Zant, and M.C. Wooten. 2007. Genetic relatedness and spatial associations of jointly captured Alabama beach mice (*Peromyscus polionotus ammobates*). Journal of Mammalogy 88:580-588.

Teo, S.L.H, A. Boustany, H. Dewar, M.J.W. Stokesbury, K.C. Weng, S. Beemer, A.C. Seitz, C.J. Farwell, E.D. Prince, and B.A. Block. 2007a. Annual migrations, diving behavior, and thermal biology of Atlantic bluefin tuna, *Thunnus thynnus*, on their Gulf of Mexico breeding grounds. Marine Biology 151:1-18.

Teo, S.L.H, A. Boustany, and B.A. Block. 2007b. Oceanographic preferences of Atlantic bluefin tuna, *Thunnus thynnus*, on their Gulf of Mexico breeding grounds. Marine Biology 152:1105-1119.

Terres, J.K. 1991. The Audubon Society encyclopedia of North American birds. New York, NY: Wing Books. 1,109 pp.

Terrens, G.W. and R.D. Tait. 1996. Monitoring ocean concentrations of aromatic hydrocarbons from produced formation water discharges to Bass Strait, Australia. Presented at the Society of Petroleum Engineers International Conference on Health, Safety, and Environment, New Orleans, LA, June 9-12, 1996. SPE 36033. Pp. 739-747.

Teslik, L.H. and C. Menegatti. 2010. Oil spill will hurt U.S. economy, but not big enough to cause recession. *The Washington Post*. Internet website: http://www.washingtonpost.com/wp-dyn/content/article/2010/07/01/AR2010070105311_pf.html. Accessed July 3, 2010.

Tetrahedron, Inc. 1996. Reliability of blowout preventers tested under fourteen and seven days time interval. Study report prepared for the U.S. Dept. of the Interior, Minerals Management Service. TA&R Project 253. 33 pp. Internet website: http://www.boemre.gov/tarprojects/253/AA.PDF.

Texas Parks and Wildlife Department. 1990. Texas colonial waterbird census summary. Texas Parks and Wildlife Department and the Texas Colonial Waterbird Society, Special Administrative Report.

Texas Parks and Wildlife Department. 1999. Seagrass conservation plan for Texas. Texas Parks and Wildlife, Resource Protection Division, Austin, TX. 79 pp. Internet website: http://www.tpwd.state.tx.us/publications/pwdpubs/media/pwd_bk_r0400_0041.pdf.

Thatcher, C.A., S.B. Hartley, and S.A. Wilson. 2011. Bank erosion of navigation canals in the western and central Gulf of Mexico. U.S. Dept. of the Interior, Geological Survey, National Wetlands Resource Center, Open-File Report 2010-1017 and U.S. Dept. of the Interior, Bureau of Ocean Energy Management, Regulation and Enforcement, Gulf of Mexico OCS Region, New Orleans, LA, OCS Study BOEMRE 2010-039. 32 pp. + 2 apps. Internet website: http://pubs.usgs.gov/of/2010/1017_p/pdf/OF10-1017.pdf.

The Encyclopedia of Earth. 2008. Gulf of Mexico large marine ecosystem. Internet website: http://www.eoearth.org/article/Gulf_of_Mexico_large_marine_ecosystem?topic=49522. Updated December 28, 2010. Accessed January 11, 2011.

The Federal Interagency Solutions Group. 2010. Oil budget calculator: *Deepwater Horizon*. Technical Documentation. A report to the National Incident Command by The Federal Interagency Solutions Group, Oil Budget Calculator Science and Engineering Team. November 2010. 217 pp. Internet website: http://www.noaanews.noaa.gov/stories2010/PDFs/OilBudgetCalc_Full_HQ-Print_111110.pdf.

The Greater Lafourche Port Commission (TGLPC). 2010a. Map of waterfront property available at Port Fourchon. Internet website: http://www.portfourchon.com/site100-01/1001757/docs/2010_7_1_waterfront.pdf. Accessed December 2, 2010.

The Greater Lafourche Port Commission (TGLPC). 2010b. Map of non-waterfront property available at Port Fourchon. Internet website: http://www.portfourchon.com/site100-01/1001757/docs/2010_7_1_nonwaterfront.pdf. Accessed December 3, 2010.

The Greater Lafourche Port Commission (TGLPC). 2010c. Port Fourchon north expansion. Internet website: http://www.portfourchon.com/explore.cfm/northernexpansion/. Accessed December 3, 2010.

The Greater Lafourche Port Commission (TGLPC). 2010d. South Lafourche airport in "excellent condition:" Many improvements since Port Commission acquisition. Internet website: http://www.portfourchon.com/explore.cfm/20100222airptrev/. Accessed December 3, 2010.

The Heinz Center. 2010. Evaluation of erosion hazards. Prepared for the Federal Emergency Management Agency. Contract EMW-97-CO-0375. 205 pp.

The Knowland Group. 2010. The Knowland Group releases oil spill survey findings following Memorial Day. Internet website: http://www.hotelnewsresource.com/article46295.html. Accessed June 4, 2010.

The Louis Berger Group, Inc. 2004. OCS-related infrastructure in the Gulf of Mexico fact book. U.S. Dept. of the Interior, Minerals Management Service, Gulf of Mexico OCS Region, New Orleans, LA. OCS Study MMS 2004-027. 249 pp.

The Louisiana Justice Institute. 2010. Briefing document: Impact of BP oil spill on African-American fisher communities in Louisiana. Internet website: http://www.louisianajusticeinstitute.org/files/all/docs/Briefing_Document_Vol_1-Issue_1.pdf. Accessed March 28, 2011.

The Oil Drum. 2009. USA Gulf of Mexico oil production forecast update. Internet website: http://www.theoildrum.com/node/5081. Posted February 9, 2009. Accessed January 4, 2011.

The White House. 2010. Establishing the Gulf Coast Ecosystem Restoration Task Force. Office of the Press Secretary, Executive Order, October 5, 2010. Internet website: http://www.whitehouse.gov/the-press-office/2010/10/05/executive-order-gulf-coast-ecosystem-restoration-task-force.

Thistle, D. 1981. Natural physical disturbances and communities of marine soft bottoms. Marine Ecology Progress Series 6:223-228.

Thompson, J.H. 1979. Effects of drilling mud on seven species of reef-building coral as measured in field and laboratory. Report to the U.S. Dept. of the Interior, Geological Survey from Texas A&M University, Department of Oceanography, College Station, TX. TA&R Project No. 20. Internet website: http://www.boemre.gov/tarprojects/020/20_aa.pdf.

Thompson, J.H., Jr. and T.J. Bright. 1980. Effects of an offshore drilling fluid on selected corals. In: Proceedings: , Volume 2. Symposium on Research on Environmental Fate and Effects of Drilling Fluids and Cuttings, Lake Buena Vista, FL, January 21-24, 1980. Washington, DC: American Petroleum Institute. Pp. 1044-1078. (ERL,GB X227).

Thompson, J.H., E.A. Shinn, Jr., and T.J. Bright. 1980. Effects of drilling mud on seven species of reef-building corals as measured in the field and laboratory. In: Geyer, R.A., ed. Marine environmental pollution. Amsterdam: Elsevier Scientific Publishing Company. Elsevier Oceanography Series 27A. . Pp 433-453.

Thompson, M.J., W.W. Schroeder, and N.W. Phillips. 1999. Ecology of live bottom habitats of the northeastern Gulf of Mexico: A community profile. U.S. Dept. of the Interior, Geological Survey, Biological Resources Division, USGS/BRD/CR-1999-0001 and Minerals Management Service, Gulf of Mexico OCS Region, New Orleans, LA. OCS Study MMS 99-0004. x + 74 pp.

Thorhaug, A. 1988. Dispersed oil effects on mangroves, seagrasses, and corals in the wider Caribbean. Proceedings of the 6th International Coral Reef Symposium, Australia 2:337-339.

Thorhaug, A., J. Marcus, and F. Booker. 1986. Oil and dispersed oil on subtropical and tropical seagrasses in laboratory studies. Marine Pollution Bulletin 17:357-631.

Tiner, R.W. 1984. Wetlands of the United States: Current status and recent trends. U.S. Dept. of the Interior, Fish and Wildlife Service, Newton Corner, MA. vii + 59 pp.

Tkalich, P. and E.S. Chan. 2002. Vertical mixing of oil droplets by breaking waves. Marine Pollution Bulletin 44:1219-1229.

Tokotch, B. 2010. Oil and coral fact sheet. 3 pp. Internet website: http://sero.nmfs.noaa.gov/sf/deepwater_horizon/Oil-CoralOnePage.pdf. Accessed December 6, 2010.

Tolbert, C.M. 1995. Oil and gas development and coastal income inequality: Case studies at the place level. U.S. Dept. of the Interior, Minerals Management Service, Gulf of Mexico OCS Region, New Orleans, LA. OCS Study MMS 94-0052. 75 pp.

Tolbert, C.M. and M. Sizer. 1996. U.S. commuting zones and labor market areas: 1990 update. U.S. Dept. of Agriculture, Economic Research Service, Rural Economy Division. Staff Paper No. AGES-9614.

Toll Road News. 2009. LA1 bridge to Gulf oil & gas is tolling. Internet website: http://tollroadsnews.com/node/4305. Accessed December 3, 2010.

Torres, J.L. 2001. Impacts of sedimentation on the growth rates of *Montastraea annularis* in southwest Puerto Rico. Bulletin of Marine Science 69(2):631-637.

Torres, R., M. Chiappone, F. Geraldes, Y. Rodriguez, and M. Vega. 2001. Sedimentation as an important environmental influence on Dominican Republic reefs. Bulletin of Marine Science 69(2):805-818.

Traylor-Holzer, K. 2005. Revised population viability analysis for the Alabama beach mouse *Peromyscus polionotus ammobates*. Report to the U.S. Dept. of the Interior, Fish and Wildlife Service from IUCN/SSC Conservation Breeding Specialist Group, Apple Valley, MN. 31 pp.

Traylor-Holzer, K., R. Lacy, D. Reed, and O. Byers. 2005. Alabama beach mouse population and habitat viability analysis: Final report. Conservation Breeding Specialist Group, Apple Valley, MN.

Trefry, J.H. 1981. A review of existing knowledge on trace metals in the Gulf of Mexico. In: Proceedings of a symposium on environmental research needs in the Gulf of Mexico (GOMEX). Volume II-B. U.S. Dept. of Commerce, National Oceanic and Atmospheric Administration, Environmental Research Laboratory. Pp. 225-259.

Trefry, J.H. and J.P. Smith. 2003. Forms of mercury in drilling fluid barite and their fate in the marine environment: A review and synthesis. In: Proceedings of the SPE/EPA/DOE Exploration and Production Environmental Conference, March 10-12, 2003, San Antonio, TX. Paper SPE 80571-MS. 10 pp.

Trefry, J.H., K.L. Naito, R.P. Trocine, and S. Metz. 1995. Distribution and bioaccumulation of heavy metals from produced water discharges to the Gulf of Mexico. Water Science and Technology 32(2):31-36.

Trefry, J.H., R.P. Trocine, M.L. McElvaine, R.D. Rember, and L. Hawkins. 2003. Concentrations of total mercury and methylmercury in sediment adjacent to offshore drilling sites. In: Proceedings of the SPE/EPA/DOE Exploration and Production Environmental Conference, March 10-12, 2003, San Antonio, TX. Paper SPE 80569-MS. 12 pp.

Trivelpiece, W.Z., R.G. Butler, D.S. Miller, and D.B. Peakall. 1984. Reduced survival of chicks on oil-dosed adult Leach's storm-petrels. Condor 86:81-82.

Tuler, S., T. Webler, K. Dow, and F. Lord. 2009. Human dimensions impacts of oil spills: Brief summaries of human impacts of oil and oil spill response efforts. Social and Environmental Research Institute. Project funded by the Coastal Response Research Center. Internet website: http://www.seri-us.org/projects/HDOil.html.

Tuler, S., T. Weber, R. Lord, and K. Dow. 2010. A case study into the human dimensions of the DM-932 oil spill in New Orleans. Greenfield MA: Social and Environmental Research Institute. 32 pp.

Tunnell, J.W., Jr., Q.R. Dokken, M.E. Kindinger, and L.C. Thebeau. 1981. Effects of the *Ixtoc I* oil spill on the intertidal and subtidal infaunal populations along lower Texas coast barrier island beaches. In: Proceedings 1981 Oil Spill Conference, March 2-5, Atlanta, GA. Washington DC: American Petroleum Institute. Pp. 467-475.

Turner, R.E. and D.R. Cahoon, eds. 1987. Causes of wetland loss in the coastal Central Gulf of Mexico. U.S. Dept. of the Interior, Minerals Management Service, Gulf of Mexico OCS Region, New Orleans, LA. OCS Study MMS 87-0119 (Volume I: Executive Summary), 87-0120 (Volume II: Technical Narrative), and 87-0121 (Volume III: Appendices). 32, 400, and 122 pp., respectively.

Turner, R.E., R. Costanza, and W. Scaife. 1982. Canals and wetland erosion rates in coastal Louisiana. In: Conference on Coastal Erosion and Wetland Modification in Louisiana: Causes, Consequences, and Options. U.S. Dept. of the Interior, Fish and Wildlife Service, Office of Biological Services. FWS/OBS 82/59.

Turner, R.E., J.M. Lee, and C. Neill. 1994. Backfilling canals to restore wetlands: Empirical results in coastal Louisiana. Wetlands Ecology and Management 3(1):63-78.

Tuttle, J.R. and A.J. Combe III. 1981. Flow regime and sediment load affected by alterations of the Mississippi River. In: Cross, R.D. and Williams, D.L., eds. Proceedings, National Symposium: Freshwater Inflow Estuaries. U.S. Dept. of the Interior, Fish and Wildlife Service, Office of Biological Services. FWS/OBS-81/104. Pp. 334-348. Internet website: http://www.gomr.boemre.gov/PI/PDFImages/ESPIS/3/3779.pdf.

United Louisiana Vietnamese American Fisherfolks. 2010. Loss of subsistence use claim framework & template for Louisiana Vietnamese American fisherfolks & other Louisiana fisherfolks.

United Nations Environment Programme. 2009. Marine litter: A global challenge. Nairobi, Kenya: United Nations Environmental Programme. 232 pp. Internet website: http://www.unep.org/pdf/unep_marine_litter-a_global_challenge.pdf.

Upton, H.F. 2010. Commercial fishery disaster assistance. Congressional Research Service. Report for Congress. RL 34209. Internet website: http://www.fas.org/sgp/crs/misc/RL34209.pdf.

U.S. Congress, Office of Technology Assessment. 1990. Coping with an oiled sea: an analysis of oil spill response technologies, OTA-BP-O-63, Washington, DC: U.S. Government Printing Office. 70 pp. Internet website: http://www.fas.org/ota/reports/9011.pdf. Accessed December 27, 2010.

U.S. Dept. of Agriculture. Economic Research Service. 2004. County typology codes. Internet website: http://www.ers.usda.gov/Data/TypologyCodes/. Accessed September 20, 2010.

U.S. Dept. of Commerce. 2010. Estimating the economic effect of the deepwater drilling moratorium on the Gulf Coast economy: Inter-agency report, September 16, 2010. Report presented at the Department of Commerce Testimony—111th Congress by Rebecca Blank, Under Secretary for Economic Affairs, U.S. Dept. of Commerce. 25 pp. Internet website: http://www.commerce.gov/sites/default/files/documents/2010/november/blank091610_report.pdf. Accessed December 12, 2010.

U.S. Dept. of Commerce. Census Bureau. 2003. Language use and English-speaking ability: 2000. Internet website: http://www.census.gov/prod/2003pubs/c2kbr-29.pdf. Accessed July 2011.

U.S. Dept. of Commerce. Census Bureau. 2010. American FactFinder: Profile of demographic characteristics; Louisiana, Texas, Alabama, Mississippi and Florida. Data retrieved March 15, 2011.

U.S. Dept. of Commerce. National Aeronautics and Space Administration. 2003. SeaWiFS Project—detailed description. Internet website: http://oceancolor.gsfc.nasa.gov/SeaWiFS/BACKGROUND/SEAWIFS_970_BROCHURE.html. Updated July 30, 2003. Accessed January 11, 2011.

U.S. Dept. of Commerce. National Marine Fisheries Service. 2007a. Report to Congress on the impact of Hurricanes Katrina, Rita, and Wilma on commercial and recreational fishery habitat of Alabama, Florida, Louisiana, Mississippi, and Texas. July 2007. 191 pp. + apps. Internet website: http://www.nmfs.noaa.gov/msa2007/docs/HurricaneImpactsHabitat_080707_1200.pdf. Accessed December 30, 2010.

U.S. Dept. of Commerce. National Marine Fisheries Service. 2007b. Endangered Species Act Section 7 consultation on the effects of the five-year outer continental shelf oil and gas leasing program (2007-2012) in the Central and Western Planning Areas of the Gulf of Mexico. Biological Opinion. June 29. F/SER/2006/02611. 127 pp.

U.S. Dept. of Commerce. National Marine Fisheries Service. 2008. Information and databases on fisheries landings. Internet website (latest data for 2008): http://www.st.nmfs.gov/st1/commercial/landings/annual_landings.html. Accessed October 6, 2010.

U.S. Dept. of Commerce. National Marine Fisheries Service. 2010a. Essential fish habitat; a marine fish habitat conservation mandate for Federal agencies. South Atlantic Region. Internet website: http://sero.nmfs.noaa.gov/hcd/pdfs/efhdocs/sa_guide_2010.pdf.

U.S. Dept. of Commerce. National Marine Fisheries Service. 2010b. Recovery plan for the sperm whale (*Physeter macrocephalus*). U.S. Dept. of Commerce, National Marine Fisheries Service, Silver Spring, MD. 165 pp.

U.S. Dept. of Commerce. National Marine Fisheries Service. 2010c. Information and databases on fisheries landings. Internet website (latest data for 2009): http://www.st.nmfs.gov/st1/commercial/landings/annual_landings.html. Accessed September 25, 2010.

U.S. Dept. of Commerce. National Marine Fisheries Service. 2010d. Fisheries economics of the U.S. Internet website: http://www.st.nmfs.noaa.gov/st5/publication/fisheries_economics_2008.html. Accessed December 28, 2010.

U.S. Dept. of Commerce. National Marine Fisheries Service. 2010e. Recreational fisheries statistics queries. Internet website: http://www.st.nmfs.noaa.gov/st1/recreational/queries/index.html. Queried December 1, 2010.

U.S. Dept. of Commerce. National Marine Fisheries Service. 2011a. 2010-2011 cetacean unusual mortality event in the northern Gulf of Mexico. Internet website: http://www.nmfs.noaa.gov/pr/health/mmume/cetacean_gulfofmexico2010.htm. Accessed October 10, 2011.

U.S. Dept. of Commerce. National Marine Fisheries Service. 2011b. Dolphins and whales and the Gulf of Mexico oil spill. Internet website: http://www.nmfs.noaa.gov/pr/health/oilspill/mammals.htm. Accessed September 18, 2011.

U.S. Dept. of Commerce. National Marine Fisheries Service. 2011c. Sea turtles and the Gulf of Mexico oil spill. Internet website: http://www.nmfs.noaa.gov/pr/health/oilspill/turtles.htm. Accessed August 25, 2011.

U.S. Dept. of Commerce. National Marine Fisheries Service. 2011d. Information and databases on fisheries landings. Internet website (latest data for 2010): http://www.st.nmfs.gov/st1/commercial/landings/annual_landings.html. Accessed September 27, 2011.

U.S. Dept. of Commerce. National Marine Fisheries Service. 2011e. U.S. national bycatch report (Karp, W.A., L.L. Desfosse, and S.G. Brooke, eds). U.S. Dept. of Commerce, NOAA Technical Memorandum NMFS-F/SPO-117C. 508 pp.

U.S. Dept. of Commerce. National Marine Fisheries Service. 2011f. *Deepwater Horizon*: A preliminary bibliography of published research and expert commentary. Internet website: http://www.lib.noaa.gov/researchtools/subjectguides/dwh_bibliography.pdf. Accessed November 8, 2011.

U.S. Dept. of Commerce, National Marine Fisheries Service and U.S. Dept. of the Interior, Fish and Wildlife Service. 2007a. Leatherback sea turtle (*Dermochelys coriacea*); 5-year review: Summary and evaluation. U.S. Dept. of Commerce, National Marine Fisheries Service, Silver Spring, MD, and U.S. Dept. of the Interior, Fish and Wildlife Service, Southeast Region, Jacksonville Ecological Service Field Office, Jacksonville, FL. 79 pp. Internet website: http://www.fws.gov/northflorida/seaTurtles/2007-Reviews/2007-leatherback-turtle-5-year-review-final.pdf.

U.S. Dept. of Commerce, National Marine Fisheries Service and U.S. Dept. of the Interior, Fish and Wildlife Service. 2007b. Green sea turtle (*Chelonia mydas*); 5-year review: Summary and evaluation. U.S. Dept. of Commerce, National Marine Fisheries Service, Silver Spring, MD, and U.S. Dept. of the Interior, Fish and Wildlife Service, Southeast Region, Jacksonville Ecological Service Field Office, Jacksonville, FL. 102 pp. Internet website: http://www.fws.gov/northflorida/SeaTurtles/2007-Reviews/2007-green-turtle-5-year-review-final.pdf.

U.S. Dept. of Commerce, National Marine Fisheries Service and U.S. Dept. of the Interior, Fish and Wildlife Service. 2007c. Hawksbill sea turtle (*Eretmochelys imbricata*); 5-year review: Summary and evaluation. U.S. Dept. of Commerce, National Marine Fisheries Service, Silver Spring, MD, and U.S. Dept. of the Interior, Fish and Wildlife Service, Southeast Region, Jacksonville Ecological Service Field Office, Jacksonville, FL. 90 pp. Internet website: http://www.fws.gov/northflorida/SeaTurtles/2007-Reviews/2007-hawksbill-turtle-5-year-review-final.pdf.

U.S. Dept. of Commerce, National Marine Fisheries Service and U.S. Dept. of the Interior, Fish and Wildlife Service. 2007d. Kemp's ridley sea turtle (*Lepidochelys kempii*); 5-year review: Summary and evaluation. U.S. Dept. of Commerce, National Marine Fisheries Service, Silver Spring, MD, and U.S. Dept. of the Interior, Fish and Wildlife Service, Southeast Region, Jacksonville Ecological Service Field Office, Jacksonville, FL. 50 pp. Internet website: http://www.fws.gov/northflorida/SeaTurtles/2007-Reviews/2007-Kemps-ridley-turtle-5-year-review-final.pdf.

U.S. Dept. of Commerce, National Marine Fisheries Service and U.S. Dept. of the Interior, Fish and Wildlife Service. 2007e. Loggerhead sea turtle (*Caretta caretta*); 5-year review: Summary and evaluation. U.S. Dept. of Commerce, National Marine Fisheries Service, Silver Spring, MD, and U.S. Dept. of the Interior, Fish and Wildlife Service, Southeast Region, Jacksonville Ecological Service Field Office, Jacksonville, FL. 65 pp. Internet website: http://www.fws.gov/northflorida/SeaTurtles/2007-Reviews/2007-Loggerhead-turtle-5-year-review-final.pdf.

U.S. Dept. of Commerce, National Marine Fisheries Service and U.S. Dept. of the Interior, Fish and Wildlife Service. 2008. Recovery plan for the northwest Atlantic population of the loggerhead sea turtle (*Caretta caretta*), second revision. U.S. Dept. of Commerce, National Marine Fisheries Service, Silver Spring, MD.

U.S. Dept. of Commerce. National Oceanic and Atmospheric Administration. 1997. Alabama coastal hazards assessment (CD-ROM). U.S. Dept. of Commerce, National Oceanic and Atmospheric Administration, Coastal Service Center, Charleston SC.

U.S. Dept. of Commerce. National Oceanic and Atmospheric Administration. 2000. Shoreline assessment manual, third edition. U.S. Dept. of Commerce, National Oceanic and Atmospheric Administration, Office of Response and Restoration, Seattle, WA. HAZMAT Report 2000-1. 120 pp. Internet website: http://www.fws.gov/contaminants/FWS_OSCP_05/fwscontingencyappendices/N-Manuals-Response-Assessment/ShorelineAssessment_NOAA.pdf. Accessed February 13, 2010.

U.S. Dept. of Commerce. National Oceanic and Atmospheric Administration. 2005. NOAA attributes recent increase in hurricane activity to naturally occurring multi-decadal climate variability. *NOAA Magazine*. November 29, 2005. Internet website: http://www.magazine.noaa.gov/stories/mag184.htm.

U.S. Dept. of Commerce. National Oceanic and Atmospheric Administration. 2006. NOAA fact sheet, small diesel spills (500-5000 gallons) (Office of Response and Restoration). November 2006. Internet website: http://response.restoration.noaa.gov/book_shelf/974_diesel.pdf.

U.S. Dept. of Commerce. National Oceanic Atmospheric Administration. 2007. National Artificial Reef Plan: Guidelines for siting, construction, development, and assessment of artificial reefs. Internet website: http://www.nmfs.noaa.gov/sfa/PartnershipsCommunications/recfish/NARPREVISION_3_07_07_FINAL.pdf.

U.S. Dept. of Commerce. National Oceanic and Atmospheric Administration. 2008a. The Gulf of Mexico at a glance. U.S. Dept. of Commerce, National Oceanic and Atmospheric Administration, National Ocean Service, Washington, DC. 34 pp. Internet website: http://gulfofmexicoalliance.org/pdfs/gulf_glance_1008.pdf. Accessed February 27, 2009.

U.S. Dept. of Commerce. National Oceanic and Atmospheric Administration. 2008b. Interagency report on marine debris sources, impacts, strategies, and recommendations. Interagency Marine Debris Coordinating Committee, Silver Spring, MD. 62 pp.

U.S. Dept. of Commerce. National Oceanic and Atmospheric Administration. 2008c. NOAA responds to New Orleans barge collision oil spill. Internet website: http://www.noaanews.noaa.gov/stories2008/20080724_oilspill.html. Accessed November 26, 2010.

U.S. Dept. of Commerce. National Oceanic and Atmospheric Administration. 2010a. Using booms in response to oil spills. National Ocean Service. 4 pp. Internet website: http://sero.nmfs.noaa.gov/sf/deepwater_horizon/NOAA_boom_fact_sheet.pdf. Last revised May 10, 2010. Accessed December 27, 2010.

U.S. Dept. of Commerce. National Oceanic and Atmospheric Administration. 2010b. Administration's Joint Analysis Group releases first scientific report on subsea monitoring data from Gulf spill: Provides snapshot of where oil is subsea in vicinity of the wellhead, June 23, 2010. Internet website: http://www.noaanews.noaa.gov/stories2010/20100623_brooks.html. Accessed July 7, 2010.

U.S. Dept. of Commerce. National Oceanic and Atmospheric Administration. 2010c. Second Federal analysis gives further clues about location and movement of subsurface oil, July 23, 2010. Internet website: http://www.noaanews.noaa.gov/stories2010/20100722_jag.html. Accessed August 11, 2010.

U.S. Dept. of Commerce. National Oceanic and Atmospheric Administration. 2010d. No dead zones observed or expected as part of BP *Deepwater Horizon* oil spill: Report finds decreased, but stabilized levels of dissolved oxygen in Gulf areas with subsurface oil, September 7, 2010. Internet website: http://www.noaanews.noaa.gov/stories2010/20100907_jag3.html. Accessed January 29, 2011.

U.S. Dept. of Commerce. National Oceanic and Atmospheric Administration. 2010e. Environmental Response Management Application (ERMA). Internet website: http://gomex.erma.noaa.gov. Accessed October 14, 2010.

U.S. Dept. of Commerce. National Oceanic and Atmospheric Administration. 2010f. Corals that are candidates for listing under the ESA. U.S. Dept. of Commerce, NOAA Fisheries Office of Protected Resources. Internet website: http://www.nmfs.noaa.gov/pr/species/invertebrates/corals.htm. Accessed December 1, 2010.

U.S. Dept. of Commerce. National Oceanic and Atmospheric Administration. 2010g. NOAA's oil spill response: Rehabilitated sea turtles released into Gulf of Mexico habitat. Internet website: http://www.noaanews.noaa.gov/stories2010/PDFs/seaturtlesbpfactsheet_101910.pdf. Accessed October 18, 2011:

U.S. Dept. of Commerce. National Oceanic and Atmospheric Administration. 2010h. NOAA's oil spill response: Effects of oil on marine mammals and sea turtles. *NOAA*, May 12, 2010. Internet website: http://response.restoration.noaa.gov/book_shelf/1887_Marine-Mammals-Sea-Turtles-fact-sheet.pdf.

U.S. Dept. of Commerce. National Oceanic and Atmospheric Administration. 2010i. *Deepwater Horizon*/BP oil spill response: Shoreline threat update; southern Florida, Florida Keys and east coast *Deepwater Horizon*/BP oil spill, July 30, 2010. U.S. Dept. of Commerce, NOAA, Office of Response and Restoration.

U.S. Dept. of Commerce. National Oceanic and Atmospheric Administration. 2010j. *Deepwater Horizon*/BP oil spill: Federal fisheries closure and other information. Internet website: http://sero.nmfs.noaa.gov/deepwater_horizon_oil_spill.htm. Accessed September 21, 2010.

U.S. Dept. of Commerce. National Oceanic and Atmospheric Administration. 2010k. Resources related to Environmental Sensitivity Index (ESI) maps. Internet website: http://response.restoration.noaa.gov/resource_resourcetopic.php?RECORD_KEY(resourcetopics)=resourcetopic_id&resourcetopic_id(resourcetopics)=37. Accessed December 3, 2010.

U.S. Dept. of Commerce. National Oceanic and Atmospheric Administration. 2011a. The Gulf of Mexico at a glance: The second glance. U.S. Dept. of Commerce, National Oceanic and Atmospheric Administration, National Ocean Service, Washington, DC.

U.S. Dept. of Commerce. National Oceanic and Atmospheric Administration. 2011b. Environmental Response Management Application (ERMA). Internet website: http://gomex.erma.noaa.gov. Accessed September 28, 2011.

U.S. Dept. of Commerce. National Oceanic and Atmospheric Administration. 2011c. Elkhorn coral (*Acropora palmata*). U.S. Dept. of Commerce, NOAA Fisheries, Office of Protected Resources. Internet website: http://www.nmfs.noaa.gov/pr/species/invertebrates/elkhorncoral.htm. Accessed June 6, 2011.

U.S. Dept. of Commerce. National Oceanic and Atmospheric Administration. 2011d. Threats to marine turtles: Threats in the marine environment. Internet website: http://www.nmfs.noaa.gov/pr/species/turtles/threats.htm. Accessed May 20, 2011.

U.S. Dept. of Commerce. National Oceanic and Atmospheric Administration. 2011e. Endangered species listing for Atlantic bluefin tuna not warranted. Internet website: http://www.noaanews.noaa.gov/stories2011/20110527_bluefintuna.html. Posted May 27, 2011. Accessed June 9, 2011.

U.S. Dept. of Commerce. National Oceanic and Atmospheric Administration. 2011f. NOAA: All federal waters of the Gulf once closed to fishing due to the spill now open: More than 1,000 square miles opened today. Internet website: http://www.noaanews.noaa.gov/stories2011/20110419_gulfreopening.html. Posted April 19, 2011. Accessed May 13, 2011.

U.S. Dept. of Commerce. National Oceanic and Atmospheric Administration. 2011g. *Deepwater Horizon*/BP oil spill: Seafood surveillance data. Internet website: http://sero.nmfs.noaa.gov/deepwater_horizon_oil_spill.htm.

U.S. Dept. of Commerce. National Oceanic and Atmospheric Administration. National Hurricane Center. 2006. U.S. mainland hurricane strikes by state, 1851-2004. Internet website: http://www.nhc.noaa.gov/paststate.shtml. Accessed October 24, 2006.

U.S. Dept. of Energy. 2010. Creating an offshore wind industry in the United States: A strategic work plan for the United States Department of Energy, fiscal years 2011 – 2015. U.S. Dept. of Energy, Office of Energy Efficiency and Renewable Energy, Wind & Water Power Program. September 2, 2010. Internet website: http://www.windpoweringamerica.gov/pdfs/offshore/offshore_wind_strategic_plan.pdf.

U.S. Dept. of Energy. Energy Information Administration. 2006. Natural gas processing: The crucial link between natural gas production and its transportation to market. U.S. Dept. of Energy, Energy Information Administration, Office of Oil and Gas, Washington DC, January 2006.

U.S. Dept. of Energy. Energy Information Administration. 2010a. Oil: Crude and petroleum products explained, use of oil. Internet website: http://tonto.eia.doe.gov/energyexplained/index.cfm?page=oil_use. Last updated May 25, 2011. Accessed October 12, 2011.

U.S. Dept. of Energy. Energy Information Administration. 2010b. Crude and petroleum products explained, oil imports and exports. Internet website: http://tonto.eia.doe.gov/energyexplained/index.cfm?page=oil_imports. Last updated June 24, 2011. Accessed October 12, 2011.

U.S. Dept. of Energy. Energy Information Administration. 2010c. Table 6.3. Natural gas imports, exports, and net imports, 1949-2009. Internet website: http://tonto.eia.doe.gov/totalenergy/data/annual/txt/ptb0603.html. Accessed October 12, 2011.

U.S. Dept. of Energy. Energy Information Administration. 2010d. Natural gas explained, where our natural gas comes from. Internet website: http://tonto.eia.doe.gov/energyexplained/index.cfm?page=natural_gas_where. Last updated December 21, 2010. Accessed October 12, 2011.

U.S. Dept. of Energy. Energy Information Administration. 2010e. Gulf of Mexico fact sheet. Internet website: http://www.eia.doe.gov/special/gulf_of_mexico/index.cfm. Updated December 30, 2010. Accessed April 27, 2011.

U.S. Dept. of Energy. Energy Information Administration. 2011a. Natural gas consumption by end use. Internet website: http://tonto.eia.doe.gov/dnav/ng/ng_cons_sum_dcu_nus_a.htm. Last updated September 9, 2011. Accessed October 12, 2011.

U.S. Dept. of Energy. Energy Information Administration. 2011b. Short-term energy and summer fuels outlook. Internet website: http://www.eia.gov/emeu/steo/pub/contents.html#US_Crude_Oil_And_Liquids_Fuels. Posted April 12, 2011. Accessed April 27, 2011.

U.S. Dept. of Health and Human Services. Food and Drug Administration. 2011. Gulf of Mexico oil spill update: Information current as of Monday, May 2, 2011. Internet website: http://www.fda.gov/food/ucm210970.htm. Accessed May 2, 2011.

U.S. Dept. of Homeland Security. Coast Guard. 2010a. Polluting incidents in and around U.S. waters. A spill/release compendium: 1969-2008. Office of Investigations & Compliance Analysis (CG-545), Washington DC. Internet website: http://www.safety4sea.com/admin/images/media/pdf/2010.09.01-Spill_Compendium.pdf. Accessed December 23, 2010.

U.S. Dept. of Homeland Security. Coast Guard. 2010b. Ballast water management. Internet website: http://www.uscg.mil/hq/cg5/cg522/cg5224/bwm.asp. Accessed October 28, 2010.

U.S. Dept. of Homeland Security. Coast Guard. 2010c. *Deepwater Horizon* response daily report, period 91. July 21, 2010. Coast Guard Unified Area Command.

U.S. Dept. of Homeland Security. Coast Guard. 2010d. *Deepwater Horizon* response daily report, period 175. October 12, 2010. Coast Guard Unified Area Command.

U.S. Dept. of Homeland Security. Coast Guard. 2010e. Barataria Bay oil spill. National Response Center. Incident report no. 948993. July 27, 2010.

U.S. Dept. of Homeland Security. Federal Emergency Management Agency. 2008. Disaster declared parishes in Louisiana because of Hurricane Gustav. Internet website: http://www.fema.gov/news/eventcounties.fema?id=10468.

U.S. Dept. of Labor. Bureau of Labor Statistics. 2010a. Quarterly census of employment and wages for 2001-2009. Internet website: http://www.bls.gov/cew/. Accessed December 1, 2010.

U.S. Dept. of Labor. Bureau of Labor Statistics. 2010b. Fact sheet: Employment in the oil and gas well drilling industry. Internet website: http://www.bls.gov/cew/oil_gas_drilling.htm. Accessed July 1, 2010.

U.S. Dept. of Labor. Occupational Safety and Health Administration. 2010. Keeping workers safe during oil spill response and cleanup operations: Gulf oil response and heat. Internet website: http://www.osha.gov/oilspills/heatstress.html. Accessed January 12, 2011.

U.S. Dept. of the Army. Corps of Engineers. 2002a. Ocean dumping report for calendar 2001: Dredged material. 205 pp. Internet website: http://el.erdc.usace.army.mil/odd/Download_Sites/LC_files/LC_2001.pdf.

U.S. Dept. of the Army. Corps of Engineers. 2002b. Diamondback terrapin (*Malaclemys terrapin* (spp)). Internet website: http://el.erdc.usace.army.mil/tessp/profile.cfm?Type=Freshwater%20Turtles&Name=Diamondback%20Terrapin&View=Species. Accessed October 18, 2010.

U.S. Dept. of the Army. Corps of Engineers. 2004a. Louisiana coastal area (LCA), Louisiana: Ecosystem restoration study. Volume I: LCA Study—main report and Volume II: Programmatic environmental impact statement. U.S. Dept. of the Army, Corps of Engineers, New Orleans District, New Orleans, LA. 506 and 918 pp., respectively. Internet website: http://www.lca.gov/Library/ProductList.aspx?Prodtype=0&folder=1118. Accessed March 18, 2011.

U.S. Dept. of the Army. Corps of Engineers. 2005a. U.S. Army Corps of Engineers response to Hurricanes Katrina & Rita in Louisiana. Environmental Assessment EA #433. Internet website: http://www.nolaenvironmental.gov/nola_public_data/projects/usace_levee/docs/original/KatrinaRitaEAJune_8_06.pdf. Accessed September 2006.

U.S. Dept. of the Army. Corps of Engineers. 2005b. Corps emergency permitting procedures due to hurricanes. Internet website: http://www.nolaenvironmental.gov/nola_public_data/projects/usace_levee/docs/original/KatrinaRitaEAJune_8_06.pdf. Accessed December 1, 2010.

U.S. Dept. of the Army. Corps of Engineers. 2008. Maintenance dredging and disposal of dredged materials Mississippi and Louisiana portions of the Gulf Intracoastal Waterway federally authorized navigation project: Draft environmental assessment, January 2008. Mobile District Office, Mobile, AL. 232 pp. Internet website: http://www.sam.usace.army.mil/pd/EAs/GIWW_DRAFTEAforPUBLIC(2)jj.pdf. Accessed May 20, 2011.

U.S. Dept. of the Army. Corps of Engineers, 2009a. Louisiana coastal protection and restoration: Final technical report and comment addendum—programmatic cumulative effects analysis appendix. U.S. Dept. of the Army, Corps of Engineers, New Orleans District, Mississippi Valley Division. 49 pp. with annexes. Internet website: http://lacpr.usace.army.mil/FinalReport/Vol%20IV/Programmatic%20Cumulative%20Effects%20Analysis.pdf.

U.S. Dept. of the Army. Corps of Engineers. 2009b. Corps hurricane response. Task Force hope status report newsletter, December 14, 2009. 8 pp. Internet website: http://www.mvn.usace.army.mil/hps2/pdf/Dec_14_2009.pdf.

U.S. Dept. of the Army. Corps of Engineers. 2009c. Louisiana coastal protection and restoration: Final technical report and comment addendum—main report. U.S. Dept. of the Army, Corps of Engineers, New Orleans District, Mississippi Valley Division. 265 pp. with attachments. Internet website: http://lacpr.usace.army.mil/default.aspx?p=LACPR_Final_Technical_Report.

U.S. Dept. of the Army. Corps of Engineers. 2010. Draft supplemental environmental assessment for the beach erosion control and storm damage reduction project, Panama City Beach, Bay County. Mobile District, Planning and Environmental Division, Environmental Resources Branch, Coastal Environment Team. 27 pp.

U.S. Dept. of the Army. Corps of Engineers. 2011a. Amount of dredged material ocean disposed by year in cubic yards by single district. Internet website: http://el.erdc.usace.army.mil/odd/. Stated as current through 2008. Accessed January 27, 2011.

U.S. Dept. of the Army. Corps of Engineers. 2011b. United States of America ocean dumping report for calendar year 2008 dredged material. Headquarters, Washington DC. Internet website: http://el.erdc.usace.army.mil/odd/file.htm. Stated as current through 2008. Accessed January 27, 2011.

U.S. Dept. of the Interior. 2010a. Increased safety measures for energy development on the outer continental shelf, May 27, 2010. U.S. Dept. of the Interior, Washington, DC. 44 pp. Internet website: http://www.doi.gov/deepwaterhorizon/loader.cfm?csModule=security/getfile&PageID=33598.

U.S. Dept. of the Interior. 2010b. Salazar divides MMS's three conflicting missions. Press Release. May 19, 2010. Internet website: http://www.doi.gov/news/pressreleases/Salazar-Divides-MMSs-Three-Conflicting-Missions.cfm. Accessed October 4, 2011.

U.S. Dept. of the Interior. 2010c. Change of the name of the Minerals Management Service to the Bureau of Ocean Energy Management, Regulation, and Enforcement. Secretarial Order No. 3302. Internet website. http://www.doi.gov/deepwaterhorizon/loader.cfm?csModule=security/getfile&PageID=35872. Posted June 18, 2010. Accessed October 4, 2011.

U.S. Dept. of the Interior. Bureau of Land Management. 1982. *Ixtoc I* oil spill economic impact study. U.S. Dept. of the Interior, Bureau of Land Management, New Orleans OCS Office, New Orleans, LA. Study no. 1982-33.

U.S. Dept. of the Interior. Bureau of Ocean Energy Management, Regulation and Enforcement. 2010a. Modifications to suspension of deepwater drilling operations: Environmental assessment and finding of no significant impact (October 12, 2010). U.S. Dept. of the Interior, Bureau of Ocean Energy Management, Regulation and Enforcement, Herndon, VA. 43 pp. Internet website: http://www.boemre.gov/eppd/PDF/EAModificationsSuspension10122010.pdf.

U.S. Dept. of the Interior. Bureau of Ocean Energy Management, Regulation and Enforcement. 2010b. Fact sheet: The workplace safety rule on safety and environmental management systems (SEMS). U.S. Dept. of the Interior, Bureau of Ocean Energy Management, Regulation and Enforcement, Gulf of Mexico OCS Region, New Orleans, LA. 2 pp. Internet website: http://www.doi.gov/news/pressreleases/loader.cfm?csModule=security/getfile&PageID=45791.

U.S. Dept. of the Interior. Bureau of Ocean Energy Management, Regulation and Enforcement. 2010c. Technical Information Management System (TIMS). Accessed September 13, 2010.

U.S. Dept. of the Interior. Bureau of Ocean Energy Management, Regulation and Enforcement. 2010d. BOEMRE issues guidance for deepwater drillers to comply with strengthened safety and environmental standards. Press Release and Document. December 13, 2010. 18 pp. Internet website: http://www.boemre.gov/ooc/press/2010/press1213.htm. Accessed December 27, 2010.

U.S. Dept. of the Interior. Bureau of Ocean Energy Management, Regulation and Enforcement. 2010e. Loss of well control—statistics and summaries 2006-2010. Internet website: http://www.boemre.gov/incidents/blowouts.htm. Updated November 19, 2010. Accessed December 15, 2010.

U.S. Dept. of the Interior. Bureau of Ocean Energy Management, Regulation and Enforcement. 2010f. BOEMRE website incident statistics and summaries 1996-2010. Internet website: http://www.boemre.gov/incidents/IncidentStatisticsSummaries.htm. Specifically accessed the page Gulf of Mexico Region Spills ≥ 50 Barrels (2,100 gallons)—2007: http://www.boemre.gov/incidents/SigPoll2007.htm. Accessed November 11, 2010.

U.S. Dept. of the Interior. Bureau of Ocean Energy Management, Regulation and Enforcement. 2010g. BOEMRE website incident statistics and summaries 1996-2010. Internet websites: http://www.boemre.gov/incidents/IncidentStatisticsSummaries.htm. Specifically accessed the page Gulf of Mexico Region Spills ≥ 50 Barrels (2,100 gallons)—2008: http://www.boemre.gov/incidents/SigPoll2008.htm. Accessed November 30, 2010.

U.S. Dept. of the Interior. Bureau of Ocean Energy Management, Regulation and Enforcement. 2010h. Questions, answers, and related resources. Internet website: http://www.gomr.boemre.gov/homepg/offshore/egom/faq.html. Accessed October 5, 2010.

U.S. Dept. of the Interior. Bureau of Ocean Energy Management, Regulation and Enforcement. 2010i. Summary OCS spills of 50 barrels (2,100 gallons) and greater, calendar year 1964-2009. Internet website: http://www.boemre.gov/incidents/spills1964-1995.htm. Accessed November 24, 2010.

U.S. Dept. of the Interior. Bureau of Ocean Energy Management, Regulation and Enforcement. 2010j. Federal and academic scientists return from deep-sea research cruise in Gulf of Mexico: Scientists observe damage to deep-sea corals. Press Release. November 4, 2010. Internet website: http://www.boemre.gov/ooc/press/2010/press1104a.htm. Accessed November 24, 2010.

U.S. Dept. of the Interior. Bureau of Ocean Energy Management, Regulation and Enforcement. 2011a. Draft report: Update of oil spill occurrence rates for offshore oil spills. Received from Melinda Mayes on July 5, 2011.

U.S. Dept. of the Interior. Bureau of Ocean Energy Management, Regulation and Enforcement. 2011b. Gulf of Mexico OCS oil and gas lease sale: 2011; Western Planning Area Lease Sale 218—final supplemental environmental impact statement. 2 vols. U.S. Dept. of the Interior, Bureau of Ocean Energy Management, Regulation and Enforcement, Gulf of Mexico OCS Region, New Orleans, LA. OCS EIS/EA BOEMRE 2011-034.

U.S. Dept. of the Interior. Fish and Wildlife Service. 1973. Amendments to lists of endangered fish and wildlife. Title 50 Code of Federal Regulations Part 17. 38 FR 106, p. 14678, June 4, 1973.

U.S. Dept. of the Interior. Fish and Wildlife Service. 1977. Determination of critical habitat for Mississippi sandhill crane. Title 50 Code of Federal Regulations Part 17. Final rulemaking. 42 FR 152, pp. 39985-39988, August 8, 1977.

U.S. Dept. of the Interior. Fish and Wildlife Service. 1984. Title 50 Code of Federal Regulations Part 17, endangered and threatened wildlife and plants; U.S. breeding population of the wood stork determined to be endangered. Final rule. 49 FR 40, pp. 7332-7335, February 28, 1984.

U.S. Dept. of the Interior. Fish and Wildlife Service. 1985a. Endangered and threatened wildlife and plants; determination of endangered status and critical habitat for three beach mice; final rule. *Federal Register* 50 FR 109, pp. 23872-23889.

U.S. Dept. of the Interior. Fish and Wildlife Service. 1985b. Critical habitat designation Choctawhatchee beach mouse. 50 CFR 1 §17.95.

U.S. Dept. of the Interior. Fish and Wildlife Service. 1987. Recovery plan for the Choctawhatchee, Perdido Key, and Alabama beach mouse. U.S. Dept. of the Interior, Fish and Wildlife Service, Atlanta, GA. 45 pp.

U.S. Dept. of the Interior. Fish and Wildlife Service. 1991. Mississippi sandhill crane recovery plan, U.S. Dept. of the Interior, Fish and Wildlife Service, Atlanta, GA. 42 pp.

U.S. Dept. of the Interior. Fish and Wildlife Service. 1994. Whooping crane recovery plan (second revision). U.S. Dept. of the Interior, Fish and Wildlife Service, Albuquerque, NM. 92 pp.

U.S. Dept. of the Interior. Fish and Wildlife Service. 1996. Revised recovery plan for the U.S. breeding population of the wood stork. U.S. Dept. of the Interior, Fish and Wildlife Service, Atlanta, GA. 41 pp.

U.S. Dept. of the Interior. Fish and Wildlife Service. 1998. Endangered and threatened wildlife and plants. 50 CFR 17.11 and 17.12. December 31, 1998. 56 pp.

U.S. Dept. of the Interior. Fish and Wildlife Service. 1999. National wetlands inventory: 1996 coastal Mississippi habitat data. U.S. Dept. of the Interior, Fish and Wildlife Service, National Wetlands Center, Lafayette, LA.

U.S. Dept. of the Interior. Fish and Wildlife Service. 2000. Fisheries resources annual report. U.S. Dept. of the Interior, Fish and Wildlife Service, Panama City, FL. 28 pp.

U.S. Dept. of the Interior. Fish and Wildlife Service. 2003. Recovery plan for the Great Lakes, piping plover (*Charadrius melodious)*. U.S. Dept. of the Interior, Fish and Wildlife Service, Great Lakes—Big Rivers Region. 141 pp.

U.S. Dept. of the Interior. Fish and Wildlife Service. 2004a. Hurricane Ivan wreaks havoc on southeast refuges 2004. Environmental Contaminants Program. Internet website: http://www.fws.gov/contaminants/DisplayNews.cfm?NewsID=3953873A-54D8-4997-A9EF22BA218F7275. Posted September 24, 2004. Accessed April 14, 2011.

U.S. Dept. of the Interior. Fish and Wildlife Service. 2004b. Preliminary assessment of Alabama beach mouse (*Peromyscus polionotus ammobates*) distribution and habitat following Hurricane Ivan. U.S. Dept. of the Interior, Fish and Wildlife Service, Daphne, AL. 18 pp.

U.S. Dept. of the Interior. Fish and Wildlife Service. 2004c. Model evaluation for predicting hurricane effects on Alabama beach mouse habitat: Technical support to the Daphne Ecological Services Field Office, Vero Beach, FL. 17 pp.

U.S. Dept. of the Interior. Fish and Wildlife Service. 2005a. Preliminary assessment of Alabama beach mouse (*Peromyscus polionotus ammobates*) distribution and habitat following the 2005 hurricane season. U.S. Dept. of the Interior, Fish and Wildlife Service, Daphne, AL. 18 pp.

U.S. Dept. of the Interior. Fish and Wildlife Service. 2006a. Endangered and threatened wildlife and plants; critical habitat for the Alabama beach mouse: Proposed rule. 50 CFR 17 RIN 1018-AU46. *Federal Register* 71:21.

U.S. Dept. of the Interior. Fish and Wildlife Service. 2007. Endangered Species Act Section 7 consultation on the effects of the five-year outer continental shelf oil and gas leasing program (2007-2012) in the Central and Western Planning Areas of the Gulf of Mexico. Biological Opinion, September 14.

U.S. Dept. of the Interior. Fish and Wildlife Service. 2009. Endangered and threatened wildlife and plants; removal of the brown pelican (*Pelecanus occidentalis*) from the federal list of endangered and threatened wildlife. *Federal Register*, Volume 74, pp. 59443-59472; 50 CFR 17, RIN 1018-AV28.

U.S. Dept. of the Interior. Fish and Wildlife Service. 2010a. *Deepwater Horizon* oil spill response (spill by the numbers section). Internet website: http://www.fws.gov/home/dhoilspill/. Accessed September 27, 2010. (FWS oil spill response weekly update. Report for the week of Saturday, September 25 – Friday, September 30, 2010. Internet website: http://www.fws.gov/home/dhoilspill/)

U.S. Dept. of the Interior. Fish and Wildlife Service. 2010b. Endangered and threatened wildlife and plants; 5-year status reviews of 10 southeastern species. Notice of initiation of reviews; request for information. 75 FR 68, pp. 18233-18234, April 9, 2010.

U.S. Dept. of the Interior. Fish and Wildlife Service. 2010c. Title 50 Code of Federal Regulations Part 17, endangered and threatened wildlife and plants; 90-day finding on a petition to reclassify the U.S. breeding population of wood storks from endangered to threatened.

U.S. Dept. of the Interior. Fish and Wildlife Service. 2010d. FWS *Deepwater Horizon* oil spill response. Weekly bird impact data and consolidated wildlife reports. Internet website: http://www.fws.gov/home/dhoilspill/pdfs/Bird%20Data%20Species%20Spreadsheet%2011302010.pdf.

U.S. Dept. of the Interior. Fish and Wildlife Service. 2011a. *Deepwater Horizon* bird impact data from the DOI-ERDC NRDA database 12 May 2011. 6 pp. Internet website: http://www.fws.gov/home/dhoilspill/pdfs/Bird%20Data%20Species%20Spreadsheet%2005122011.pdf. Accessed July 11, 2011.

U.S. Dept. of the Interior. Fish and Wildlife Service. 2011b. Species report. Internet website: http://ecos.fws.gov/tess_public/SpeciesReport.do. Accessed on June 28, 2011.

U.S. Dept. of the Interior, Fish and Wildlife Service and Gulf States Marine Fisheries Commission. 1995. Gulf sturgeon (*Acipenser oxyrinchus desotoi*) recovery/management plan. Prepared by the Gulf Sturgeon Recovery/Management Task Team for the U.S. Dept. of the Interior, Fish and Wildlife Service, Southeast Region, Atlanta, GA; the Gulf States Marine Fisheries Commission, Ocean Springs, MS; and the U.S. Dept. of Commerce, National Marine Fisheries Service, Washington, DC.

U.S. Dept of the Interior, Fish and Wildlife Service and U.S. Dept of Commerce, Census Bureau. 2006. National survey of fishing, hunting, and wildlife-associated recreation. 168 pp.

U.S. Dept. of the Interior, Fish and Wildlife Service and U.S. Dept. of Commerce, National Marine Fisheries Service. 2009. Gulf sturgeon (*Acipenser oxyrinchus desotoi*)—5-year review: Summary and evaluation. U.S. Dept. of the Interior, Fish and Wildlife Service, Southeast Region, Panama City

Ecological Services Field Office, Panama City, FL, and U.S. Dept. of Commerce, National Marine Fisheries Service, Southeast Region, Office of Protected Species, St. Petersburg, FL. 49 pp. Internet website: http://www.nmfs.noaa.gov/pr/pdfs/species/gulfsturgeon_5yearreview.pdf.

U.S. Dept. of the Interior. Geological Survey. 1988. Report to Congress: Coastal barrier resource system. Recommendations for additions to or deletions from the Coastal Barrier Resource System. Vol. 18, Louisiana.

U.S. Dept. of the Interior. Geological Survey. 1998. Chandeleur Islands, La.—1992 submerged aquatic vegetation. Geospatial_Data_Presentation_Form: Map. Maintained by the U.S. Dept. of the Interior, Geological Survey, National Wetlands Research Center.

U.S. Dept. of the Interior. Geological Survey. 2004. Seagrass habitat in the northern Gulf of Mexico: Degradation, conservation and restoration of a valuable resource. U.S. Dept. of the Interior, Geological Survey, Gulf of Mexico Program, 855-R-04-001. Internet website: http://gulfsci.usgs.gov/gom_ims/pdf/pubs_gom.pdf.

U.S. Dept. of the Interior. Geological Survey. 2005. Post Hurricane Katrina flights over Louisiana's barrier islands. U.S. Dept. of the Interior, Geological Survey, National Wetlands Research Center, Lafayette, LA. Internet website: http://www.nwrc.usgs.gov/hurricane/katrina_rita/katrina-post-hurricane-flights.htm. Accessed May 19, 2011.

U.S. Dept. of the Interior. Geological Survey. 2010a. Summary of the water cycle. Internet website: http://ga.water.usgs.gov/edu/watercyclesummary.html. Accessed October 4, 2010.

U.S. Dept. of the Interior. Geological Survey. 2010b. NAS—nonindigenous aquatic species. *Pterois volitans/miles*. Internet website: http://nas.er.usgs.gov/queries/collectioninfo.aspx?NoCache=8%2F11%2F2009+10%3A53%3A53+AM&SpeciesID=963&State=&County=&HUCNumber=. Accessed October 18, 2010.

U.S. Dept. of the Interior. Minerals Management Service. 1987. Programmatic environmental assessment: Structure removal activities, Central and Western Gulf of Mexico Planning Areas. U.S. Dept. of the Interior, Minerals Management Service, Gulf of Mexico OCS Region, New Orleans, LA. OCS EIS/EA MMS 87-0002. 84 pp.

U.S. Dept. of the Interior. Minerals Management Service. 1997. Gulf of Mexico OCS oil and gas lease Sales 169, 172, 175, 178 and 182: Central Planning Area—final environmental impact statement. U.S. Dept. of the Interior, Minerals Management Service, Gulf of Mexico OCS Region, New Orleans, LA. OCS EIS/EA MMS 97-0033.

U.S. Dept. of the Interior. Minerals Management Service. 2000. Gulf of Mexico deepwater operations and activities: Environmental assessment. U.S. Dept. of the Interior, Minerals Management Service, Gulf of Mexico OCS Region, New Orleans, LA. OCS EIS/EA MMS 2000-001. 264 pp. Internet website: http://www.gomr.boemre.gov/PDFs/2000/2000-001.pdf.

U.S. Dept. of the Interior. Minerals Management Service. 2001a. Proposed use of floating production, storage, and offloading systems on the Gulf of Mexico outer continental shelf, Western and Central Planning Areas—final environmental impact statement. U.S. Dept. of the Interior, Minerals Management Service, Gulf of Mexico OCS Region, New Orleans, LA. OCS EIS/EA MMS 2000-090. 782 pp. Internet website: http://www.gomr.boemre.gov/PDFs/2000/2000-090.pdf.

U.S. Dept. of the Interior. Minerals Management Service. 2001b. Gulf of Mexico oil and gas Lease Sale 181: Eastern Planning Area—final environmental impact statement. 2 vols. U.S. Dept. of the Interior, Minerals Management Service, Gulf of Mexico OCS Region, New Orleans, LA. OCS EIS/EA MMS 2001-051.

U.S. Dept. of the Interior. Minerals Management Service. 2001c. Outer continental shelf oil & gas leasing program: 2002-2007—draft environmental impact statement, October 2001. 2 vols. U.S. Dept. of the Interior, Minerals Management Service, Herndon, VA. OCS EIS/EA MMS 2001-079.

U.S. Dept. of the Interior. Minerals Management Service. 2005. Structure-removal operations on the Gulf of Mexico outer continental shelf—programmatic environmental assessment. U.S. Dept. of the Interior, Minerals Management Service, Gulf of Mexico OCS Region, New Orleans, LA. OCS EIS/EA MMS 2005-013.

U.S. Dept. of the Interior. Minerals Management Service. 2006a. Planning area resources addendum to assessment of undiscovered technically recoverable oil and gas resources of the Nation's outer continental shelf, 2006. MMS Fact Sheet RED-2006-02, July 2006. U.S. Dept. of the Interior, Minerals Management Service, Gulf of Mexico Region, New Orleans, LA. 2 pp. Internet website: http://www.boemre.gov/revaldiv/PDFs/NA2006BrochurePlanningAreaInsert.pdf.

U.S. Dept. of the Interior. Minerals Management Service. 2006b. Deepwater Gulf of Mexico 2006: America's expanding frontier. U.S. Dept. of the Interior, Minerals Management Service, Gulf of Mexico OCS Region, New Orleans, LA. OCS Report MMS 2006-022. 144 pp. Internet website: http://www.gomr.boemre.gov/homepg/whatsnew/techann/2006/2006-022.pdf.

U.S. Dept. of the Interior. Minerals Management Service. 2007a. Proposed final program: Outer continental shelf oil and gas leasing program, 2007-2012 (April 2007). U.S. Dept. of the Interior, Minerals Management Service, Herndon, VA. 146 pp. Internet website: http://www.boemre.gov/5-year/PDFs/MMSProposedFinalProgram2007-2012.pdf.

U.S. Dept. of the Interior. Minerals Management Service. 2007b. Outer continental shelf oil and gas leasing program: 2007-2012—final environmental impact statement. Volumes I and II. U.S. Dept. of the Interior, Minerals Management Service, Washington, DC. OCS EIS/EA MMS 2007-003. Internet website: http://www.BOEMRE.gov/5-year/PDFs/MMSProposedFinalProgram2007-2012.pdf.

U.S. Dept. of the Interior. Minerals Management Service. 2007c. Gulf of Mexico OCS oil and gas lease sales: 2007-2012; Western Planning Area Sales 204, 207, 210, 215, and 218; Central Planning Area Sales 205, 206, 208, 213, 216, and 222—final environmental impact statement. 2 vols. U.S. Dept. of the Interior, Minerals Management Service, Gulf of Mexico OCS Region, New Orleans, LA. OCS EIS/EA MMS 2007-018. Internet website: http://www.gomr.BOEMRE.gov/PDFs/2007/2007-018-Vol1.pdf.

U.S. Dept. of the Interior. Minerals Management Service. 2007d. Gulf of Mexico OCS oil and gas scenario examination: Pipeline landfalls. U.S. Dept. of the Interior, Minerals Management Service, Gulf of Mexico OCS Region, New Orleans, LA. OCS Report MMS 2007-053. 8 pp. Internet website: http://www.gomr.mms.gov/PDFs/2007/2007-053.pdf.

U.S. Dept. of the Interior. Minerals Management Service. 2007e. Gulf of Mexico OCS oil and gas scenario examination: Exploration and development activity. U.S. Dept. of the Interior, Minerals Management Service, Gulf of Mexico OCS Region, New Orleans, LA. OCS Report MMS 2007-052. 14 pp.

U.S. Dept. of the Interior. Minerals Management Service. 2007f. Final programmatic environmental impact statement for alternative energy development and production and alternate use of facilities on the outer continental shelf. U.S. Dept. of the Interior, Minerals Management Service, Herndon, VA. OCS EIS/EA 2007-046.

U.S. Dept. of the Interior. Minerals Management Service. 2007g. NTL 2007-G03: Marine trash and debris awareness and elimination. U.S. Dept. of the Interior, Minerals Management Service, Gulf of Mexico OCS Region, New Orleans, LA. Internet website: http://www.gomr.boemre.gov/homepg/regulate/regs/ntls/2007NTLs/07-g03.pdf.

U.S. Dept. of the Interior. Minerals Management Service. 2008a. Gulf of Mexico OCS oil and gas lease sales: 2009-2012; Central Planning Area Sales 208, 213, 216, and 222; Western Planning Area Sales 210, 215, and 218—final supplemental environmental impact statement. U.S. Dept. of the Interior, Minerals Management Service, Gulf of Mexico OCS Region, New Orleans, LA. OCS EIS/EA MMS 2008-041.

U.S. Dept. of the Interior. Minerals Management Service. 2008b. Preliminary evaluation of in-place gas hydrate resources: Gulf of Mexico outer continental shelf. U.S. Dept. of the Interior, Minerals Management Service, Gulf of Mexico OCS Region, New Orleans, LA. OCS Report MMS 2008-004. Internet website: http://www.mms.gov/revaldiv/GasHydrateFiles/MMS2008-004.pdf.

U.S. Dept. of the Interior. Minerals Management Service. 2008c. NTL No. 2008-G05: Shallow hazards program. U.S. Dept. of the Interior, Minerals Management Service, Gulf of Mexico OCS Region, New Orleans, LA. Internet website: http://www.gomr.boemre.gov/homepg/regulate/regs/ntls/2008NTLs/08-g05.pdf.

U.S. Dept. of the Interior. Minerals Management Service. 2009a. Petroleum spills from Federal outer continental shelf oil and gas facilities caused by major hurricanes, 2002 to 2008: Lili (2002), Ivan (2004), Katrina (2005), Rita (2005), Gustav (2008) and Ike (2008). September 24, 2009. Internet website: http://www.boemre.gov/incidents/PDFs/Hurricanes2002to2008.pdf. Accessed March 18, 2011.

U.S. Dept. of the Interior. Minerals Management Service. 2009b. NTL No. 2009-G39: Biologically-sensitive underwater features and areas. U.S. Dept. of the Interior, Minerals Management Service, Gulf of Mexico OCS Region, New Orleans, LA. Internet website: http://www.gomr.boemre.gov/homepg/regulate/regs/ntls/2009NTLs/09-G39.pdf.

U.S. Dept. of the Interior. Minerals Management Service. 2009c. NTL No. 2009-G40: Deepwater benthic communities. U.S. Dept. of the Interior, Minerals Management Service, Gulf of Mexico OCS Region, New Orleans, LA. Internet website: http://www.gomr.boemre.gov/homepg/regulate/regs/ntls/2009NTLs/09-G40.pdf.

U.S. Dept. of the Interior. Minerals Management Service. 2009d. Rigs to reefs policy addendum: Enhanced reviewing and approval guidelines in response to the post-Hurricane Katrina regulatory environment. Related document, OCS Report MMS 2000-073. Internet website: http://www.gomr.boemre.gov/homepg/regulate/environ/rigs-to-reefs/Rigs-to-Reefs-Policy-Addendum.pdf.

U.S. Dept. of the Interior. Minerals Management Service. 2009e. NTL 2009-G35: Sub-seabed disposal and offshore storage of solid wastes. Internet website: http://www.gomr.boemre.gov/homepg/regulate/regs/ntls/2009NTLs/09-G35.pdf.

U.S. Dept. of the Interior. National Park Service. 2005. November 2005 archeology e-gram. Internet website: http://www.nps.gov/archeology/pubs/egrams/0511.pdf. Accessed July 20, 2010.

U.S. Dept. of the Interior. National Park Service. 2010a. Padre Island National Seashore: Current sea turtle nesting season; sea turtle nesting in Texas. Internet website: http://www.nps.gov/pais/naturescience/current-season.htm. Accessed February 16, 2011.

U.S. Dept. of the Interior. National Park Service. 2010b. Experience America's best idea: National park getaways; Gulf Islands National Seashore, Florida & Mississippi. Internet website: http://www.nps.gov/getaways/guis/. Accessed April 14, 2011.

U.S. Dept. of the Interior. Office of Public Affairs. 2010a. Salazar calls for new safety measures for offshore oil and gas operations; orders six month moratorium on deepwater drilling. May 27, 2010. Internet website: http://www.boemre.gov/ooc/press/2010/press0527.htm. Accessed November 16, 2010.

U.S. Dept. of the Interior. Office of Public Affairs. 2010b. Readout of BOEMRE Director Bromwich's meeting with shallow water drilling coalition. September 14, 2010. Internet website: http://www.boemre.gov/ooc/press/2010/press0914.htm. Accessed November 16, 2010.

U.S. Dept. of Transportation. 2010. Gulf Coast ports surrounding the deepwater horizon oil spill. June 2010. Research and Innovative Technology Administration. Internet website: http://www.bts.gov/publications/bts_fact_sheets/2010_001/pdf/entire.pdf. Accessed August 31, 2010.

U.S. Dept. of Transportation. Coast Guard. 2003. Final environmental impact statement for the Port Pelican LLC deepwater port license application. Commandant, U.S. Dept. of Transportation, Coast Guard, Washington, DC.

U.S. Dept. of Transportation. Federal Highway Administration. 2004. Louisiana 1 improvements: Golden Meadow to Port Fourchon. Revised Record of Decision. Internet website: http://www.dotd.state.la.us/press/LA1_ROD_Addm.pdf. Accessed November 19, 2010.

U.S. Dept. of Transportation. National Transportation Safety Board. 1998. Safety recommendation M-98-124. Internet website: http://www.ntsb.gov/Recs/letters/1998/M98_124.pdf. Accessed October 2003.

U.S. Dept. of Transportation. Maritime Administration (MARAD). 2009. Vessel calls snapshot, 2009. 10 pp. Internet website: http://www.marad.dot.gov/documents/Vessel_Calls_at_US_Ports_Snapshot.pdf.

U.S. Dept. of Transportation. Maritime Administration (MARAD). 2010. Deepwater port licensing program: Pending applications. Internet website: http://www.marad.dot.gov/ports_landing_page/deepwater_port_licensing/dwp_planned_ports/dwp_planned_ports.htm. Accessed September 30, 2010.

U.S. Dept. of Transportation. Maritime Administration (MARAD). 2011. Cruise summary tables: North American cruises by departure port. Internet website: http://www.marad.dot.gov/documents/north_america_cruise_summary_data.xls. Accessed July 8, 2011.

U.S. Environmental Protection Agency. 2000a. Environmental assessment of final effluent limitation guidelines and standards for synthetic-based drilling fluids and other non-aqueous drilling fluids in the oil and gas extraction point source category. U.S. Environmental Protection Agency, Office of Water, Washington, DC. EPA-821-B-00-014. 184 pp.

U.S. Environmental Protection Agency. 2000b. Sector notebook project: Oil and gas extraction. 51 pp. Internet website: http://www.epa.gov/compliance/resources/publications/assistance/sectors/notebooks/oilgaspt1.pdf.

U.S. Environmental Protection Agency. 2001. Coastal condition report. EPA-620/R-01/005. Internet website: http://www.epa.gov/owow/oceans/nccr/downloads.html. Accessed August 24, 2009.

U.S. Environmental Protection Agency. 2002. Exemption of oil and gas exploration and production wastes from federal hazardous waste regulations. U.S. Environmental Protection Agency, Office of Solid Wastes, Washington, DC. EPA530-K-01-004. 40 pp. Internet website: http://www.epa.gov/osw/nonhaz/industrial/special/oil/oil-gas.pdf.

U.S. Environmental Protection Agency. 2004a. Final NPDES general permit for new and existing sources and new dischargers in the offshore subcategory of the oil and gas extraction category for the western portion of the outer continental shelf of the Gulf of Mexico (GMG290000). U.S. Environmental Protection Agency. 117 pp. Internet website: http://www.epa.gov/region6/water/npdes/genpermit/gmg290000finalpermit2004.pdf.

U.S. Environmental Protection Agency. 2005. Coastal condition report II. EPA-620/R-03/002. Internet website: http://www.epa.gov/owow/oceans/nccr/2005/downloads.html/. Accessed August 24, 2009.

U.S. Environmental Protection Agency. 2007a. Region 6 compliance assurance and enforcement, offshore and oil and gas NPDES permits. Internet website: http://www.epa.gov/earth1r6/6en/w/offshore/home.htm. Accessed November 26, 2010.

U.S. Environmental Protection Agency. 2007b. National Estuary Program coastal condition report. U.S. Environmental Protection Agency, Office of Water, Office of Research and Development, Washington DC. EPA-842/B-06/001. Internet website: http://water.epa.gov/type/oceb/nep/nepccr_index.cfmAccessed February 1, 2008.

U.S. Environmental Protection Agency. 2007c. USEPA Region 6 NPDES OCS general permit no. GMG290000. Internet website: http://www.epa.gov/earth1r6/6en/w/offshore/permit10012007.pdf. Accessed April 28, 2009.

U.S. Environmental Protection Agency. 2007d. NPDES general permit for new and existing sources and new dischargers in the offshore subcategory of the oil and gas extraction category for the western portion of the outer continental shelf of the Gulf of Mexico (GMG290000). U.S. Environmental Protection Agency. 15 pp. Internet website: http://www.epa.gov/Region06/water/npdes/genpermit/gmg290000fedreg.pdf.

U.S. Environmental Protection Agency. 2008a. Coastal condition report III. EPA/842-R-08-002. Internet website: http://www.epa.gov/nccr/. Accessed February 27, 2009.

U.S. Environmental Protection Agency. 2008b. National Pollutant Discharge Elimination System (NPDES), vessel discharges, final vessel general permit. 5 pp. Internet website: http://cfpub.epa.gov/npdes/home.cfm?program_id=350. Updated December 15, 2008. Accessed April 20, 2009.

U.S. Environmental Protection Agency. 2009a. Region 4 environmental assessment for the National Pollutant Discharge Elimination System permitting for eastern Gulf of Mexico offshore oil and gas exploration, development and production. Permit 904/P-09-001. 129 pp. Internet website: http://www.epa.gov/region04/water/permits/documents/ea_12_09_09.pdf.

U.S. Environmental Protection Agency. 2009b. Draft National Pollutant Discharge Elimination System (NPDES) general permit no. GEG460000 for offshore oil and gas activities in the Eastern Gulf of Mexico. 186 pp. Internet website: http://www.epa.gov/region4/water/permits/documents/draft_r4_ocspermit_v24fr_10152009.pdf. Accessed January 12, 2009.

U.S. Environmental Protection Agency. 2010a. EPA response to BP spill in the Gulf of Mexico. Air data from the Gulf coastline. Internet website: http://www.epa.gov/bpspill/air.html. Accessed December 1, 2010.

U.S. Environmental Protection Agency. 2010b. Region 4 air permits. Internet website: http://www.epa.gov/region4/air/permits/index.htm. Accessed November 2010.

U.S. Environmental Protection Agency. 2010c. Greenhouse gas reporting program. Internet website: http://www.epa.gov/climatechange/emissions/ghgrulemaking.html. Accessed February 1, 2011.

U.S. Environmental Protection Agency. 2010d. Particulate matter. Internet website: http://www.epa.gov/pm/. Accessed December 2, 2010.

U.S. Environmental Protection Agency. 2010e. Odors from the BP oil spill. Internet website: http://www.epa.gov/BPSpill/odor.html. Accessed October 1, 2010.

U.S. Environmental Protection Agency. 2010f. BP's analysis of subsurface dispersant use. Internet website: http://www.epa.gov/bpspill/dispersants-bp.html. Accessed July 9, 2010.

U.S. Environmental Protection Agency. 2010g. Water quality standards for the State of Florida's lakes and flowing waters. Internet website: http://www.epa.gov/waterscience/standards/rules/florida/factsheet.html. Accessed March 9, 2010.

U.S. Environmental Protection Agency. 2010h. Oil and gas NPDES permits. Internet website: http://www.epa.gov/region04/water/permits/oil_gas.html. Last updated January 15, 2010. Accessed November 26, 2010.

U.S. Environmental Protection Agency. 2010i. Recovered oil, contaminated materials and liquid and solid wastes management directive, June 29, 2010 (Louisiana). 9 pp. Internet website: http://www.epa.gov/bpspill/waste/wastemanagementdirective_la.pdf. Accessed August 31, 2010.

U.S. Environmental Protection Agency. 2010j. Recovered oil, contaminated materials and liquid and solid wastes management directive, June 29, 2010 (Mississippi, Alabama, Florida). 10 pp. Internet website: http://www.epa.gov/bpspill/waste/wastemanagementdirective_msalfl.pdf. Accessed August 31, 2010.

U.S. Environmental Protection Agency. 2010k. Waste staging and decontamination areas in Alabama, Florida, Louisiana and Mississippi, June 28-October 4. Internet website: http://www.epa.gov/bpspill/data/waste_facility_assessments.pdf. Accessed October 10, 2010.

U.S. Environmental Protection Agency. 2010l. Dispersant air sampling. Internet website: http://www.epa.gov/bpspill/dispersant-air-sampling.html. Accessed October 28, 2011.

U.S. Environmental Protection Agency. 2010m. Dispersants toxicity testing—Phase II questions and answers; August 2, 2010. Internet website: http://www.epa.gov/bpspill/dispersants/qanda-phase2.pdf. Accessed January 4, 2011.

U.S. Environmental Protection Agency. 2011a. National Ambient Air Quality Standards (NAAQS). Internet website: http://www.epa.gov/air/criteria.html. Last updated April 18, 2011. Accessed April 26, 2011.

U.S. Environmental Protection Agency. 2011b. 8-hour ozone nonattainment area/state/county report. Internet website: http://www.epa.gov/oaqps001/greenbk/gnca.html. Last updated April 21, 2011. Accessed April 26, 2011.

U.S. Environmental Protection Agency. 2011c. General conformity: Regulatory actions. Internet website: http://www.epa.gov/air/genconform/regs.html. Accessed June 12, 2011.

U.S. Environmental Protection Agency. 2011d. Questions and answers on dispersants. Internet website: http://www.epa.gov/bpspill/dispersants-qanda.html#chemicals. Accessed September 8, 2010.

U.S. Environmental Protection Agency and U.S. Dept. of Army, Corps of Engineers. 2003. Ocean Dredged Material Disposal Program: Regional implementation agreement. USEPA Region 6, USACOE Galveston District, USACOE New Orleans District. July 2003. Internet website: http://www.epa.gov/region6/water/ecopro/em/ocean/ria.pdf.

U.S. Government Accountability Office. 2007. Coastal wetlands: Lessons learned from past efforts in Louisiana could help guide future restoration and protection. Government Accountability Office, Washington DC. GAO 08-130. 62 pp. Internet website: http://www.gao.gov/new.items/d08130.pdf.

U.S. House of Representatives. Committee on Energy and Commerce. Subcommittee on Commerce, Trade, and Consumer Protection. 2010. The BP oil spill and the Gulf Coast tourism: Assessing the impact. Internet website: https://hsdl.org/?view&doc=126706&coll=limited.

U.S. Travel Association. 2010. Economic impact of travel and tourism. The Power of Travel Data Center. Internet website: http://poweroftravel.org/statistics.

Valentine, J. 2010. Official communication. Media reports of fisheries closures offsetting population losses from the spill. Senior Marine Scientist & Associate Professor, Dauphin Island Sea Lab and University of South Alabama. November 18, 2010.

Valentine, D.L., J.D. Kessler, M.C. Redmond, S.D. Mendes, M.B. Heintz, C. Farwell, L. Hu, F.S. Kinnaman, S. Yvon-Lewis, M. Du, E.W. Chan, F. Garcia Tigreros, and C.J. Villaneuva. 2010. Propane respiration jump-starts microbial response to a deep oil spill. Science Express. 9 pp. Internet website: http://ecosystems.mbl.edu/mbl_micro_eco/pdf/Valentine2010.pdf. Posted September 16, 2010. Accessed March 18, 2011.

Vandermuelen, J.H. 1982. Some conclusions regarding long-term effects of some major oil spills. Philosophical Transactions of the Royal Society of London. Series B, Biological Communities and Ecosystems 297(1087):335-351.

Vandegrift, K.J., S.H. Sokolow, P. Daszak, and A.M. Kilpatrick. 2010. Ecology of avian influenza viruses in a changing world. Annals of the New York Academy of Sciences 1195:113-128.

Varanasi, U., J.E. Stein, L.L. Johnson, T.K. Collier, E. Casillas, and M.S. Myers. 1992. Evaluation of bioindicators of contaminant exposure and effects in coastal ecosystems. In: McKenzie, D.H., D.E. Hyatt, and V.J. McDonald, eds. Ecological indicators, Volume 1. Proceedings of an International Symposium, Fort Lauderdale, FL.

Vashcenko, M.A. 1980. Effects of oil pollution on the development of sex cells in sea urchins. Biologische Anstalt Helgoland 297-300.

Veil, J.A., M.G. Puder, D. Elcock, and R.J. Redweik, Jr. 2004. A white paper describing produced water from production of crude oil, natural gas, and coal bed methane. Prepared by Argonne National Laboratory, Argonne, IL, for the U.S. Department of Energy, National Energy Technology Laboratory, Contract W-31-109-Eng-38. 79 pp. Internet website: http://www.ead.anl.gov/pub/dsp_detail.cfm?PubID=1715.

Velando, A., D. Alvarez, J. Mourino, F. Arcos, and A. Barros. 2005a. Population trends and reproductive success of the European shag *Phalacrocorax aristotelis* on the Iberian Peninsula following the *Prestige* oil spill. Journal of Ornithology 146:116-120.

Velando, A., I. Munilla, and P.M. Leyenda. 2005b. Short-term indirect effects of the ‘Prestige’ oil spill on European shags: Changes in availability of prey. Marine Ecology Progress Series 302:263-274.

Vermillion, B. 2011. Official communication. Raptors on the coast of the Gulf of Mexico. Telephone conservation, Biologist, U.S. Dept. of the Interior, Geological Survey, National Wetlands Research Center, Lafayette, LA.

Visit Florida Research. 2010. Research. Internet website: http://media.visitflorida.org/research.php. Accessed December 10, 2010.

Visser, J.M. and G.W. Peterson. 1994. Breeding populations and colony site dynamics of seabirds nesting in Louisiana. Colonial Waterbirds 17:146-152.

Vittor, B.A. 2000. Benthic macroinfauna of the northeastern Gulf of Mexico OCS, near DeSoto Canyon. In: Schroeder, W.W. and C.F. Wood, eds. Physical/Biological Oceanographic Integration Workshop for the DeSoto Canyon and Adjacent Shelf, October 19-21, 1999. U.S. Dept. of the Interior, Minerals Management Service, Gulf of Mexico OCS Region, New Orleans, LA. OCS Study MMS 2000-074. 168 pp.

Vladykov, V.D. 1955. A comparison of Atlantic sea sturgeon with a new subspecies from the Gulf of Mexico (*Acipenser ovyrhynchus desotoi*). Journal of the Fisheries Research Board of Canada 12:754-761.

Vladykov, V.D. and J.R. Greeley. 1963. Order Acipenseroidei. In: Fishes of the western North Atlantic. Memoirs of the Sears Foundation for Marine Research 1:24-60.

Wallace, R.K. 1996. Coastal wetlands in Alabama. Auburn University, Marine Extension and Research Center, Mobile, AL. Circular ANR-831 MASGP-96-018.

Wallace, B., J. Kirkley, T. McGuire, D. Austin, and D. Goldfield. 2001. Assessment of historical, social, and economic impacts of OCS development on Gulf Coast communities. U.S. Dept. of the Interior, Minerals Management Service, Gulf of Mexico OCS Region, New Orleans, LA. OCS Study MMS 2001-026. 12 pp.

Wang, F.C. 1988. Saltwater intrusion modeling: The role of man-made features. In: Turner, R.E. and D.R. Cahoon, eds. Causes of wetland loss in the coastal central Gulf of Mexico. Volume 2. U.S. Dept. of the Interior, Minerals Management Service, New Orleans, LA. OCS Study MMS 87-0120. Pp. 71-100.

Wang, P. and T. Roberts. 2010. Ongoing beach cleanup of the BP oil spill—a superficial job, literally. University of South Florida, Dept. of Geology, Coastal Research Laboratory, Tampa, FL.. 15 pp. Internet website: http://news.usf.edu/article/articlefiles/2566-PW%202nd%20Beach%20report.pdf.

Wang, D.W., S.A. Mitchell, W.J. Teague, E. Jarosz, and M.S. Hulbert. 2005. Extreme waves under Hurricane Ivan. Science 3009:896.

Wannamaker, C.M. and J.A. Rice. 2000. Effects of hypoxia on movements and behavior on selected estuarine organisms from the southeastern United States. Journal of Experimental Marine Biology and Ecology 249:145-163.

Ward, G.A., B. Baca, W. Cyriacks, R.E. Dodge, and A. Knap. 2003. Continuing long-term studies of the TROPICS Panama oil and dispersed oil spill sites. In: Proceedings of the 2003 International Oil Spill Conference, April 2-10, 2003, Vancouver, British Columbia.

Warham, J. 1990. The petrels: Their ecology and breeding systems. San Diego, CA: Academic Press. 440 pp.

Waring, G.T., E. Josephson, K. Maze-Foley, and P.E. Rosel, eds. 2009. U.S. Atlantic and Gulf of Mexico marine mammal stock assessments—2011. U.S. Dept. of Commerce, National Oceanic and Atmospheric Administration. NOAA Technical Memorandum NMFS NE 219. 598 pp.

Wartzok, D. and D.R. Ketten. 1999. Marine mammal sensory systems. In: Reynolds, J.E. and S.A. Rommel, eds. Biology of marine mammals. Washington, DC: Smithsonian Institution Press. Pp. 117-175.

Weatherly, G. 2004. Intermediate depth circulation in the Gulf of Mexico: PALACE float results for the Gulf of Mexico between April 1998 and March 2002. U.S. Dept. of the Interior, Minerals Management Service, Gulf of Mexico OSC Region, New Orleans, LA. OCS Study MMS-2004-013. 51 pp.

Weaver, D.C., G.D. Dennis, and K.J. Sulak. 2002. Northeastern Gulf of Mexico coastal marine ecosystem program: Community structure and trophic ecology of demersal fishes on the pinnacle reef tract: Final synthesis report. U.S. Dept. of the Interior, Geological Survey, USGS BSR-2001-008 and Minerals Management Service, Gulf of Mexico OCS Region, New Orleans, LA. OCS Study MMS 2002-034. 143 pp.

Weaver, D.C., E.L. Hickerson, and G.P. Schmahl. 2006. Deep reef fish surveys by submersible on Alderice, McGrail, and Sonnier Banks in the northwestern Gulf of Mexico. In: Emerging Technologies for Reef Fisheries Research and Management. U.S. Dept. of Commerce, National Oceanic and Atmospheric Administration, Seattle, WA. NOAA Professional Paper NMFS (5). Pp. 69-87.

Webb, J.W. 1988. Establishment of vegetation on oil-contaminated dunes. Shore and Beach, October. Pp. 20-23.

Webb, T. 2010. BP oil spill: Failed safety device on *Deepwater Horizon* rig was modified in China. *The Observer*. Internet website: http://www.guardian.co.uk/environment/2010/jul/18/deepwater-horizon-blow-out-preventer-china. Posted July 18, 2010. Accessed September 22, 2010.

Webb, J.W., S.K. Alexander, and J.K. Winters. 1985. Effects of autumn application of oil on *Spartina alterniflora* in a Texas salt marsh. Environ. Poll. Series A. 38(4):321-337.

Weinstein, B.L. 2010. The economic and fiscal consequences of the drop in shallow-water drilling permits: Impacts on the Gulf Coast and the Nation. Southern Methodist University, Maguire Energy Institute, Cox School of Business. September 2010. Internet website: http://pressdocs.cox.smu.edu/maguire/Maguire%20Institute%20Shallow%20Water%20Report%209-10.pdf. Accessed November 28, 2010.

Weir, R.D. 1976. Annotated bibliography of bird kills at man-made obstacles: A review of the state of the art and solutions. Canadian Wildlife Service, Ottawa.

Welsh, S.E., M. Inoue, L.J. Rouse, Jr., and E. Weeks. 2009. Observation of the deepwater manifestation of the Loop Current and Loop Current rings in the eastern Gulf of Mexico. U.S. Dept. of the Interior, Minerals Management Service, Gulf of Mexico OCS Region, New Orleans, LA. OCS Study MMS 2009-050. 110 pp.

Wells, R.J.D. and J.R. Rooker. 2004. Spatial and temporal habitat use by fishes associated with Sargassum mats in the NW Gulf of Mexico. Bulletin of Marine Science 74:81-99

Wesseling, I., A.J. Uychiacoc, P.M. Aliño, T. Aurin, and J.E. Vermaat. 1999. Damage and recovery of four Philippine corals from short-term sediment burial. Marine Ecology Progress Series 176:11-15.

West Engineering Services, Inc. 2002. Mini shear study. Prepared for the U.S. Dept. of the Interior, Minerals Management Service. TAR Project 455. 16 pp. Internet website: http://www.boemre.gov/tarprojects/455/Final%20Report.pdf.

West Engineering Services, Inc. 2004. Shear ram capability study. Prepared for the U.S. Dept. of the Interior, Minerals Management Service. TAR Project 463. Internet website: http://www.boemre.gov/tarprojects/463/(463)%20West%20Engineering%20Final%20Report.pdf.

West Engineering Services, Inc. 2006. Assess the acceptability and safety of using equipment, particularly BOP and wellhead components, at pressures in excess of rated working pressure. Prepared for the U.S. Dept. of the Interior, Minerals Management Service. TAR Project 566. 56 pp. Internet website: http://www.boemre.gov/tarprojects/566/566AA.pdf.

Wetherell, V. 1992. St. Joseph Bay Aquatic Preserve management plan: Adopted January 22, 1992. Florida Dept. of Natural Resources and Bureau of Submerged Lands and Preserves Division of State Lands.

Wheeler, N.M., S.B. Reid, K.J. Craig, J.R. Zielonka, D.R. Stauffer, and S.R. Hanna. 2008. Cumulative increment analysis for the Breton National Wilderness Area. U.S. Dept. of the Interior, Minerals Management Service, Gulf of Mexico OCS Region, New Orleans, LA. OCS Study MMS 2008-058.

White, D. 2010. Official communication. Marsh health in areas visited after the *Deepwater Horizon* spill. Professor of Biological Sciences, Marsh Ecologist, Tulane University, New Orleans, LA.

White, I.C. and J.M. Baker. 1999. The *Sea Empress* oil spill in context. International Conference on the *Sea Empress* Oil Spill, 11-13th February 1998, Cardiff, Wales.

White, D.H., C.A. Mitchell, H.D. Kennedy, A.J. Krynitsky, and M.A. Ribick. 1983. Elevated DDE and toxaphene residues in fishes and birds reflect local contamination in the lower Rio Grande Valley, Texas. The Southwestern Naturalist 28(3):325-333.

White House Press Briefing. 2010. Press briefing by Press Secretary Robert Gibbs and National Incident Commander Thad Allen (July 1, 2010). Internet website: http://www.whitehouse.gov/the-press-office/press-briefing-press-secretary-robert-gibbs-and-national-incident-commander-thad-al. Accessed July 8, 2010.

Whittle, K.J., R. Hardy, P.R. Mackie, and A.S. McGill. 1982. A quantitative assessment of the sources and fate of petroleum compounds in the marine environment. Philosophical Transactions of the Royal Society of London. B. 297:193-218.

Wicker, K.M., R.E. Emmer, D. Roberts, and J. van Beek. 1989. Pipelines, navigation channels, and facilities in sensitive coastal habitats: An analysis of Outer Continental Shelf impacts, Coastal Gulf of Mexico. Volume I: Technical narrative. U.S. Dept. of the Interior, Minerals Management Service, Gulf of Mexico OCS Region, New Orleans, LA. OCS Study MMS 89-0051. 470 pp.

Wiese, F.K., W.A. Montevecchi, G.K. Davoren, F. Huettmann, A.W. Diamond, and J. Linke. 2001. Seabirds at risk around offshore oil platforms in the north-west Atlantic. Marine Pollution Bulletin 42:1285-1290.

WikiHow. 2010. The how to manual. How to calculate the distance to the horizon. Internet website. http://www.wikihow.com/Calculate-the-Distance-to-the-Horizon. Updated September 29, 2010. Accessed December 30, 2010.

Wikipedia, The Free Encyclopedia. 2010. Offshore oil and gas in the US Gulf of Mexico. Internet website: http://en.wikipedia.org/wiki/Offshore_oil_and_gas_in_the_US_Gulf_of_Mexico. Accessed November 16, 2010.

Wilber, D.H., W. Brostoff, D.G. Clarke, and G.L. Ray. 2005. Sedimentation: Potential biological effects from dredging operations in estuarine and marine environments. DOER Technical Notes Collection.

ERDC TN-DOER-E20. U.S. Dept. of the Army, Engineer Research and Development Center, Vicksburg, MS.

Wilber, D.H., G.L. Ray, D.G. Clarke, and R.J. Diaz. 2008. Responses of benthic infauna to large-scale sediment disturbance in Corpus Christi Bay, Texas. Journal of Experimental Marine Biology and Ecology 365:13-22.

Wilhelm, S.I., G.J. Robertson, P.C. Ryan, and D.C. Schneider. 2007. Comparing an estimate of seabirds at risk to a mortality estimate from the November 2004 *Terra Nova* FPSO oil spill. Marine Pollution Bulletin 54:537-544.

Wilkinson, A. 2011. Seafood at risk: Dispersed oil poses a long-term threat. Scientific American. Internet website: http://www.scientificamerican.com/blog/post.cfm?id=seafood-at-risk-dispersed-oil-poses-2011-04-20. Posted April 20, 2011. Accessed May 2, 2011.

Wilkinson, E., L. Branch, and D.L. Miller. 2009. Connectivity of beach mouse habitat in hurricane impacted landscapes: The influence of predation risk, gap width, patch quality, and landscape context on gap crossing probability. 94th Endangered Species Act Annual Meeting, Albuquerque Convention Center, August 2-7, 2009, Albuquerque, NM.

Williams, J.H. and I.W. Duedall. 1997. Florida hurricanes and tropical storms; revised edition. Gainesville, FL: The University of Florida Press. 146 pp.

Williams, R., S. Gero, L. Bejder, J. Calambokidis, S.D. Krauss, D. Lusseau, A.J. Read, and J. Robbins. 2011. Underestimating the damage: Interpreting cetacean carcass recoveries in the context of the *Deepwater Horizon* BP incident. Conservation Letters 0:1-6.

Wilson, D.L., J.N. Fanjoy, and R.S. Billings. 2004. Gulfwide emission inventory study for the regional haze and ozone modeling efforts: Final report. U.S. Dept. of the Interior, Minerals Management Service, Gulf of Mexico OCS Region, New Orleans, LA. OCS Study 2004-072. 273 pp.

Wilson, D.L., R. Billings, R. Oommen, and R. Chang. 2007. Year 2005 Gulfwide emission inventory study. U.S. Dept. of the Interior, Minerals Management Service, Gulf of Mexico OCS Region, New Orleans, LA. OCS Study MMS 2007-067. 149 pp.

Wilson, D.L., R, Billing, R. Oommen, B. Lange, J. Marik, S. McClutchey, and H. Perez. 2010. Year 2008 Gulfwide emission inventory study. U.S. Dept. of the Interior, Bureau of Ocean Energy Management, Regulation and Enforcement, Gulf of Mexico OCS Region, New Orleans, LA. OCS Study BOEMRE 2010-045.

Winge, O. 1923. The Sargasso Sea, its boundaries and vegetation. Rep. Dan. Oceanog. Expd, 1908-1910. 3 Misc. Pap. 2:1-34

Wolfe, S.H., J.A. Reidenauer, and D.B. Means. 1988. An ecological characterization of the Florida Panhandle. U.S. Dept. of the Interior, Fish and Wildlife Service Biological Report 88(12) and Minerals Management Service, Gulf of Mexico OCS Region, New Orleans, LA. OCS Study MMS 88-0063. 278 pp.

Woods & Poole Economics, Inc. 2006. The 2006 complete economic and demographic data source (CEDDS) on CD-ROM.

Woods & Poole Economics, Inc. 2010. The 2011 complete economic and demographic data source (CEDDS) on CD-ROM.

Wooley, C.M. 1985. Evaluation of morphometric characters used in taxonomic separation of Gulf of Mexico sturgeon, *Acipenser oxyrynchus desotoi*. In: Binkowski, F.P. and S.I. Doroshov, eds. North American sturgeons: Biology and aquaculture potential. Developments in Environmental Biology of Fishes 6. Junk, Dordrecht, The Netherlands. 163 pp.

Wooley, C.M. and E.J. Crateau. 1985. Movement, microhabitat, exploitation and management of Gulf of Mexico sturgeon, Apalachicola River, Florida. North American Journal of Fisheries Management 16:590-605.

World Fishing Network. 2010. Louisiana/BP finalize multi-million dollar industry deal. Internet website: http://www.worldfishingnetwork.com/news/louisianabp-finalize-multi-million-dollar-industry-deal-24836.aspx. Accessed December 6, 2011.

Wright, D.G. and G.E. Hopky. 1998. Guidelines for the use of explosives in or near Canadian fisheries waters. Canadian Technical Report of Fisheries and Aquatic Sciences 2107.

Würsig, B., T.A. Jefferson, and D.J. Schmidly. 2000. The marine mammals of the Gulf of Mexico. College Station: Texas A&M University Press. 232 pp.

Wyers, S.C., H.R. Frith, R.E. Dodge, S.R. Smith, A.H. Knap, and T.D. Sleeter. 1986. Behavioral effects of chemically dispersed oil and subsequent recovery in *Diploria strigosa*. Marine Ecology 7:23-42.

Yarwood, G., G. Mansell, M. Jimenez, and S. Lau. 2004. 2000 Gulf-wide emissions inventory—OCS on-shore impacts modeling (Texas), a preliminary look. Prepared for the U.S. Dept. of the Interior, Minerals Management Service, New Orleans, LA. Novato, CA: ENVIRON International Corporation. September 1, 2004.

Yender, R.A. and Michel, J., eds. 2010. Oil spills in coral reefs: Planning and response considerations. Second edition. U.S. Dept. of Commerce, National Oceanic and Atmospheric Administration, Office of Response and Restoration. 82 pp. Internet website: http://response.restoration.noaa.gov/book_shelf/70_coral_full_report.pdf.

Yoshioka, P.M. and B.B. Yoshioka. 1987. Variable effects of Hurricane David on the shallow water gorgonians of Puerto Rico. Bulletin of Marine Science 40(1):132-144.

Zabala, J., I. Zuberogoitia, J.A. Martinez-Climent, and J. Etxezarreta. 2010. Do long lived seabirds reduce the negative effects of acute pollution on adult survival by skipping breeding? A study with European storm petrels (*Hydrobates pelagicus*) during the "Prestige" oil-spill. Marine Pollution Bulletin 62:109-115.

Zabarenko, D. 2010. Special report: Watching grass grow in the Gulf and cheering! News Daily Environmental Correspondent. July 7, 2010. Interview with Dr. Mendelssohn. Wetlands Ecologist, Louisiana State University. Internet website: http://www.reuters.com/article/idUSTRE66R4Z420100728. Accessed December 27, 2010.

Zeller, T., Jr. 2010. Drill ban means hard times for rig workers. *The New York Times*. Internet website: http://www.nytimes.com/2010/06/18/business/18rig.html?_r=1. Accessed June 29, 2010.

Zhang, Z. and D. McConnell. 2011. Rock physics modeling of the gas hydrate and free gas mixed system in Green Canyon 955, Gulf of Mexico, and implications for gas hydrate prospecting. U.S Dept. of Energy, National Energy Technology Laboratory, Fire in the Ice, January 2011. Pp. 15-19. Internet website: http://www.netl.doe.gov/technologies/oil-gas/FutureSupply/MethaneHydrates/newsletter/newsletter.htm. Accessed March 18, 2011.

Zieman, J.C. 1976. The ecological effects of physical damage from motor boats on turtle grass beds in Southern Florida. Aquatic Botany 2:127-139.

Zieman, J.C. 1982. The ecology of the seagrasses of south Florida: A community profile. U.S. Dept. of the Interior, Fish and Wildlife Service. FWS/OBS-82/25. 123 pp.

Zieman, J.C. and R.T. Zieman. 1989. The ecology of the seagrass meadows of the west coast of Florida: A community profile. U.S. Dept. of the Interior, Fish and Wildlife Service. Biological Report 85(7.25). 155 pp.

Zieman, J.C., R. Orth, R.C. Phillips, G. Thayer, and A. Thorhaug. 1984. The effects of oil on seagrass ecosystems. In: Cairns, J., Jr. and A.L. Buikema, Jr., eds. Restoration of habitats impacted by oil spills. Boston, MA: Butterworth Publishers.

Zingula, R.P. and D.W. Larson. 1977. Fate of drill cuttings in the marine environment. Presented at the Offshore Technology Conference, May 2-5, 1977, Houston, TX. Paper No. 3040-MS.

Zuberogoitia, I., J.A. Martinez, A. Iraeta, A. Azkona, J. Zabala, B. Jimenez, R. Merino, and G. Gomez. 2006. Short-term effects of the *Prestige* oil spill on the peregrine falcon (*Falco peregrinus*). Marine Pollution Bulletin 52:1176-1181.

CHAPTER 7

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7. PREPARERS

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CHAPTER 8

GLOSSARY

8. GLOSSARY

Acute — Sudden, short term, severe, critical, crucial, intense, but usually of short duration.

Anaerobic — Capable of growing in the absence of molecular oxygen.

Annular preventer — A component of the pressure control system in the BOP that forms a seal in the annular space around any object in the wellbore or upon itself, enabling well control operations to commence.

Anthropogenic — Coming from human sources, relating to the effect of humankind on nature.

API gravity — A standard adopted by the American Petroleum Institute for expressing the specific weight of oil.

Aromatic — Class of organic compounds containing benzene rings or benzenoid structures.

Attainment area — An area that is shown by monitored data or by air-quality modeling calculations to be in compliance with primary and secondary ambient air quality standards established by the USEPA.

Barrel (bbl) — A volumetric unit used in the petroleum industry; equivalent to 42 U.S. gallons or 158.99 liters.

Benthic — On or in the bottom of the sea.

Biological Opinion — The FWS or NMFS evaluation of the impact of a proposed action on endangered and threatened species, in response to formal consultation under Section 7 or the Endangered Species Act.

Block — A geographical area portrayed on official BOEM protraction diagrams or leasing maps that contains approximately 2,331 ha (9 mi^2).

Blowout — An uncontrolled flow of fluids below the mudline from appurtenances on a wellhead or from a wellbore.

Blowout preventer (BOP) — One of several valves installed at the wellhead to prevent the escape of pressure either in the annular space between the casing and drill pipe or in open hole (i.e., hole with no drill pipe) during drilling completion operations. Blowout preventers on jackup or platform rigs are located at the water's surface; on floating offshore rigs, BOP's are located on the seafloor.

Bottom kill — A wild well-control procedure involving the intersection of an uncontrolled well with a relief well for the purpose of pumping heavy mud or cement into the wild well to stanch the flow of oil or gas (the well control strategy for the Macondo spill deployed in mid-July 2010 that resulted in the successful capping of the well.

Cetacean — Aquatic mammal of the order Cetacea, such as whales, dolphins, and porpoises.

Chemosynthetic — Organisms that obtain their energy from the oxidation of various inorganic compounds rather than from light (photosynthetic).

Cofferdam containment dome — A vertically elongated box structure designed to fit loosely over the Macondo lower marine riser package to capture escaping oil at the surface (an early containment strategy for the Macondo spill deployed in May 2010).

Coastal waters — Waters within the geographical areas defined by each State's Coastal Zone Management Program.

Coastal wetlands — forested and nonforested habitats, mangroves, and marsh islands exposed to tidal activity. These areas directly contribute to the high biological productivity of coastal waters by input of detritus and nutrients, by providing nursery and feeding areas for shellfish and finfish, and by serving as habitat for birds and other animals.

Coastal zone — The coastal waters (including the lands therein and thereunder) and the adjacent shorelands (including the waters therein and thereunder) strongly influenced by each other and in proximity to the shorelines of the several coastal states; the zone includes islands, transitional and intertidal areas, salt marshes, wetlands, and beaches and extends seaward to the outer limit of the United States territorial sea. The zone extends inland from the shorelines only to the extent necessary to control shorelands, the uses of which have a direct and significant impact on the coastal waters. Excluded from the coastal zone are lands the use of which is by law subject to the discretion of or which is held in trust by the Federal Government, its officers, or agents. See also State coastal zone boundaries.

Completion — Conversion of a development well or an exploratory well into a production well.

Condensate — Liquid hydrocarbons produced with natural gas; they are separated from the gas by cooling and various other means. Condensates generally have an API gravity of 50^{o}-120^{o}.

Continental margin — The ocean floor that lies between the shoreline and the abyssal ocean floor, includes the continental shelf, continental slope, and continental rise.

Continental shelf — General term used by geologist to refer to the continental margin province that lies between the shoreline and the abrupt change in slope called the shelf edge, which generally occurs in the Gulf of Mexico at about 200-m (656-ft) water depth. The continental shelf is characterized by a gentle slope (about 0.1^{o}). This is different from the juridicial term used in Article 76 of the Convention on the Law of the Sea (see the definition of Outer Continental Shelf).

Continental slope — The continental margin province that lies between the continental shelf and continental rise, characterized by a steep slope (about 3^{o}-6^{o}).

Critical habitat — Specific areas essential to the conservation of a protected species and that may require special management considerations or protection.

Crude oil — Petroleum in its natural state as it emerges from a well, or after it passes through a gas-oil separator but before refining or distillation. An oily, flammable, bituminous liquid that is essentially a complex mixture of hydrocarbons of different types with small amounts of other substances.

Deferral — Action taken by the Secretary of the Interior at the time of the Area Identification to remove certain areas/blocks from the proposed sale.

Delineation well — A well that is drilled for the purpose of determining the size and/or volume of an oil or gas reservoir.

Demersal — Living at or near the bottom of the sea.

***Deepwater Horizon* (DWH) event** — All actions stemming from the April 20, 2010, explosion and subsequent sinking of the Transocean drillship *Deepwater Horizon*, up to and including the Macondo well kill declaration on September 19, 2010.

Development — Activities that take place following discovery of economically recoverable mineral resources, including geophysical surveying, drilling, platform construction, operation of onshore support facilities, and other activities that are for the purpose of ultimately producing the resources.

Development Operations Coordination Document (DOCD) — A document that must be prepared by the operator and submitted to BOEM for approval before any development or production activities are conducted on a lease in the western Gulf.

Development well — A well drilled to a known producing formation to extract oil or gas; a production well; distinguished from a wildcat or exploratory well and from an offset well.

Direct employment — Consists of those workers involved the primary industries of oil and gas exploration, development, and production operations (Standard Industrial Classification Code 13—Oil and Gas Extraction).

Discharge — Something that is emitted; flow rate of a fluid at a given instant expressed as volume per unit of time.

Dispersant — A suite of chemicals and solvents used to break up an oil slick into small droplets, which increases the surface area of the oil and hastens the processes of weathering and microbial degradation.

Dispersion — A suspension of finely divided particles in a medium.

Drilling mud — A mixture of clay, water or refined oil, and chemical additives pumped continuously downhole through the drill pipe and drill bit, and back up the annulus between the pipe and the walls of the borehole to a surface pit or tank. The mud lubricates and cools the drill bit, lubricates the drill pipe as it turns in the wellbore, carries rock cuttings to the surface, serves to keep the hole from crumbling or collapsing, and provides the weight or hydrostatic head to prevent extraneous fluids from entering the well bore and to downhole pressures; also called drilling fluid.

Economically recoverable resources — An assessment of hydrocarbon potential that takes into account the physical and technological constraints on production and the influence of costs of exploration and development and market price on industry investment in OCS exploration and production.

Effluent — The liquid waste of sewage and industrial processing.

Effluent limitations — Any restriction established by a State or the USEPA on quantities, rates, and concentrations of chemical, physical, biological, and other constituents discharged from point sources into U.S. waters, including schedules of compliance.

Epifaunal — Animals living on the surface of hard substrate.

Essential habitat — Specific areas crucial to the conservation of a species and that may necessitate special considerations.

Estuary — Coastal semienclosed body of water that has a free connection with the open sea and where freshwater meets and mixes with seawater.

Eutrophication — Enrichment of nutrients in the water column by natural or artificial methods accompanied by an increase of respiration, which may create an oxygen deficiency.

Exclusive Economic Zone (EEZ) — The maritime region extending 200 nmi from the baseline of the territorial sea, in which the United States has exclusive rights and jurisdiction over living and nonliving natural resources.

Exploration Plan (EP) — A plan that must be prepared by the operator and submitted to BOEM for approval before any exploration or delineation drilling is conducted on a lease in the Western Gulf.

Exploration well — A well drilled in unproven or semi-proven territory to determining whether economic quantities of oil or natural gas deposit are present; exploratory well.

False crawls — Refers to when a female sea turtle crawls up on the beach to nest (perhaps) but does not and returns to the sea without laying eggs.

Field — An accumulation, pool, or group of pools of hydrocarbons in the subsurface. A hydrocarbon field consists of a reservoir in a shape that will trap hydrocarbons and that is covered by an impermeable, sealing rock.

Floating production, storage, and offloading (FPSO) system — A tank vessel used as a production and storage base; produced oil is stored in the hull and periodically offloaded to a shuttle tanker for transport to shore..

Gathering lines — A pipeline system used to bring oil or gas production from a number of separate wells or production facilities to a central trunk pipeline, storage facility, or processing terminal.

Geochemical — Of or relating to the science dealing with the chemical composition of and the actual or possible chemical changes in the crust of the earth.

Geophysical survey — A method of exploration in which geophysical properties and relationships are measured remotely by one or more geophysical methods.

Habitat — A specific type of environment that is occupied by an organism, a population, or a community.

Hermatypic coral — Reef-building corals that produce hard, calcium carbonate skeletons and that possess symbiotic, unicellular algae within their tissues.

Harassment — An intentional or negligent act or omission that creates the likelihood of injury to wildlife by annoying it to such an extent as to significantly disrupt normal behavior patterns that include, but are not limited to, feeding or sheltering.

Hydrocarbons — Any of a large class of organic compounds containing primarily carbon and hydrogen. Hydrocarbon compounds are divided into two broad classes: aromatic and aliphatics. They occur primarily in petroleum, natural gas, coal, and bitumens.

Hypoxia — Depressed levels of dissolved oxygen in water, usually resulting in decreased metabolism.

Incidental take — Takings that result from, but are not the purpose of, carrying out an otherwise lawful activity (e.g., fishing) conducted by a Federal agency or applicant (see Taking).

Indirect employment — Secondary or supporting oil- and gas-related industries, such as the processing of crude oil and gas in refineries, natural gas plants, and petrochemical plants.

Induced employment — Tertiary industries that are created or supported by the expenditures of employees in the primary or secondary industries (direct and indirect employment), including consumer goods and services such as food, clothing, housing, and entertainment.

Infrastructure — The facilities associated with oil and gas development, e.g., refineries, gas processing plants, etc.

Jack-up rig — A barge-like, floating platform with legs at each corner that can be lowered to the sea bottom to raise the platform above the water.

Junk shot — A wild well-control procedure accompanying a top kill that introduces foreign objects into the drilling fluid (such as shredded rope, rubber, or golf balls) and that is designed to clog the openings or partial openings in a nonfunctioning blowout preventer (an early well control strategy for the Macondo spill in May 2010).

Kick — A deviation or imbalance, typically sudden or unexpected, between the downward pressure exerted by the drilling fluid and the upward pressure of in situ formation fluids or gases.

Landfall — The site where a marine pipeline comes to shore.

Lease — Authorization that is issued under Section 8 or maintained under Section 6 of the Outer Continental Shelf Lands Act and that authorizes exploration for, and development and production of, minerals.

Lease sale — The competitive auction of leases granting companies or individuals the right to explore for and develop certain minerals under specified conditions and periods of time.

Lease term — The initial period for oil and gas leases, usually a period of 5, 8, or 10 years depending on water depth or potentially adverse conditions.

Lessee — A party authorized by a lease, or an approved assignment thereof, to explore for and develop and produce the leased deposits in accordance with regulations at 30 CFR 250.

Lower marine riser package — The head assembly of a subsurface well at the point where the riser connects to a blowout preventer.

Macondo — Prospect name given by BP to the Mississippi Canyon Block 252 exploration well that the *Deepwater Horizon* rig was drilling when a blowout occurred on April 20, 2010.

Macondo spill — The name given to the oil spill that resulted from the explosion and sinking of the *Deepwater Horizon* rig from the period between April 24, 2010, when search and recovery vessels on site reported oil at the sea surface until uncontrolled flow from the Macondo well was capped.

Marshes — Persistent, emergent, nonforested wetlands characterized by predominantly cordgrasses, rushes, and cattails.

Military warning area — An area established by the Department of Defense within which military activities take place.

Minerals — As used in this document, minerals include oil, gas, sulphur, and associated resources, and all other minerals authorized by an Act of Congress to be produced from public lands as defined in Section 103 of the Federal Land Policy and Management Act of 1976.

Nepheloid — A layer of water near the bottom that contains significant amounts of suspended sediment.

Nonattainment area — An area that is shown by monitoring data or by air-quality modeling calculations to exceed primary or secondary ambient air quality standards established by the USEPA.

Nonhazardous oil-field wastes (NOW) — Wastes generated by exploration, development, or production of crude oil or natural gas that are exempt from hazardous waste regulation under the Resource Conservation and Recovery Act (*Regulatory Determination for Oil and Gas and Geothermal Exploration, Development and Production Wastes,* dated June 29, 1988, 53 FR 25446; July 6, 1988). These wastes may contain hazardous substances.

Naturally occurring radioactive materials (NORM) — naturally occurring material that emits low levels of radioactivity, originating from processes not associated with the recovery of radioactive material. The radionuclides of concern in NORM are Radium-226, Radium-228, and other isotopes in the radioactive decay chains of uranium and thorium.

Offloading — Unloading liquid cargo, crude oil, or refined petroleum products.

Operational discharge — Any incidental pumping, pouring, emitting, emptying, or dumping of wastes generated during routine offshore drilling and production activities.

Operator — An individual, partnership, firm, or corporation having control or management of operations on a leased area or portion thereof. The operator may be a lessee, designated agent of the lessee, or holder of operating rights under an approved operating agreement.

Organic matter — Material derived from living plants or animals.

Outer Continental Shelf (OCS) — All submerged lands that comprise the continental margin adjacent to the United States and seaward of State offshore lands.

Pelagic — Of or pertaining to the open sea; associated with open water beyond the direct influence of coastal systems.

Penaeids — Chiefly warm water and tropical prawns belonging to the family Penaeidae.

Plankton — Passively floating or weakly motile aquatic plants (phytoplankton) and animals (zooplankton).

Platform — A steel or concrete structure from which offshore development wells are drilled.

Play — A prospective subsurface area for hydrocarbon accumulation that is characterized by a particular structural style or depositional relationship.

Primary production — Organic material produced by photosynthetic or chemosynthetic organisms.

Produced water — Total water discharged from the oil and gas extraction process; production water or production brine.

Production — Activities that take place after the successful completion of any means for the extraction of resources, including bringing the resource to the surface, transferring the produced resource to shore, monitoring operations, and drilling additional wells or workovers.

Province — A spatial entity with common geologic attributes. A province may include a single dominant structural element such as a basin or a fold belt, or a number of contiguous related elements.

Ram — The main component of a blowout preventer designed to shear casing and tools in a wellbore or to seal an empty wellbore. A blind shear ram accomplishes the former and a blind ram the latter.

Recoverable reserves — The portion of the identified hydrocarbon or mineral resource that can be economically extracted under current technological constraints.

Recoverable resource estimate — An assessment of hydrocarbon or mineral resources that takes into account the fact that physical and technological constraints dictate that only a portion of resources can be brought to the surface.

Recreational beaches — Frequently visited, sandy areas along the Gulf of Mexico shorefront that support multiple recreational activities at the land-water interface. Included are National Seashores, State Park and Recreational Areas, county and local parks, urban beachfronts, and private resorts.

Refining — Fractional distillation of petroleum, usually followed by other processing (for example, cracking).

Relief — The difference in elevation between the high and low points of a surface.

Reserves — Proved oil or gas resources.

Rig — A structure used for drilling an oil or gas well.

Riser insertion tube tool — A “straw” and gasket assembly improvised during the Macondo spill response that was designed to siphon oil and gas from the broken riser of the *Deepwater*

Horizon lying on the sea bottom (an early recovery strategy for the Macondo spill in May 2010).

Royalty — A share of the minerals produced from a lease paid in either money or "in-kind" to the landowner by the lessee.

Saltwater intrusion — Saltwater invading a body of freshwater.

Sciaenids — Fishes belonging to the croaker family (Sciaenidae).

Seagrass beds — More or less continuous mats of submerged, rooted, marine, flowering vascular plants occurring in shallow tropical and temperate waters. Seagrass beds provide habitat, including breeding and feeding grounds, for adults and/or juveniles of many of the economically important shellfish and finfish.

Sediment — Material that has been transported and deposited by water, wind, glacier, precipitation, or gravity; a mass of deposited material.

Seeps (hydrocarbon) — Gas or oil that reaches the surface along bedding planes, fractures, unconformities, or fault planes.

Sensitive area — An area containing species, populations, communities, or assemblages of living resources, that is susceptible to damage from normal OCS-related activities. Damage includes interference with established ecological relationships.

Shear ram — The component in a BOP that cuts, or shears, through the drill pipe and forms a seal against well pressure. Shear rams are used in floating offshore drilling operations to provide a quick method of moving the rig away from the hole when there is no time to trip the drill stem out of the hole.

Shunting — A method used in offshore oil and gas drilling and production activities where expended cuttings and fluids are discharged through a downpipe, which terminates no more than 10 m from the ocean floor, rather than discharged at the ocean surface.

Shoreline Cleanup and Assessment Team — The on-the-scene responders for post-spill shoreline protection who established priorities, standardized procedures and establish terminology.

Spill of National Significance — Designation by the USEPA Administrator under 40 CFR 300.323 for discharges occurring in the inland zone and the Commandant of the CG for discharges occurring in the coastal zone, authorizing the appointment of a National Incident Commander for spill-response activity.

State coastal zone boundary — The State coastal zone boundaries for each CZMA-affected State are defined at http://coastalmanagement.noaa.gov/mystate/docs/StateCZBoundaries.pdf.

Structure — Any OCS facility that extends from the seafloor to above the waterline; in petroleum geology, any arrangement of rocks that may hold an accumulation of oil or gas.

Subarea — A discrete analysis area.

Subsea isolation device — An emergency disconnection and reconnection assembly for the riser at the seafloor.

Supply vessel — A boat that ferries food, water, fuel, and drilling supplies and equipment to an offshore rig or platform and returns to land with refuse that cannot be disposed of at sea.

Taking — To harass, harm, pursue, hunt, shoot, wound, kill, trap, capture, or collect any endangered or threatened species, or to attempt to engage in any such conduct (including actions that induce stress, adversely impact critical habitat, or result in adverse secondary or cumulative impacts). Harassments are the most common form of taking associated with OCS Program activities.

Tension-leg platform (TLP) — A production structure that consists of a buoyant platform tethered to concrete pilings on the seafloor with flexible cable.

Top hat — A short cylindrical sleeve with a tapered apex designed to fit atop of the lower marine riser package and to capture oil and gas from the flowing Macondo well (a functional subsurface recovery strategy for the Macondo spill in June and July, before the well was capped on July 15, 2010).

Top kill — A wild well-control procedure involving the pump-down under pressure of heavy drilling fluid to equalize pressure and to stop the flow of gas and oil exiting a blowout (an early well control strategy for the Macondo spill deployed in May 2010).

Total dissolved solids — The total amount of solids that are dissolved in water.

Total suspended particulate matter — The total amount of suspended solids in water.

Total suspended solids — The total amount of suspended solids in water.

Trunkline — A large-diameter pipeline receiving oil or gas from many smaller tributary gathering lines that serve a large area; common-carrier line; main line.

Turbidity — Reduced water clarity due to the presence of suspended matter.

Unified Area Command — A system of satellite work, coordination, and remediation stations administered by the Unified Incident Commander during a spill of national significance.

Unified Incident Command — Command and coordination center for the National Incident Commander.

Volatile organic compound (VOC) — Any organic compound that is emitted to the atmosphere as a vapor.

Water test areas — Areas within the Eastern Gulf where Department of Defense research, development, and testing of military planes, ships, and weaponry take place.

Weathering (of oil) — The aging of oil due to its exposure to the atmosphere, causing marked alterations in its physical and chemical makeup.

APPENDICES

APPENDIX A

FIGURES AND TABLES

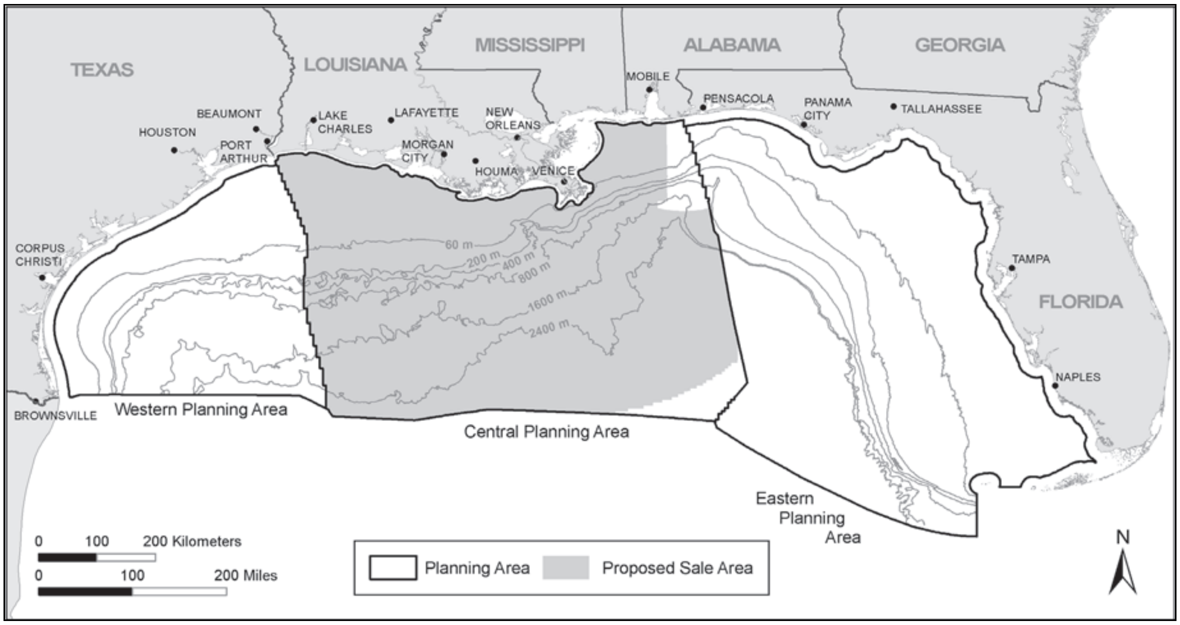

Figure 1-1. Gulf of Mexico Outer Continental Shelf Planning Areas, Proposed Lease Sale Area, and Locations of Major Cities.

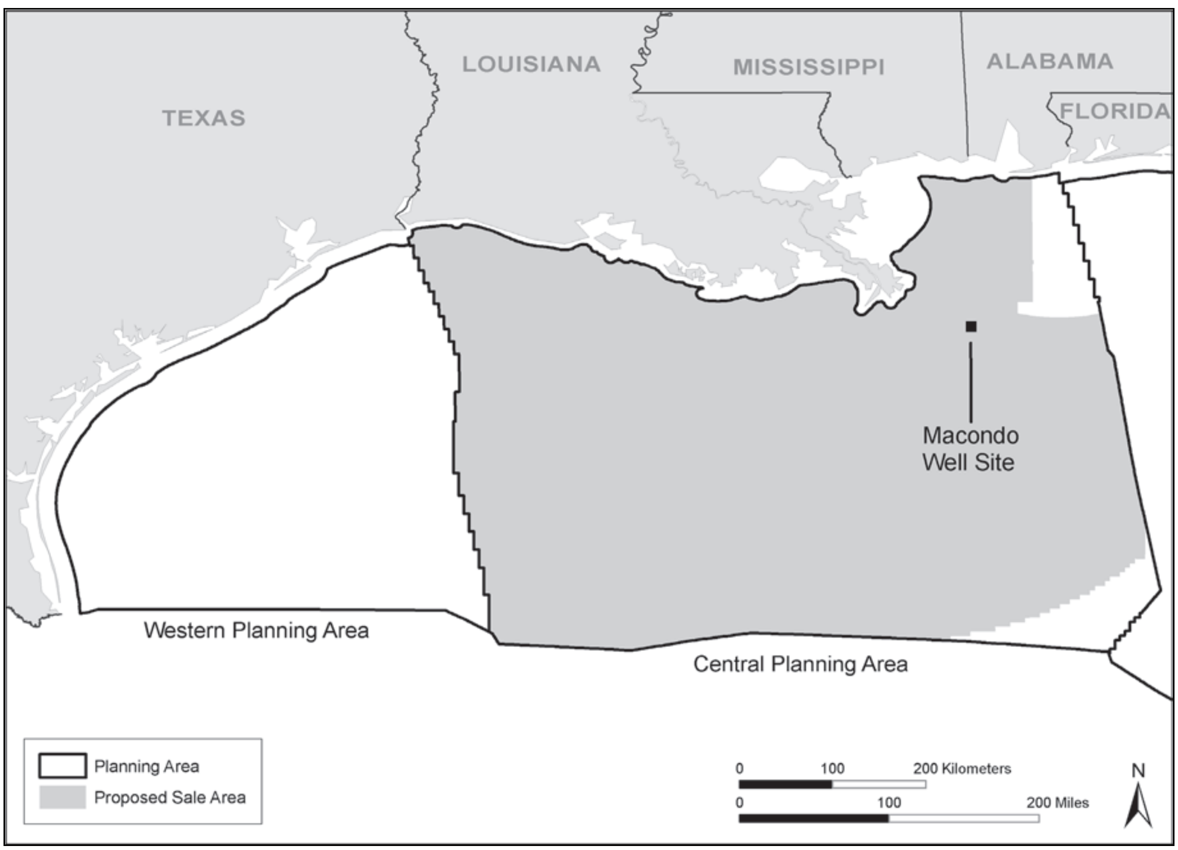

Figure 1-2. Location of the Macondo Well (location of the *Deepwater Horizon* Event in Mississippi Canyon Block 252) in the Gulf of Mexico's Central Planning Area.

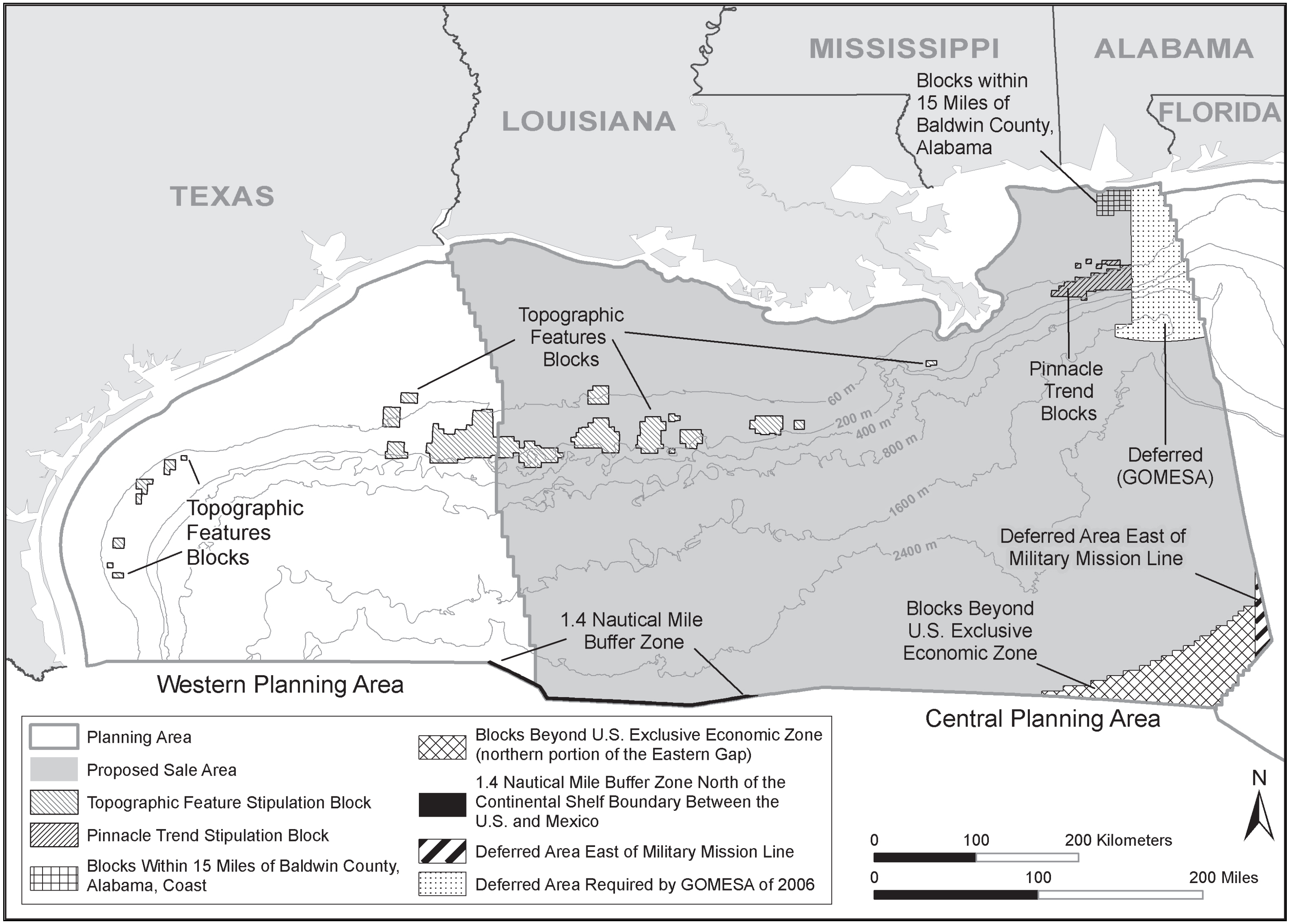

Figure 2-1. Location of Proposed Stipulations and Deferrals.

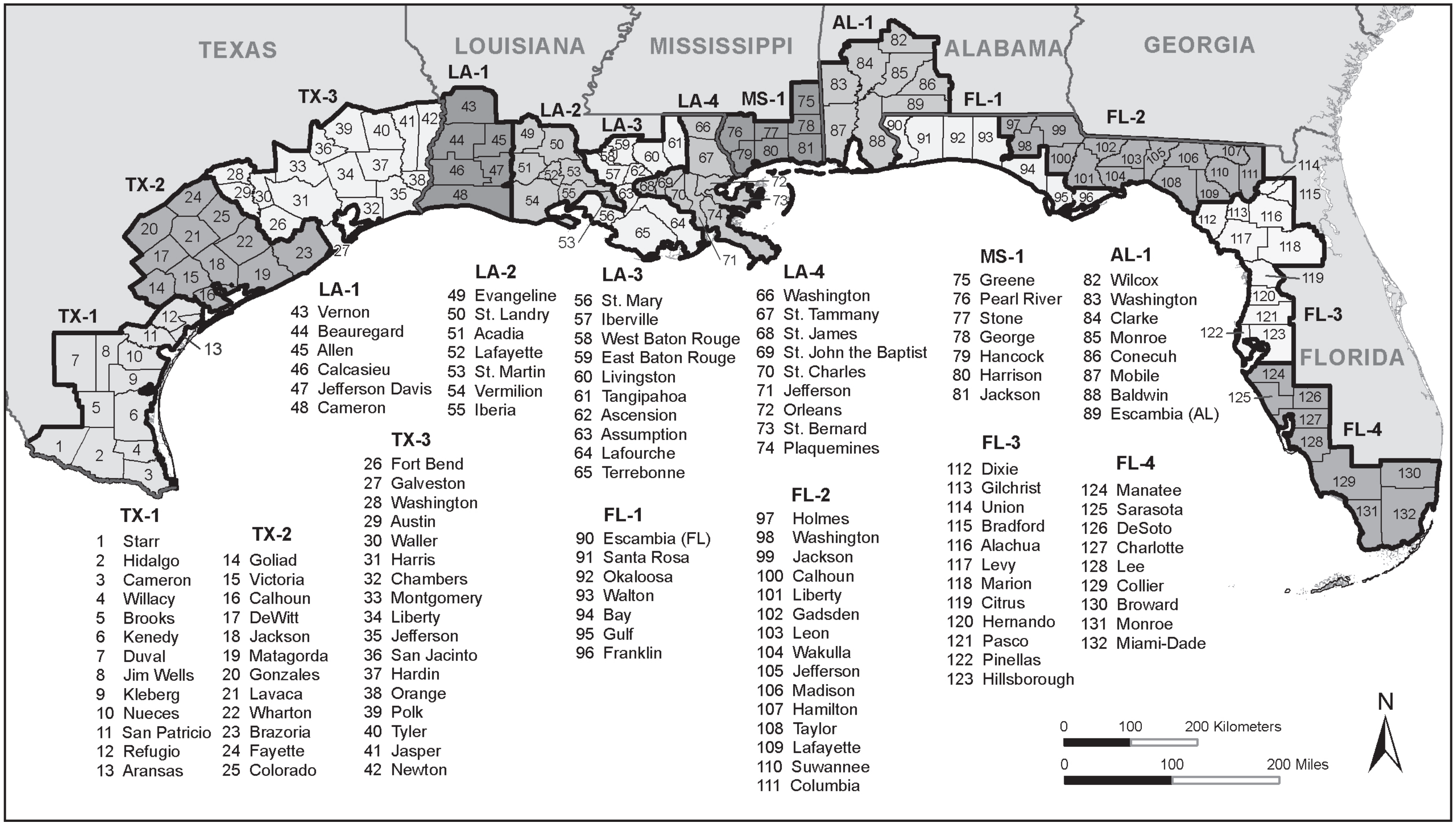

Figure 2-2. Economic Impact Areas in the Gulf of Mexico.

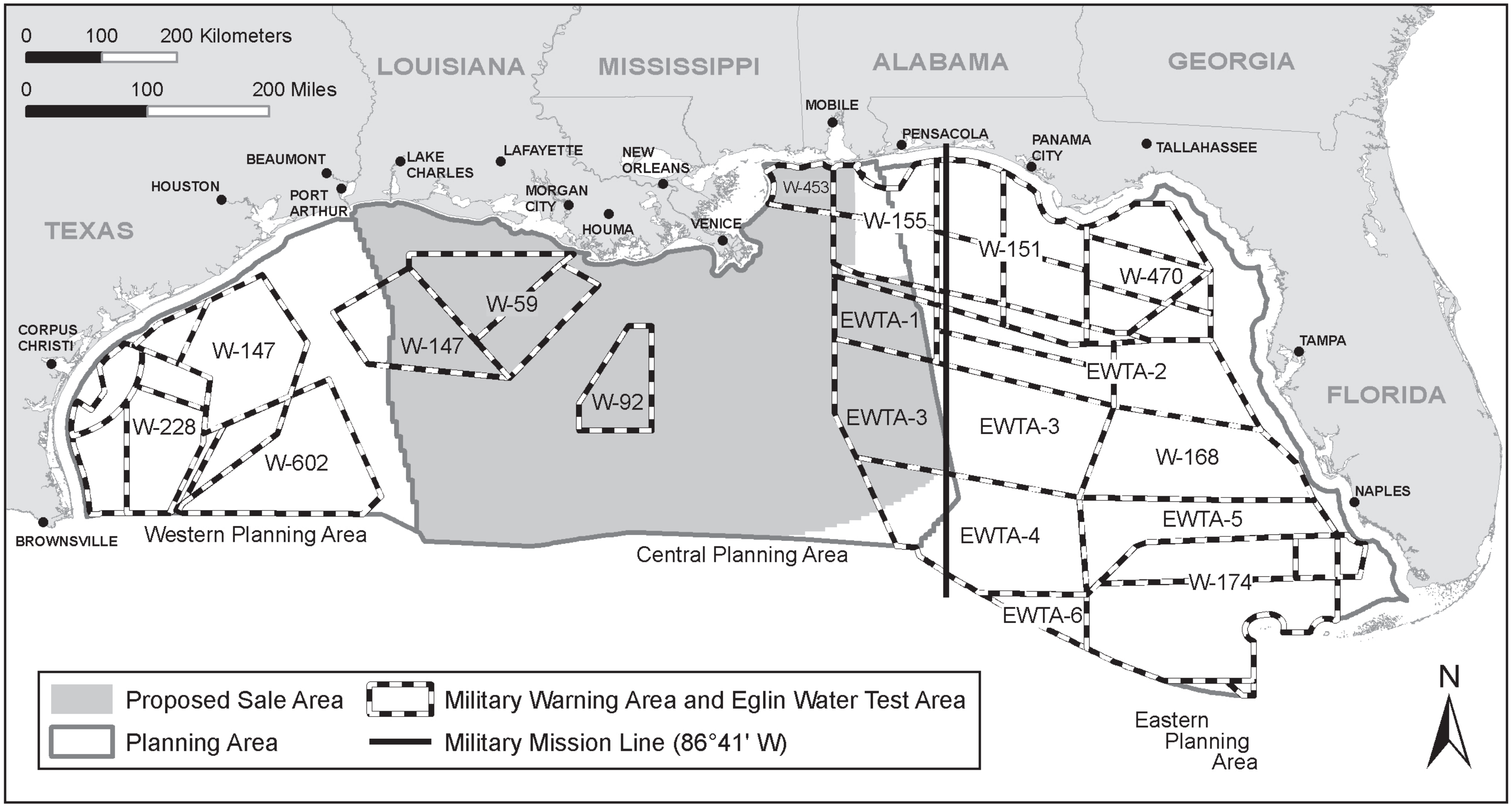

Figure 2-3. Military Warning Areas and Eglin Water Test Areas Located in the Gulf of Mexico.

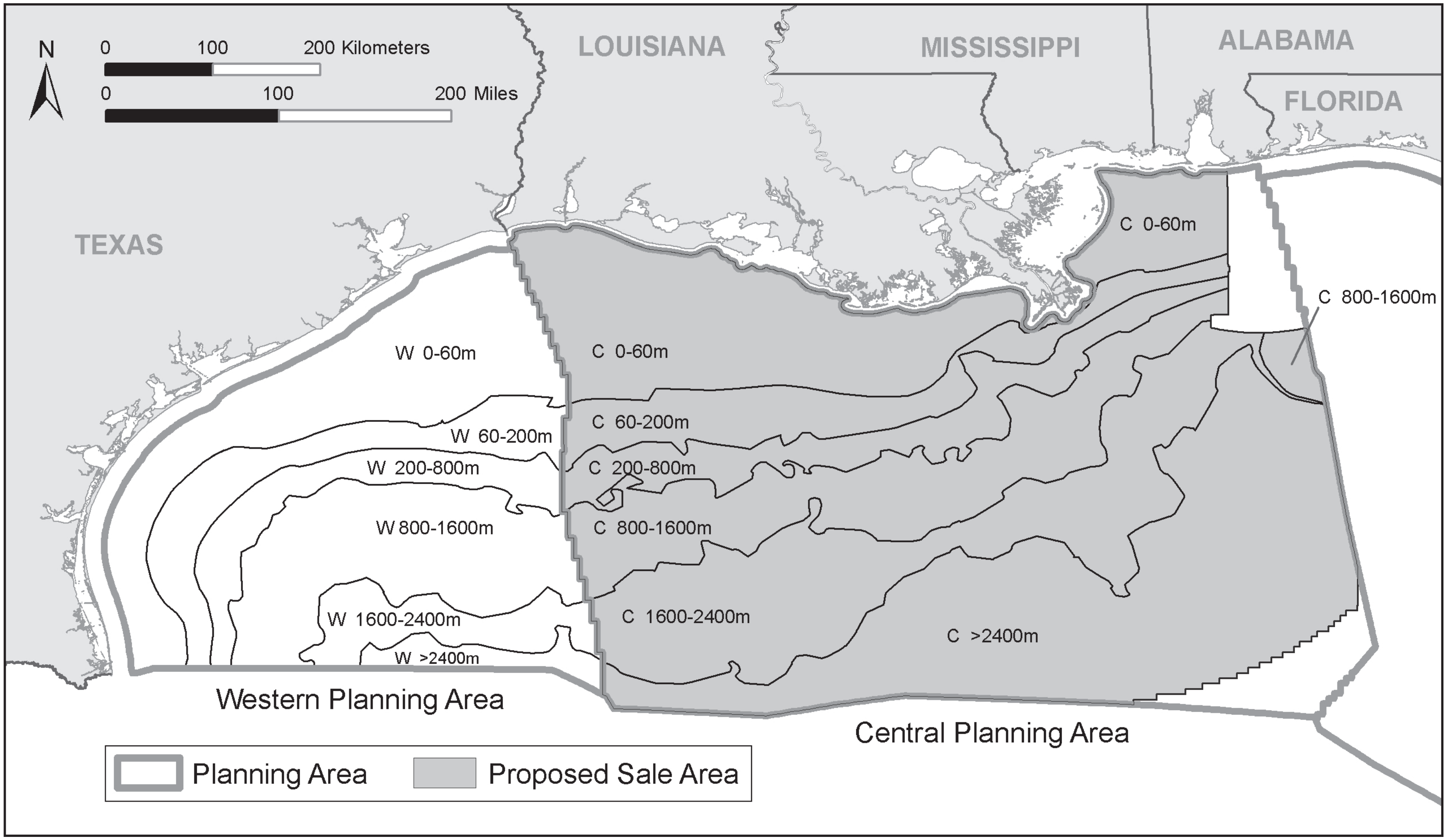

Figure 3-1. Offshore Subareas in the Gulf of Mexico.

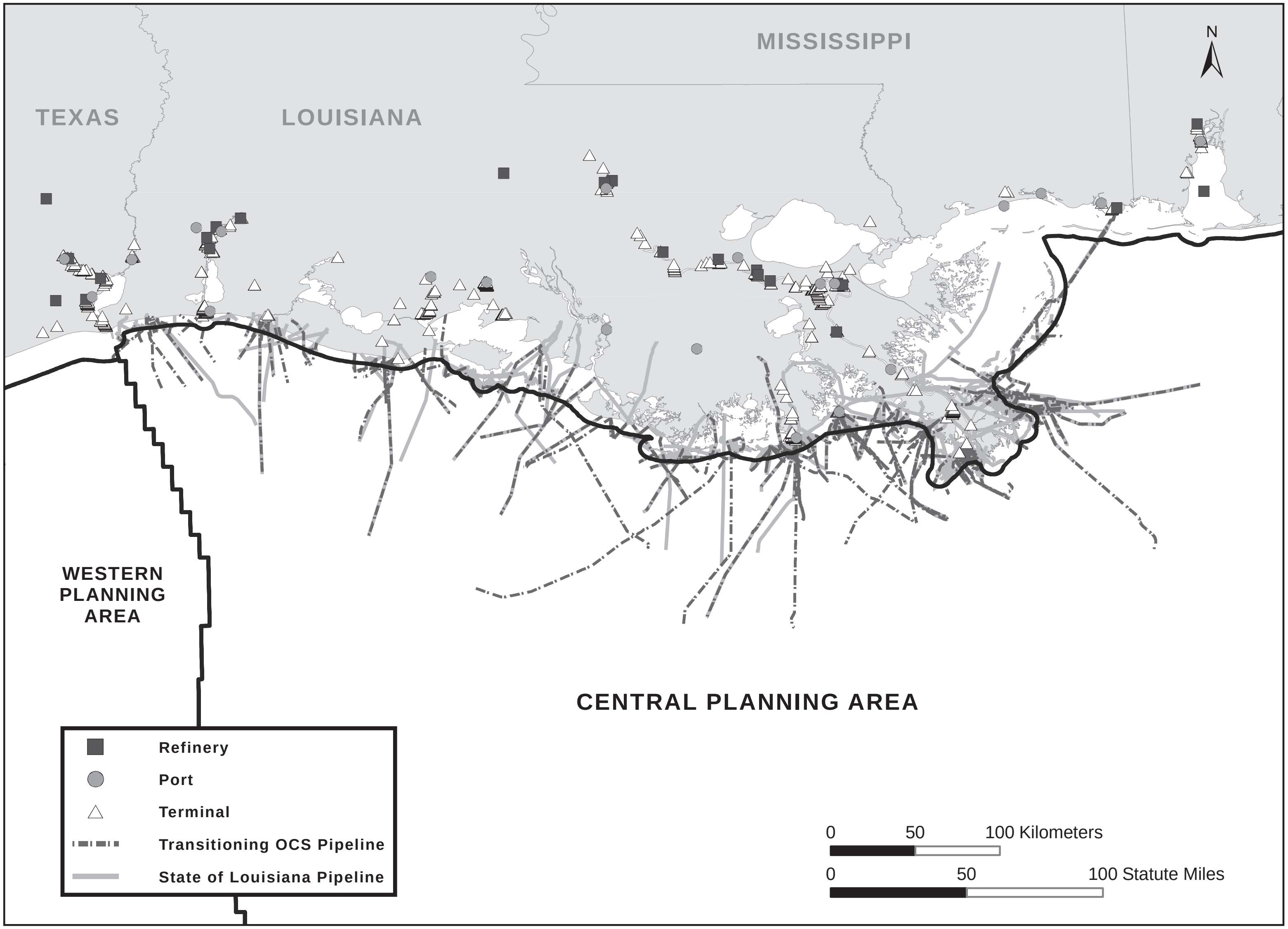

Figure 3-2. Infrastructure and Transitioning Pipelines from Federal OCS and Louisiana State Waters.

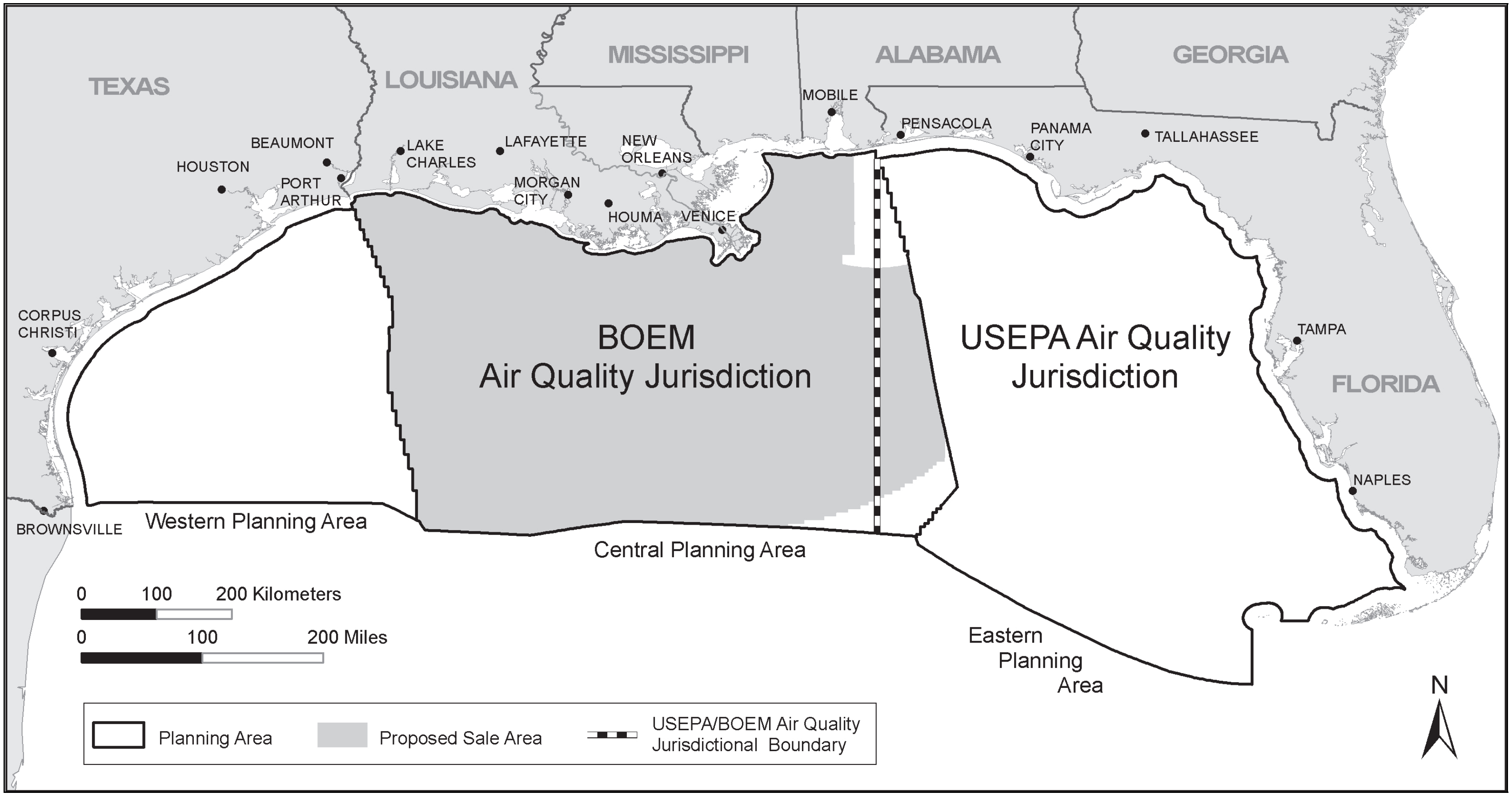

Figure 3-3. Air Quality Jurisdictional Boundary for BOEM and USEPA.

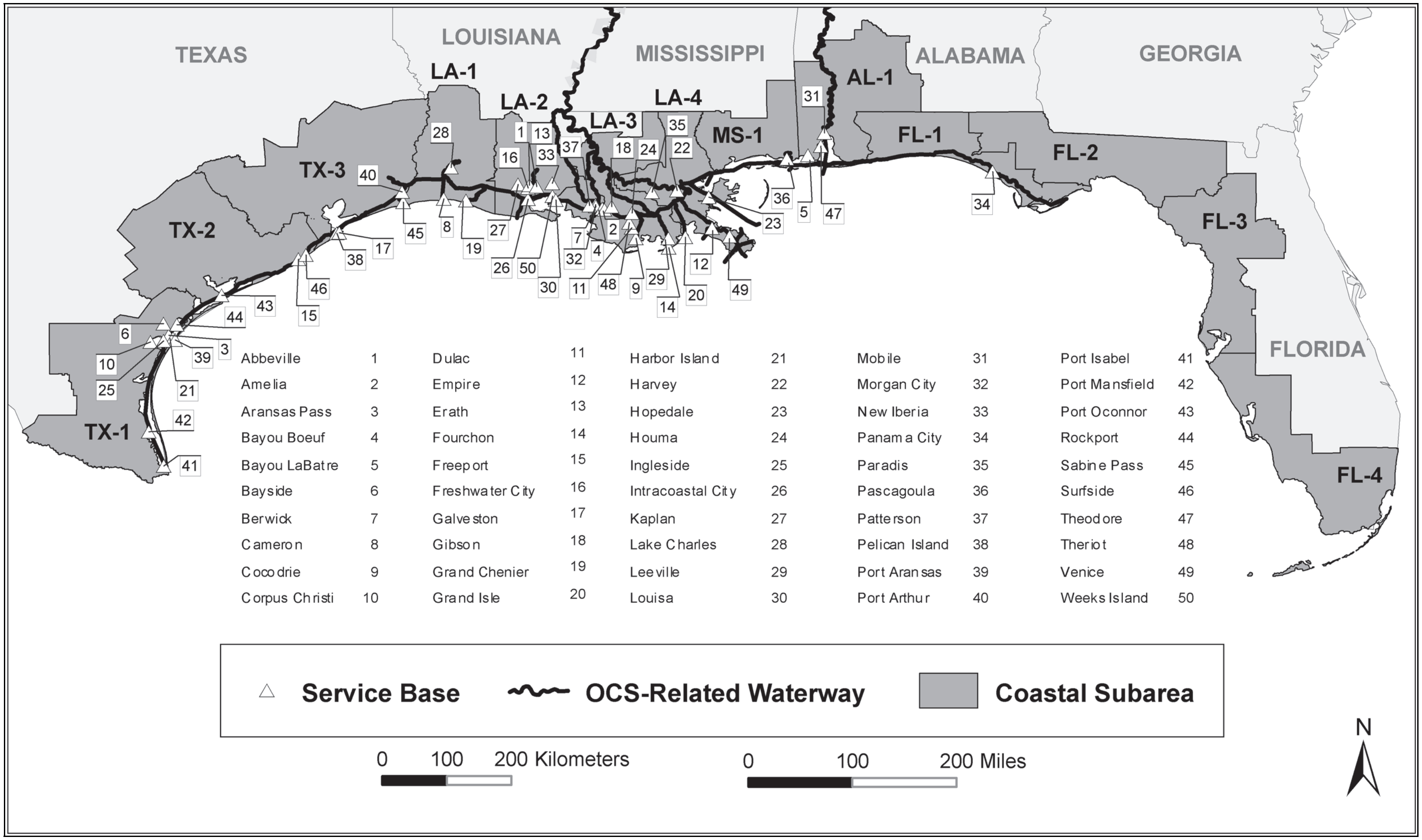

Figure 3-4. OCS-Related Service Bases in the Gulf of Mexico.

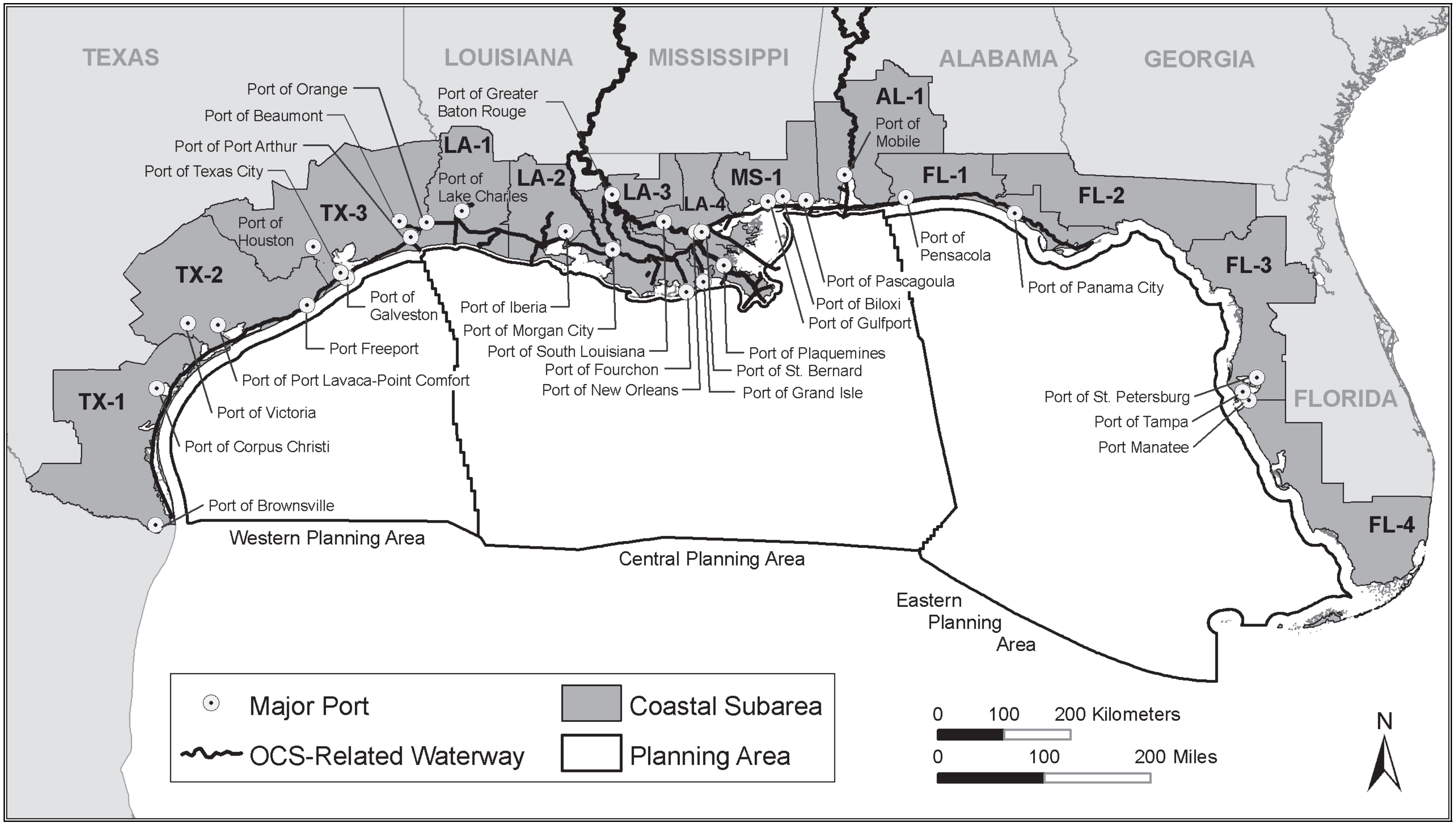

Figure 3-5. Major Ports and Domestic Waterways in the Gulf of Mexico.

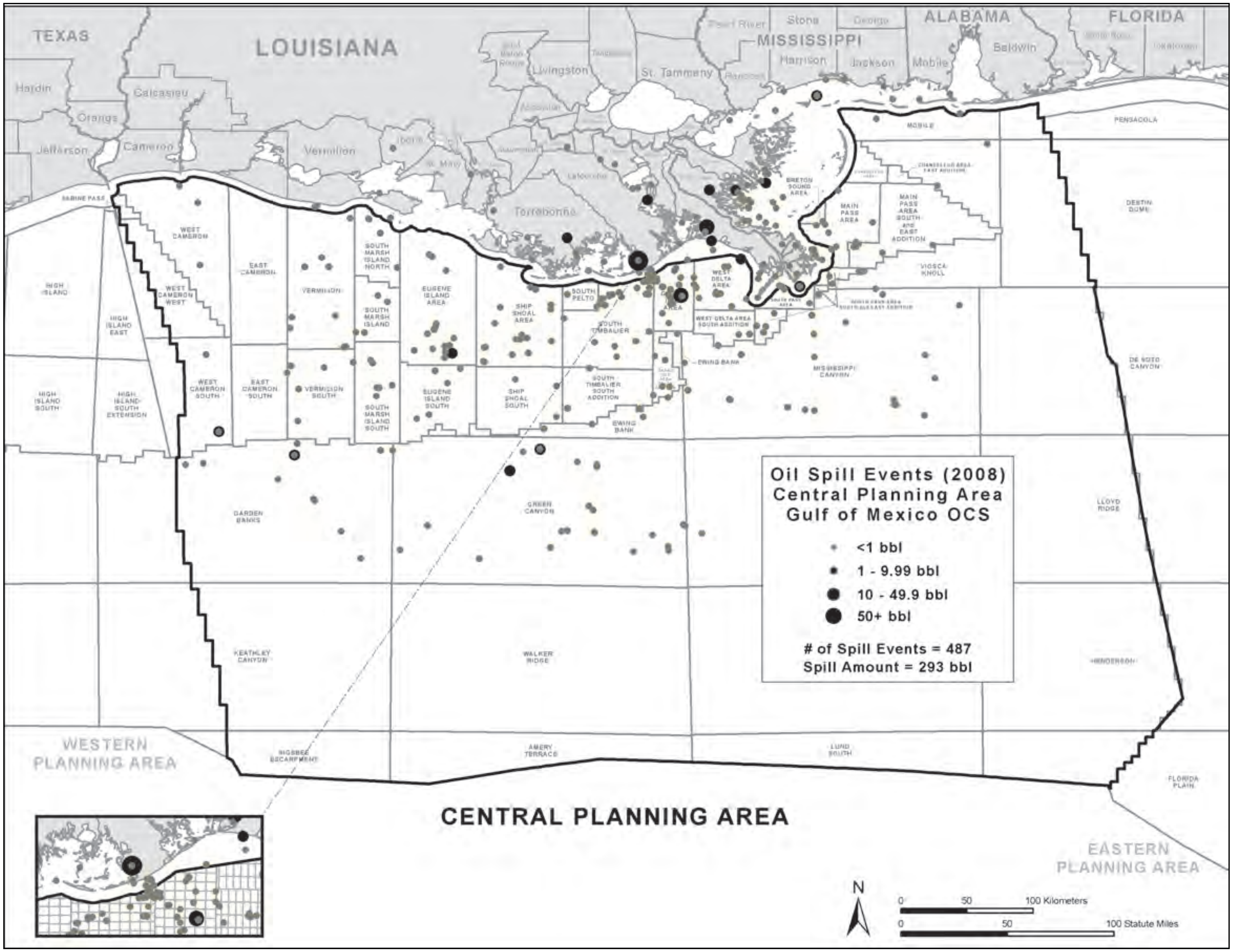

Figure 3-6. Oil-Spill Events (2008) in the Central Planning Area (Dickey, official communication, 2010).

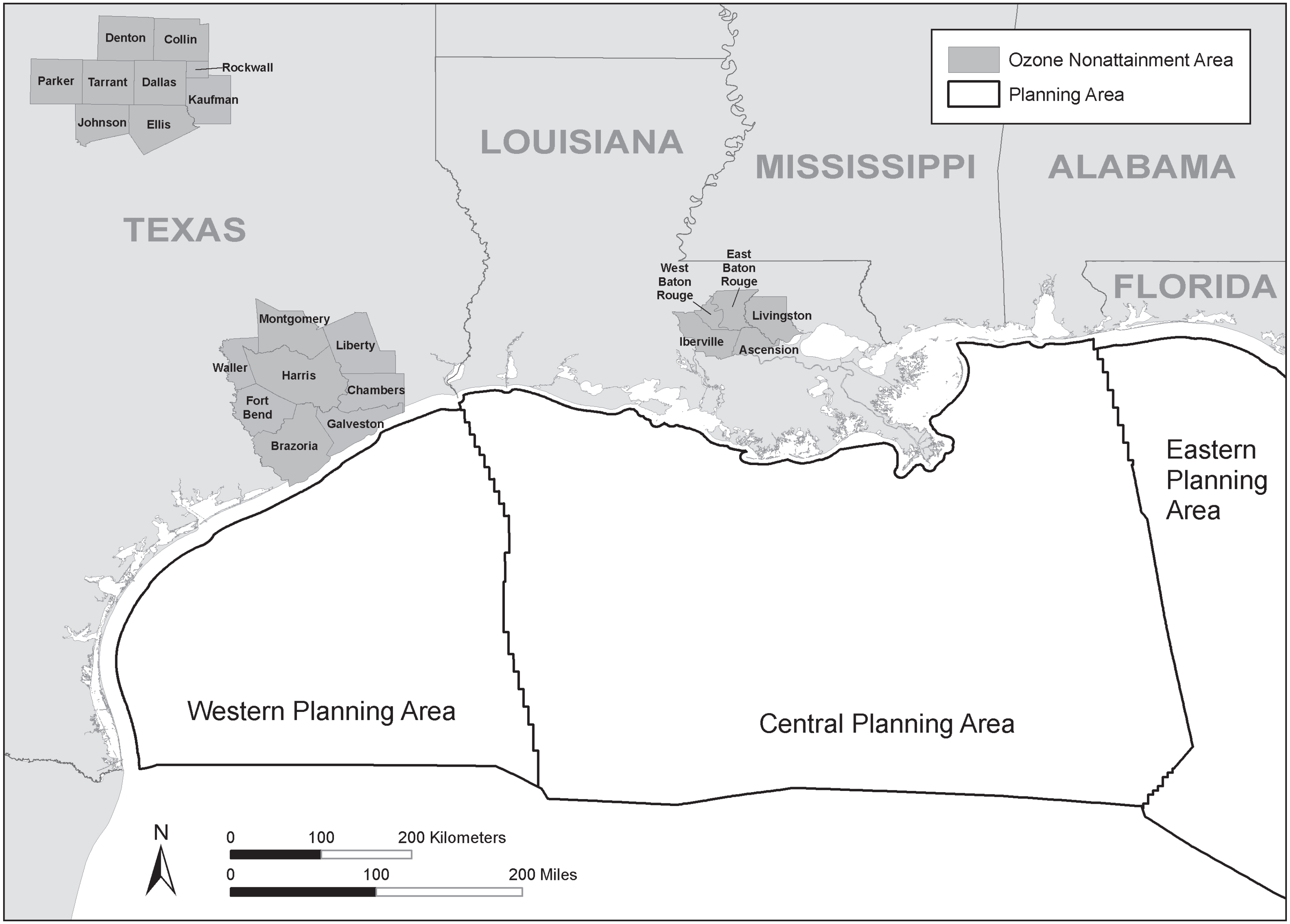

Figure 4-1. Status of Ozone Nonattainment in Coastal Counties and Parishes of the Central and Western Planning Areas (USEPA, 2011).

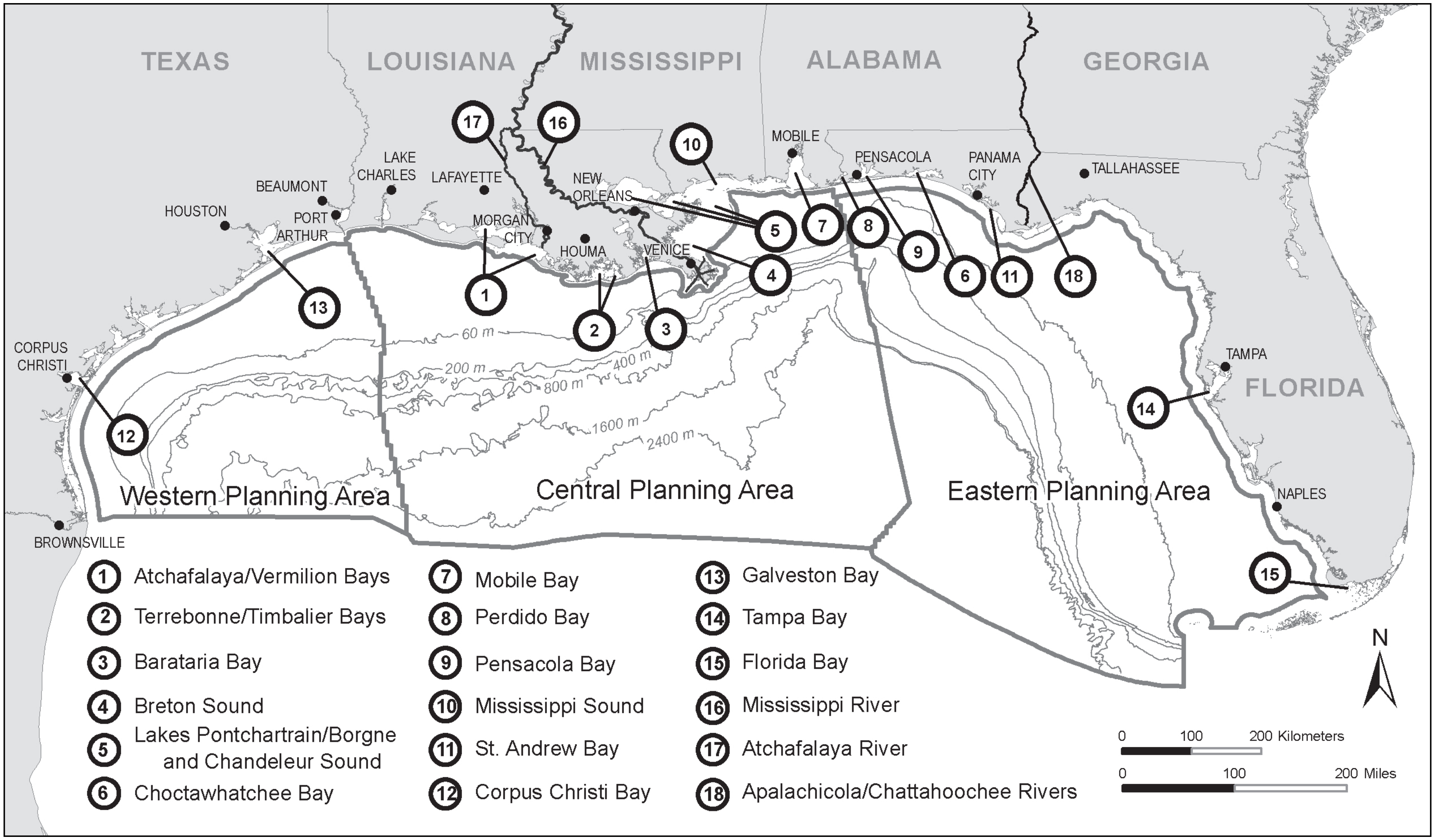

Figure 4-2. Coastal and Offshore Waters of the Gulf of Mexico with Selected Rivers and Water Depths.

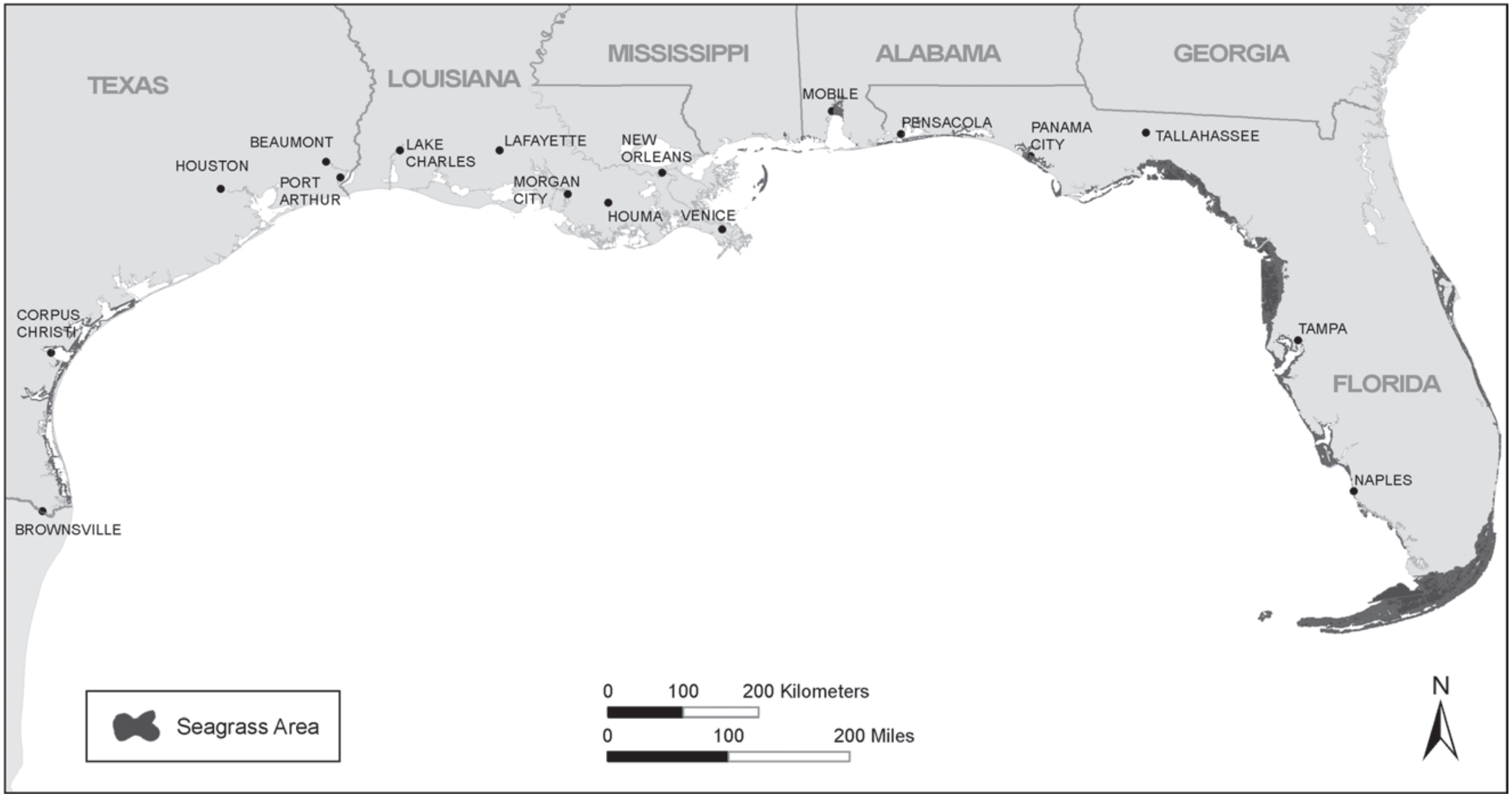

Figure 4-3. Seagrass Locations of the Northern Gulf of Mexico.

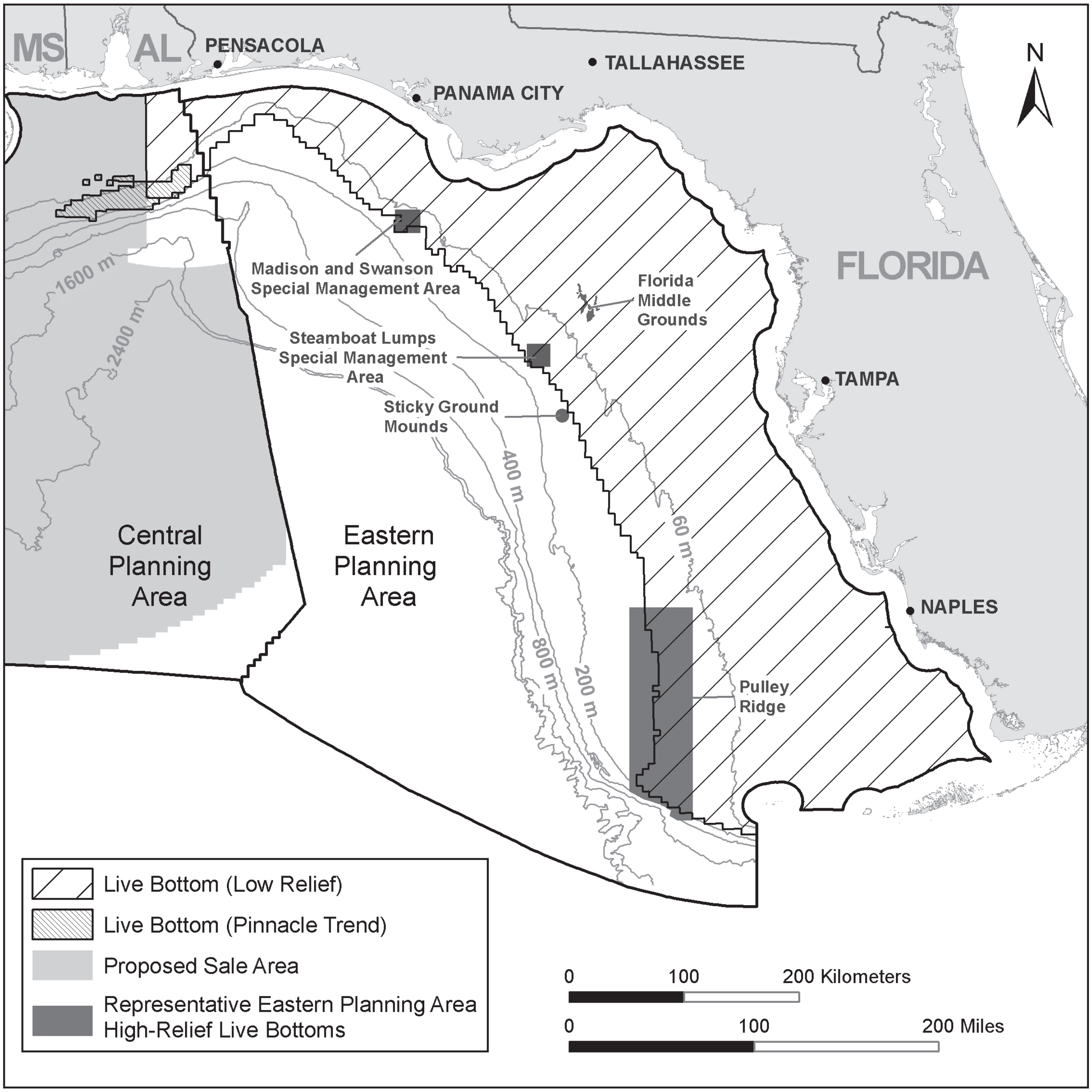

Figure 4-4. Live Bottoms (Low Relief and Pinnacle Trend) in the Central and Eastern Planning Areas.

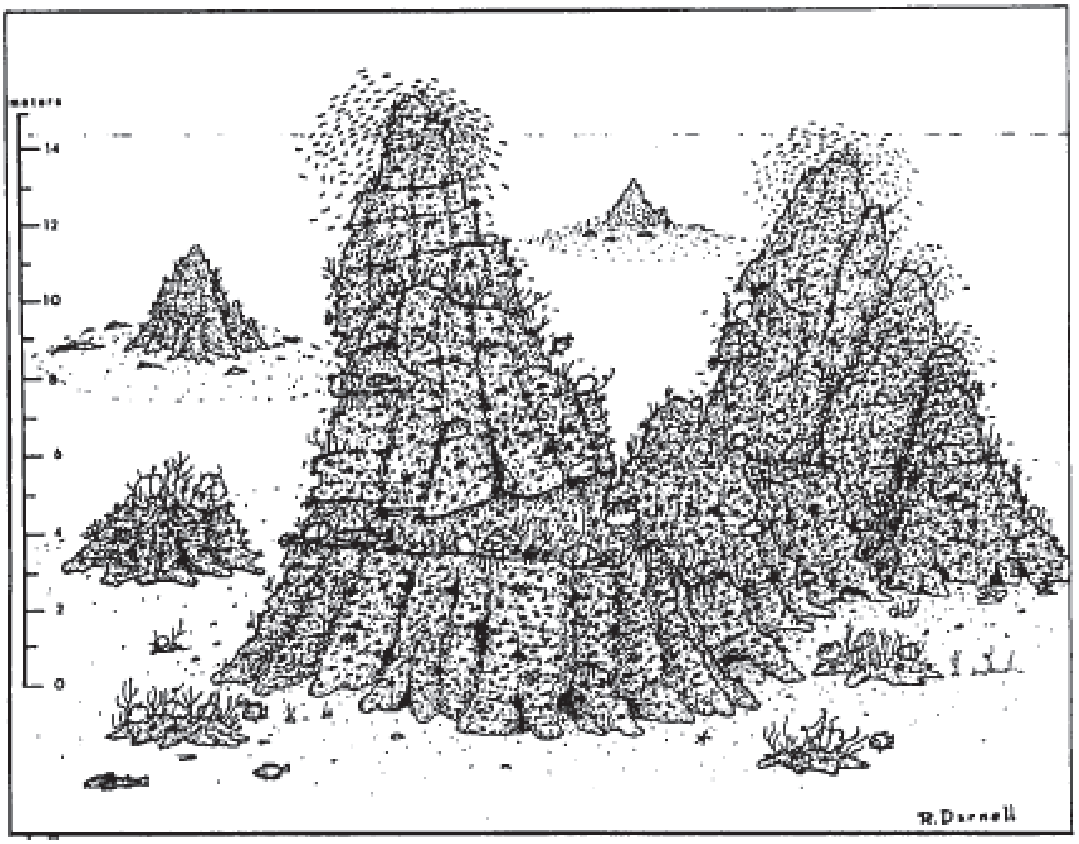

Figure 4-5. Perspective Sketch of the Submerged Landscape of a Pinnacle Province as Visualized from Sidescan Sonar and Remotely Operated Vehicle Information (Brooks and Giammona, 1990).

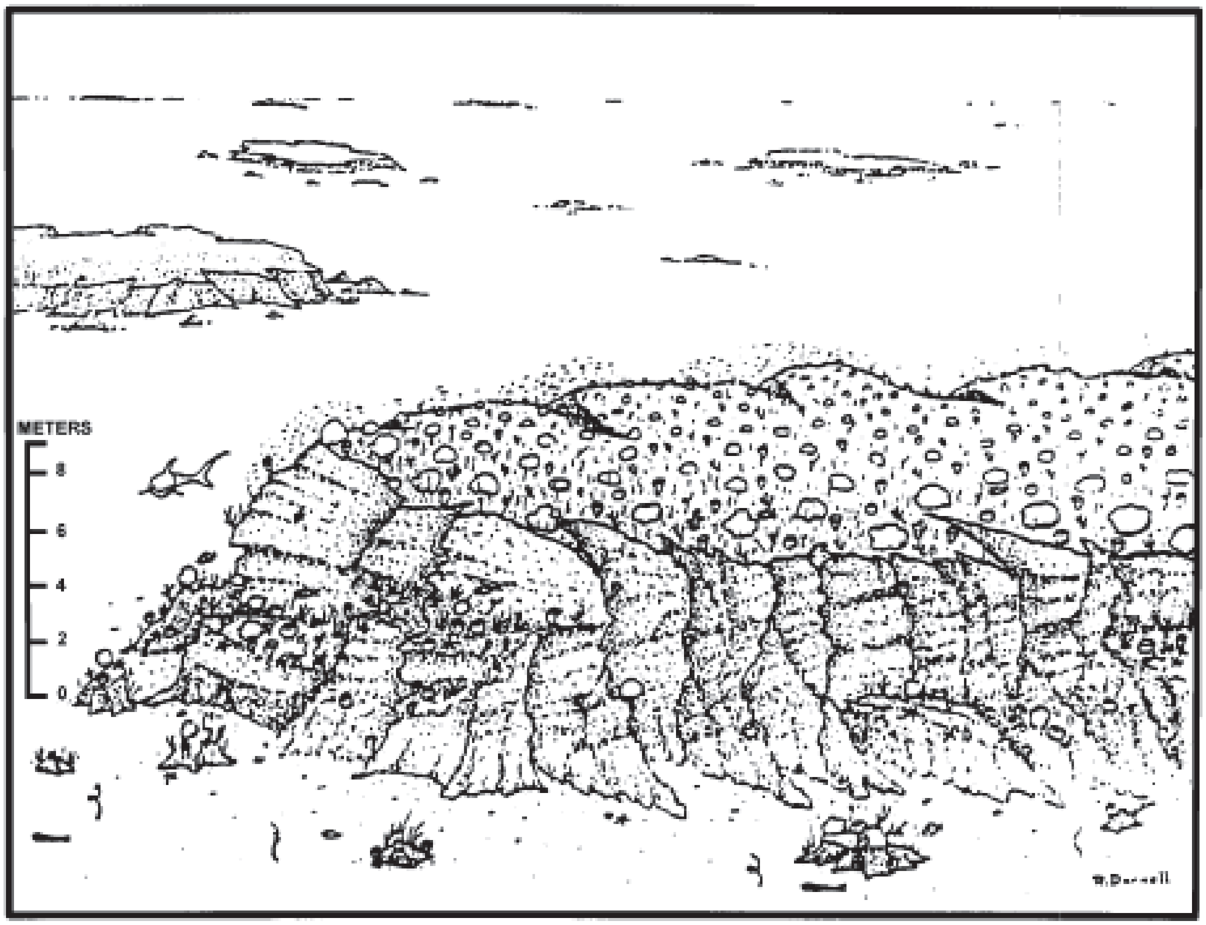

Figure 4-6. Sketch of a Submerged Ridge (Brooks and Giammona, 1990).

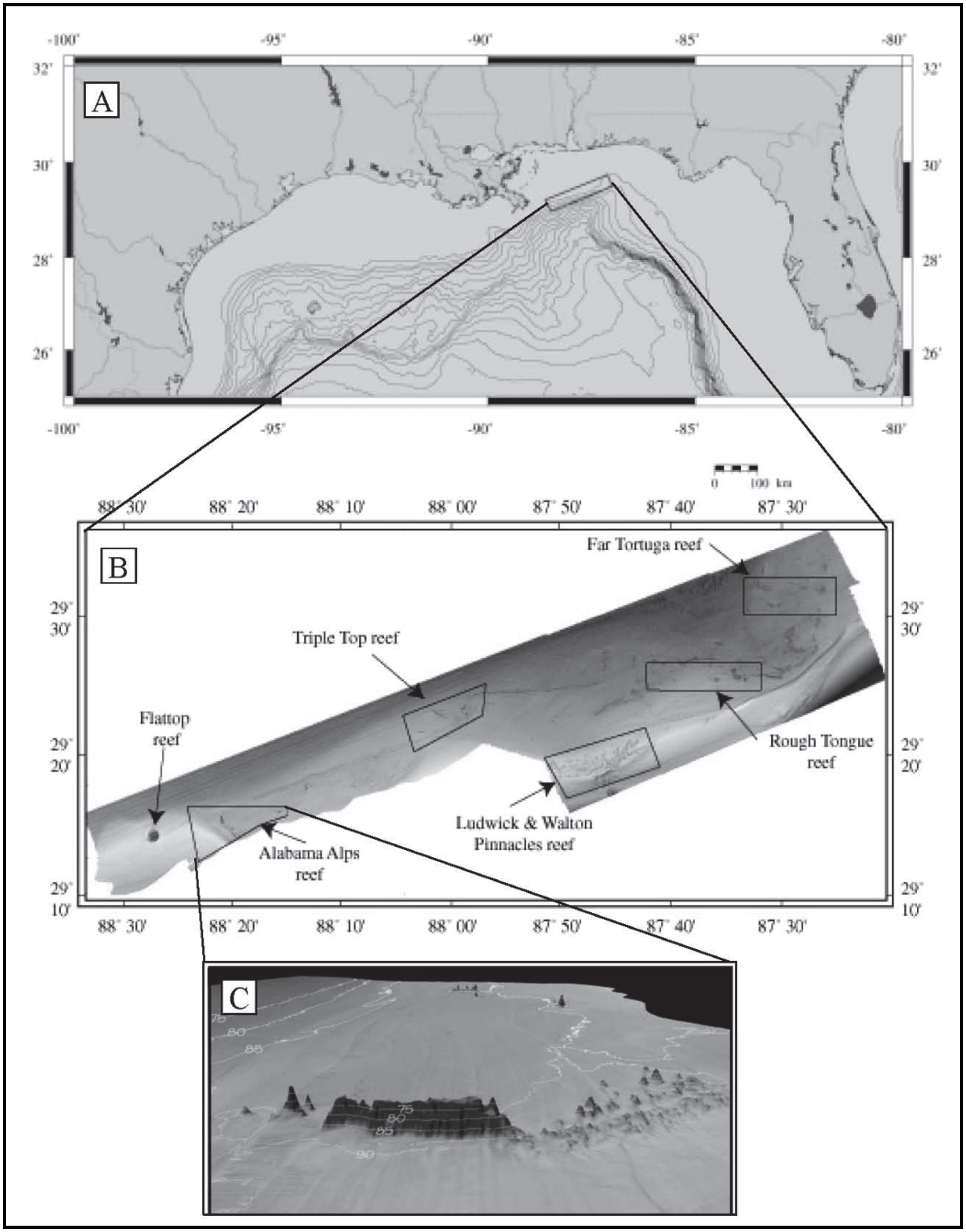

Figure 4-7. Location of the 36 Fathom Ridge within the Alabama Alps Formation (A & B) (Gardner et al., 2002) and Oblique View of the 36 Fathom Ridge within the Alabama Alps (C) (Weaver et al., 2002).

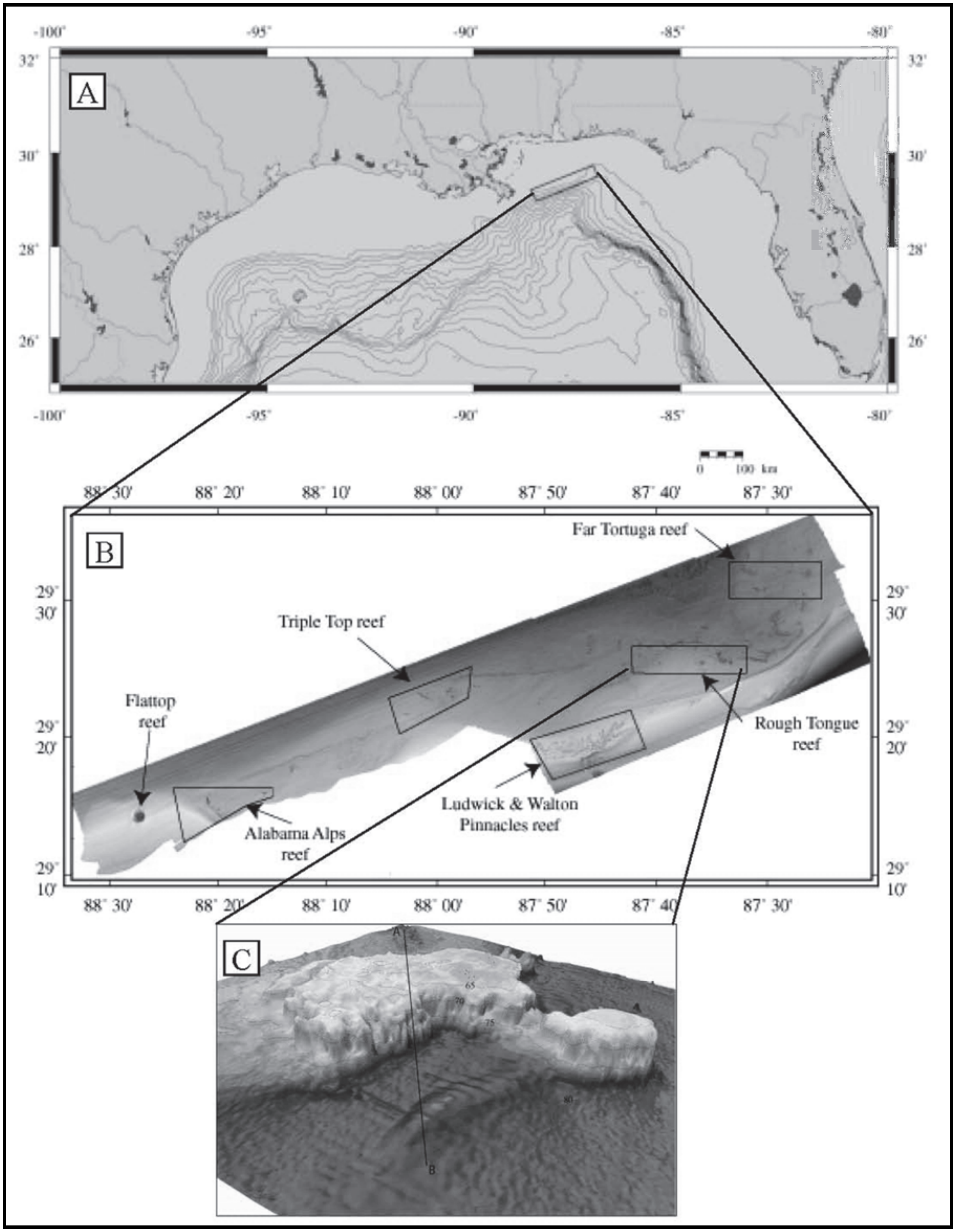

Figure 4-8. Location of Roughtongue Reef (A & B) (Gardner et al., 2002) and Oblique View of Roughtongue Reef (C) (Weaver et al., 2002).

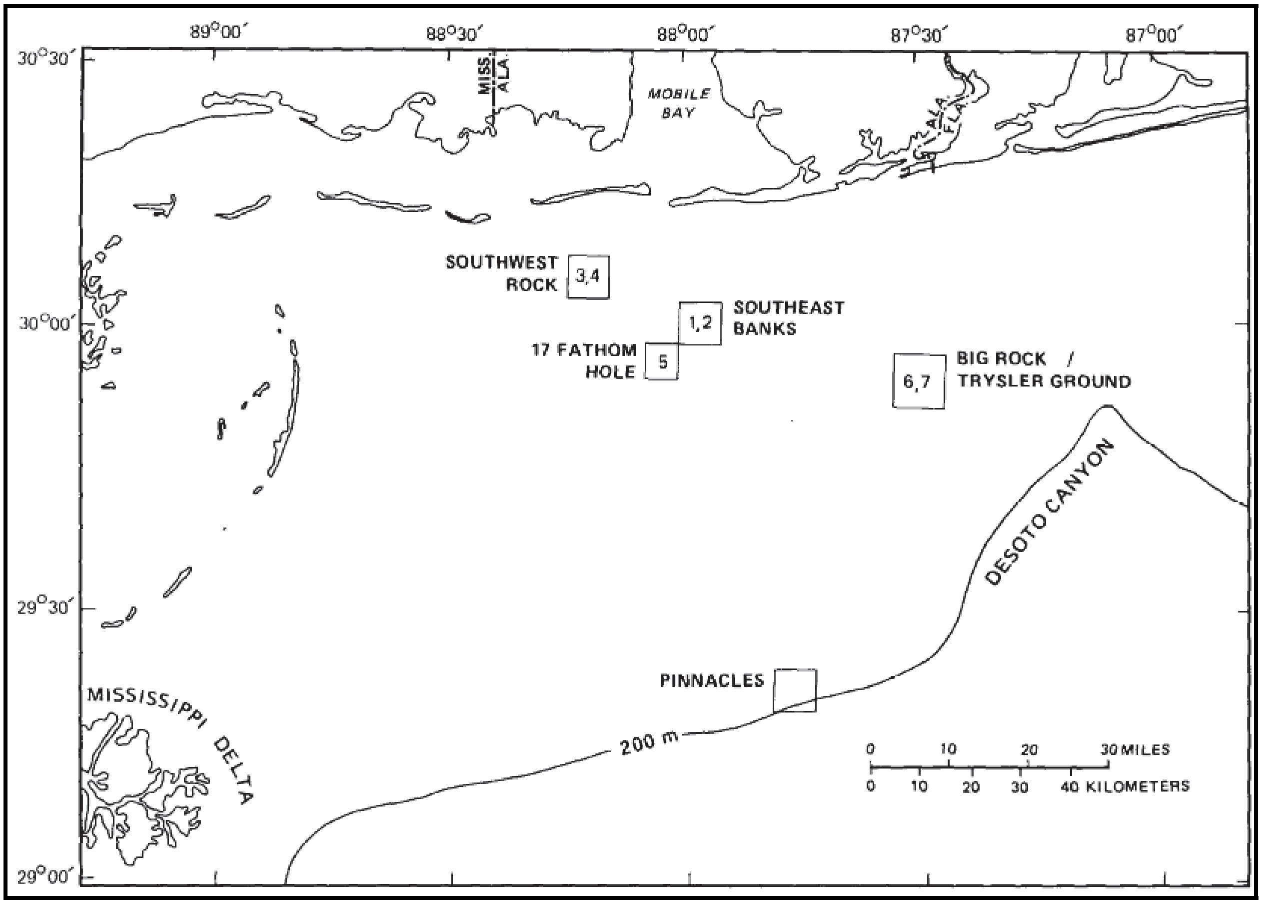

Figure 4-9. Location of Some Mapped Low-Relief, Hard-Bottom Areas and Pinnacles on the Alabama-Florida Continental Shelf (Schroeder et al., 1988).

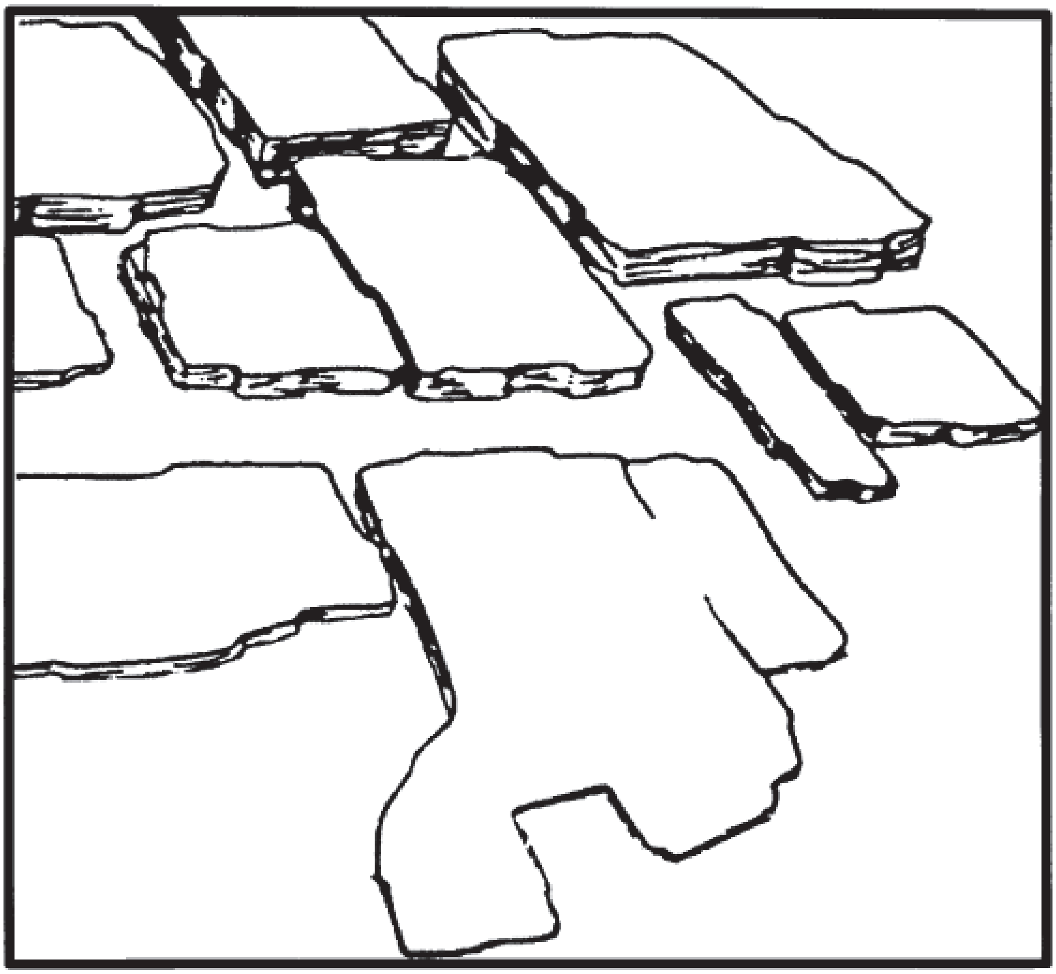

Figure 4-10. Block-Like, Hard-Bottom Substrate North of the Head of De Soto Canyon (Shipp and Hopkins, 1978).

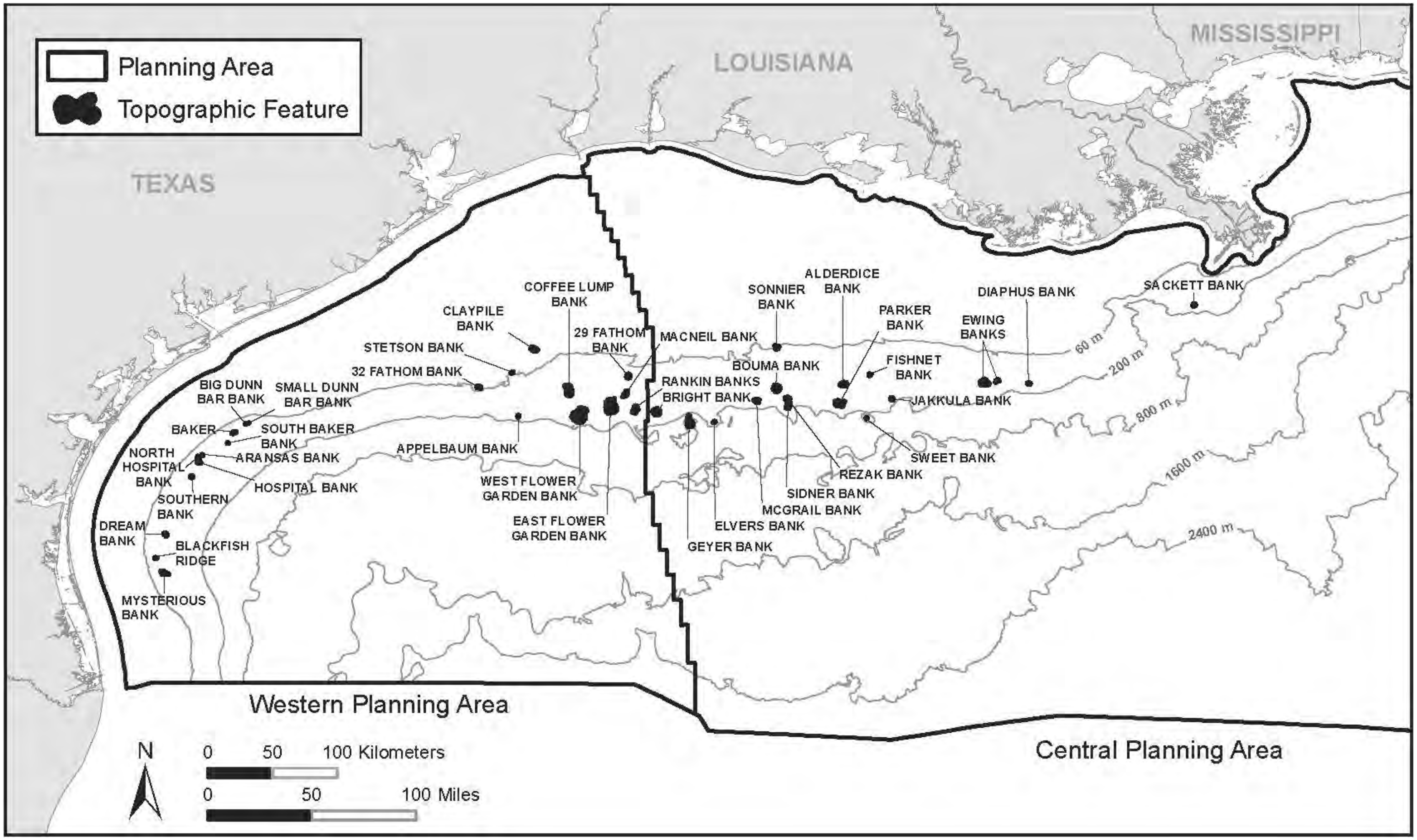

Figure 4-11. Location of Topographic Features in the Gulf of Mexico.

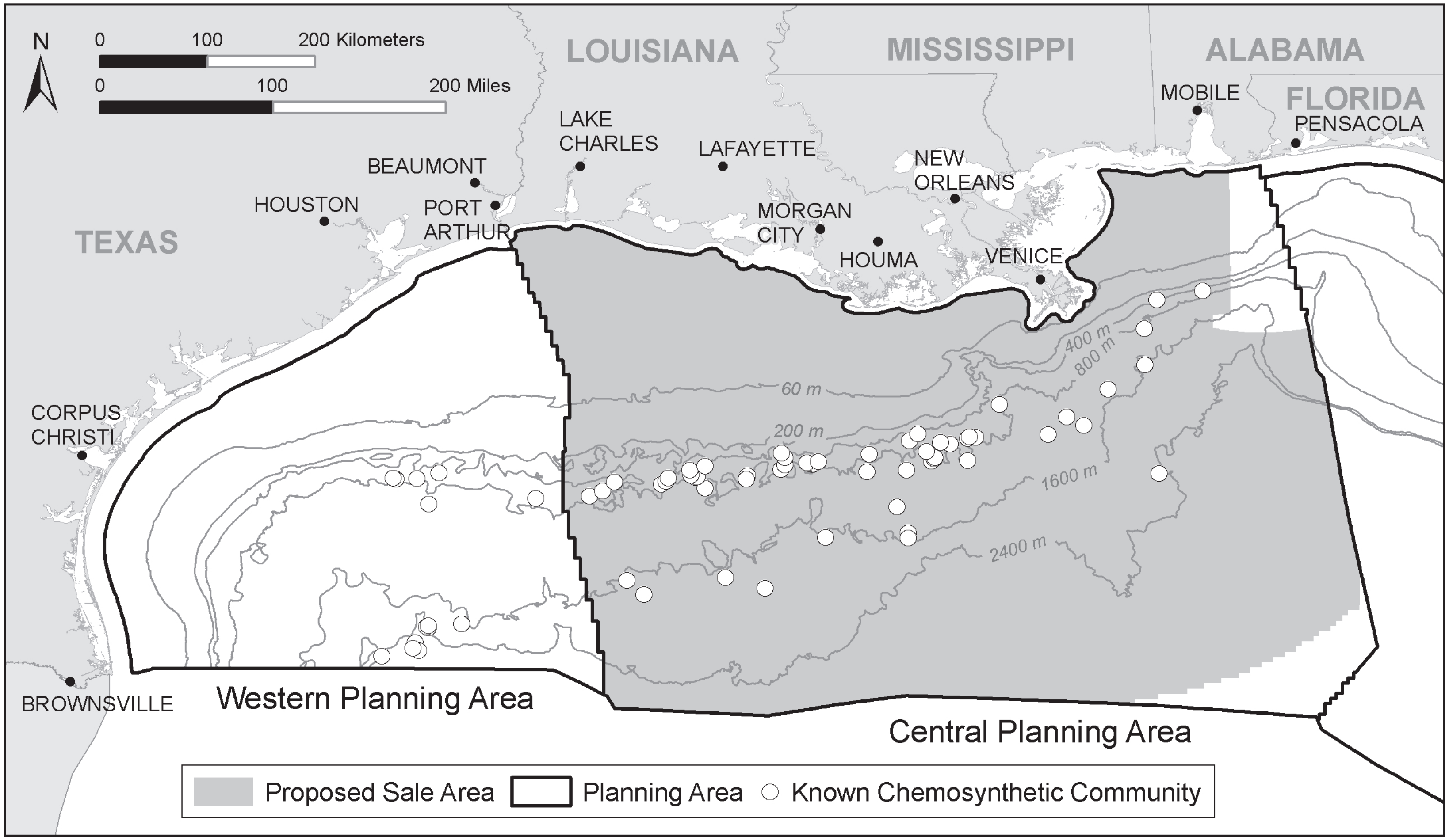

Figure 4-12. Location of Known Chemosynthetic Communities in the Gulf of Mexico.

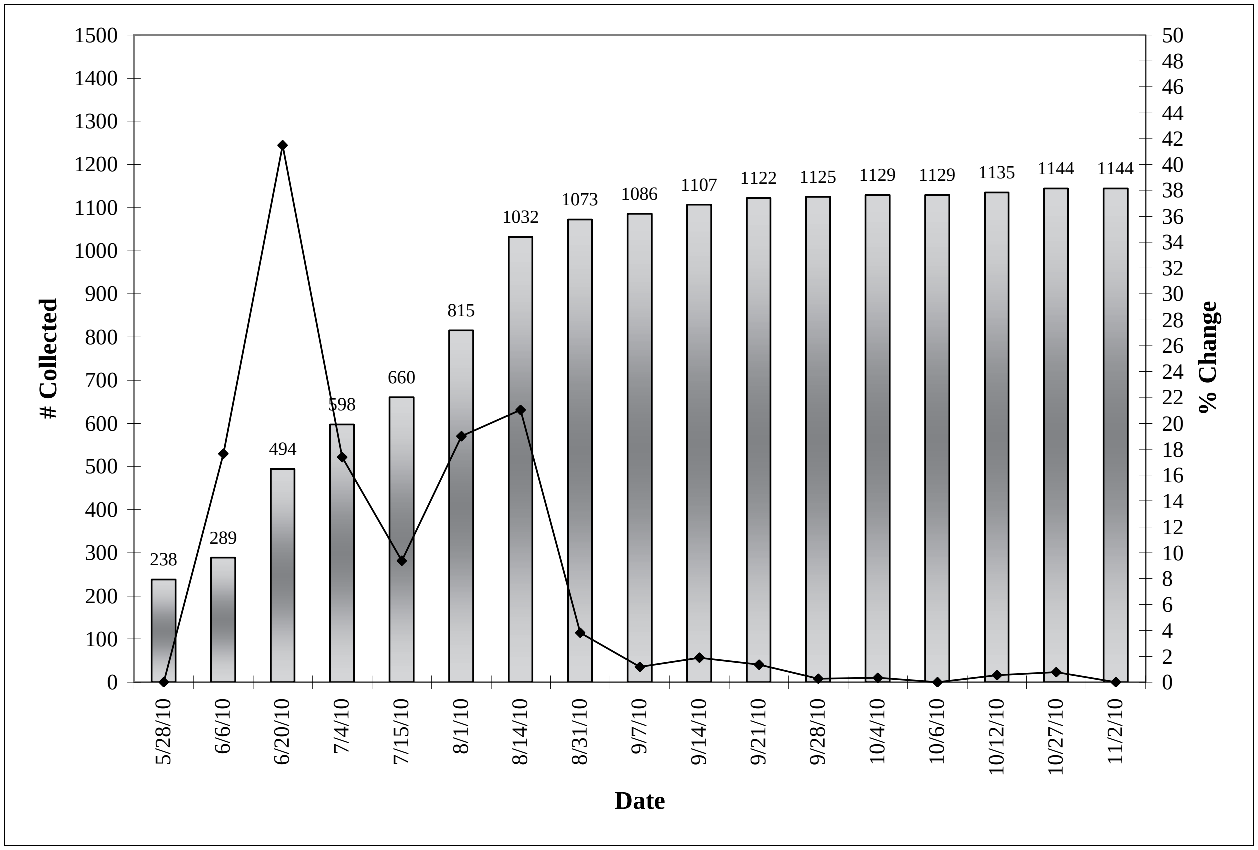

Figure 4-13. Summary of Sea Turtles Collected by Date Obtained from the Consolidated Numbers of Collected Fish and Wildlife That Have Been Reported to the Unified Area Command from the U.S. Fish and Wildlife Service, National Oceanic and Atmospheric Administration, Incident Area Commands, Rehabilitation Centers, and Other Authorized Sources Operating within the *Deepwater Horizon*/BP Incident Impact Area through November 2, 2010. (Data on the Y-axis reflects the cumulative number of individual sea turtles collected by date [alive and dead] and data on the Z-axis reflects proportional change from one reporting date to the next. For the latest available information on oiled or affected sea turtles documented in the area, event response, and daily maps of the current location of spilled oil, see RestoreTheGulf.gov, 2011).

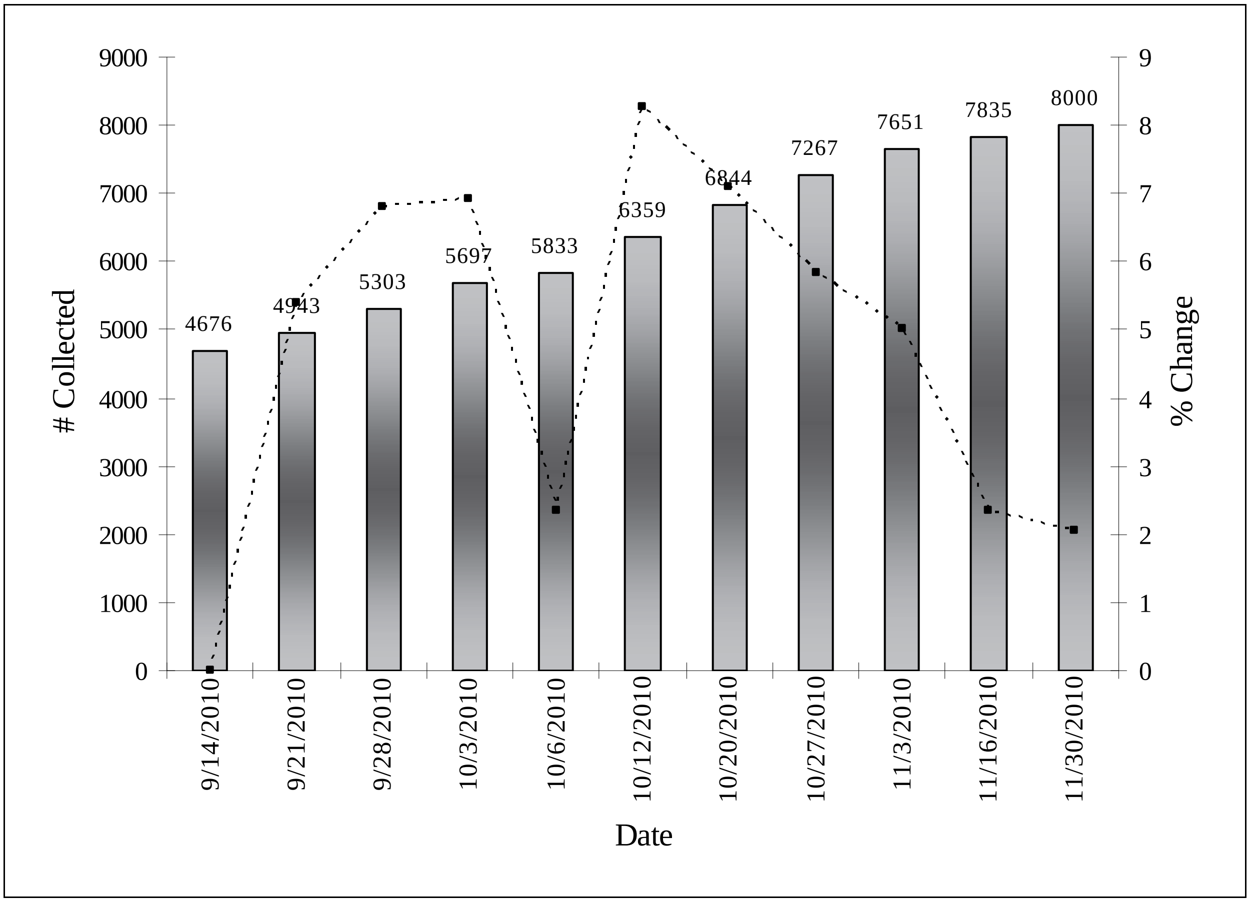

Figure 4-14. Summary of Avian Species Collected by Date Obtained from the U.S. Fish and Wildlife Service as Part of the NRDA Process through November 30, 2010. (Data on the Y-axis reflects the cumulative number of individual birds collected, identified, and summarized by date; data on the Z-axis reflects proportional change from one reporting date to the next. The data used in this table are verified as per the Fish and Wildlife Service's QA/QC processes. Disclaimer: All data should be considered provisional, incomplete, and subject to change. For more information, see USDOI, FWS, 2010).

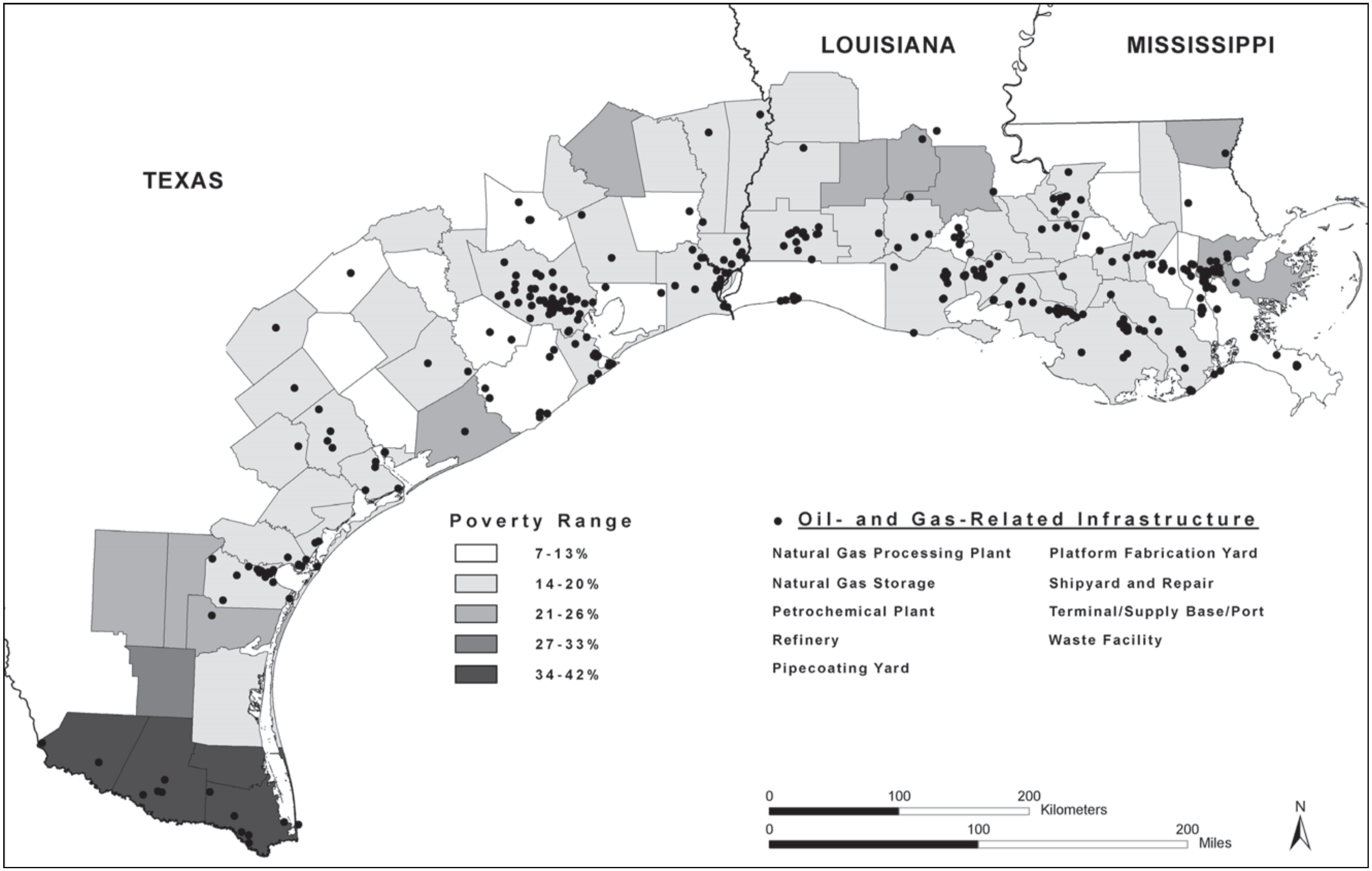

Figure 4-15. Locations of Oil- and Gas-Related Infrastructure and the Distribution of Low-Income Residents across Counties and Parishes in Texas and Louisiana based on U.S. Census Data from 2009 (USDOC, Census Bureau, 2010; Dismukes, in preparation).

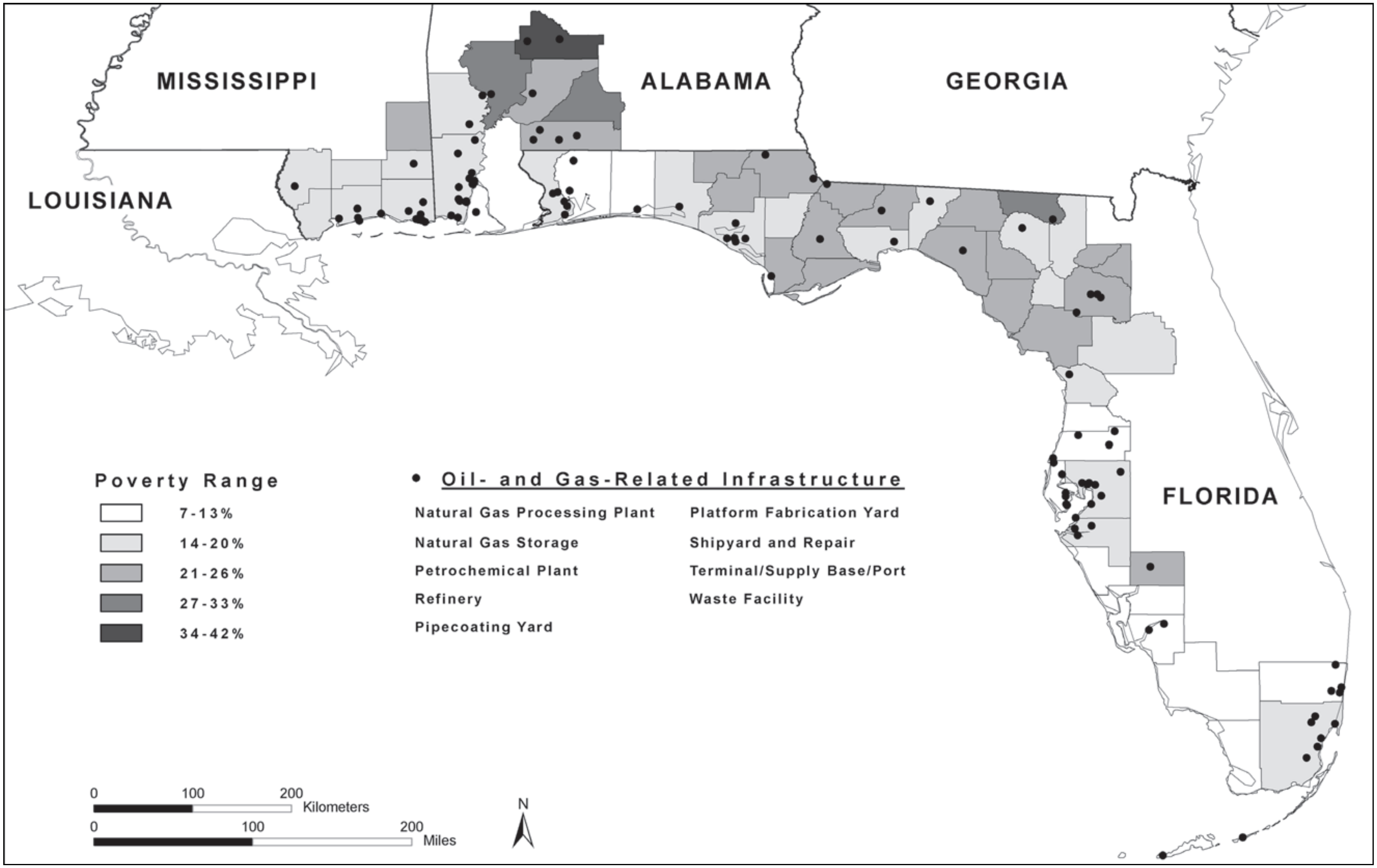

Figure 4-16. Locations of Oil- and Gas-Related Infrastructure and the Distribution of Low-Income Residents across Counties in Mississippi, Alabama, and Florida based on U.S. Census Data from 2009 (USDOC, Census Bureau, 2010; Dismukes, in preparation).

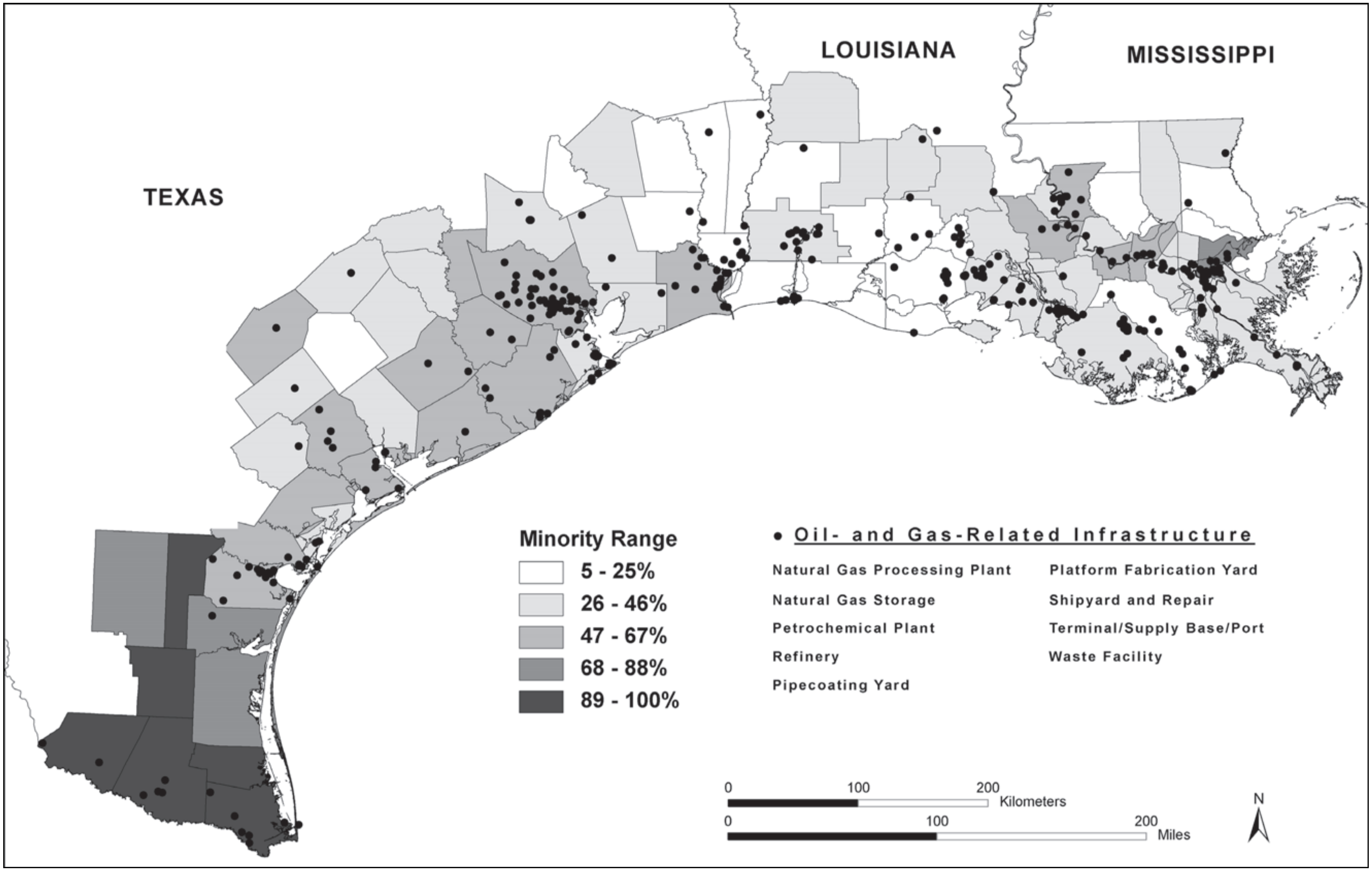

Figure 4-17. Locations of Oil- and Gas-Related Infrastructure and the Distribution of Minority Residents across Counties and Parishes in Texas and Louisiana based on U.S. Census Data from 2009 (USDOC, Census Bureau, 2010; Dismukes, in preparation).

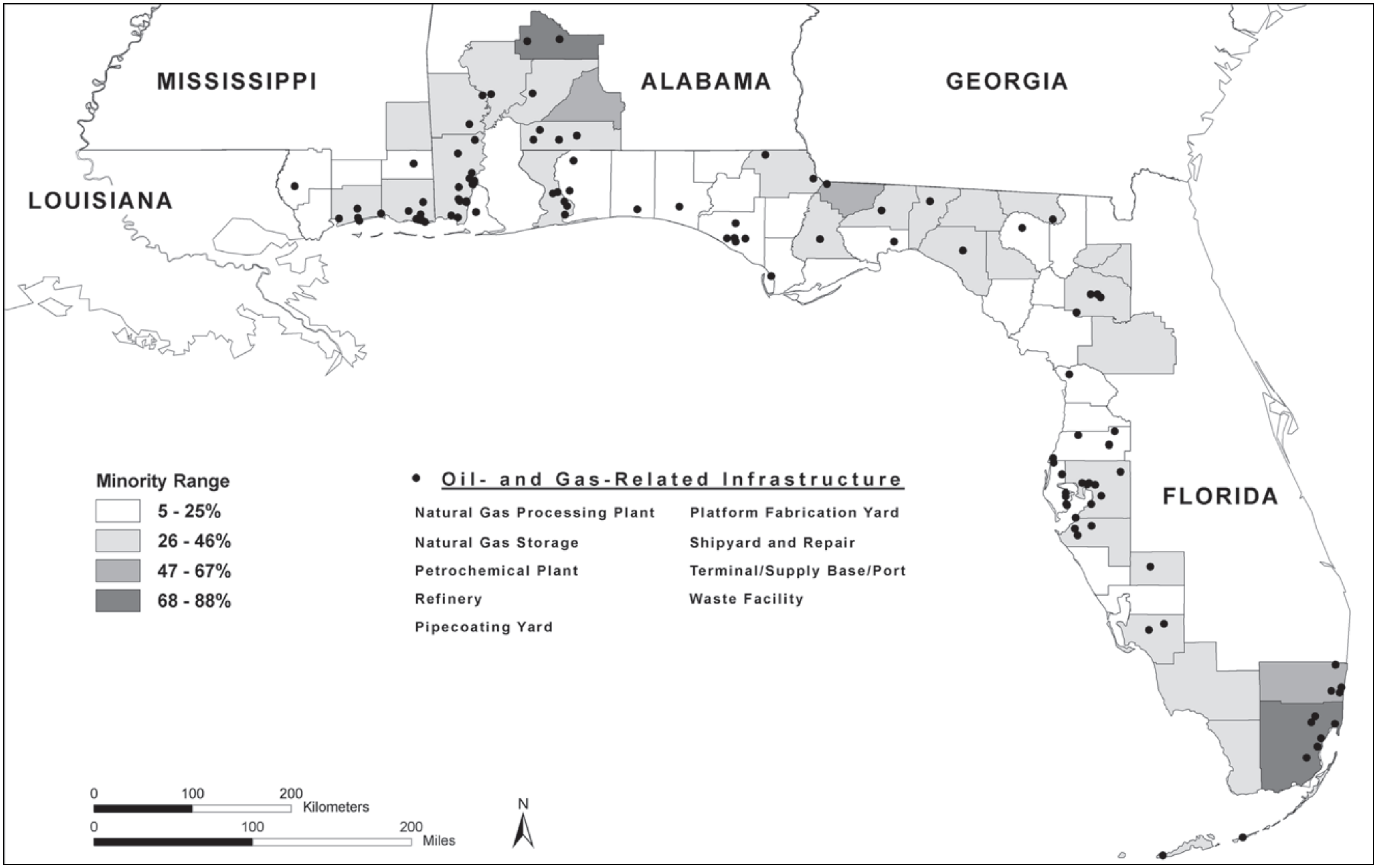

Figure 4-18. Locations of Oil- and Gas-Related Infrastructure and the Distribution of Minority Residents across Counties in Mississippi, Alabama, and Florida based on U.S. Census Data from 2009 (USDOC, Census Bureau, 2010; Dismukes, in preparation).

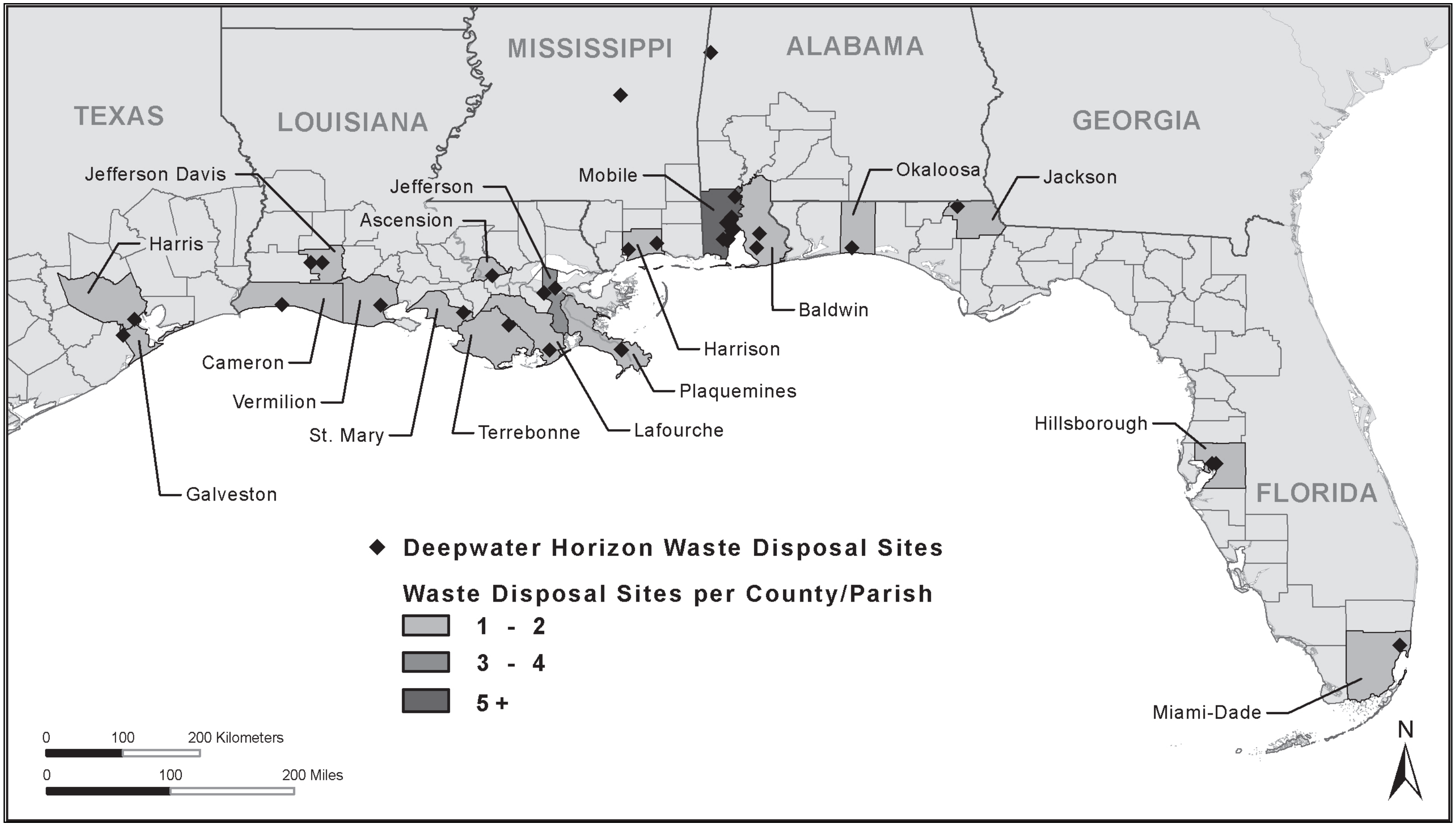

Figure 4-19. Location of All *Deepwater Horizon* Waste Disposal Sites (USDOC, NOAA, 2011; USEPA and British Petroleum, 2010; British Petroleum, 2011a and 2011b).

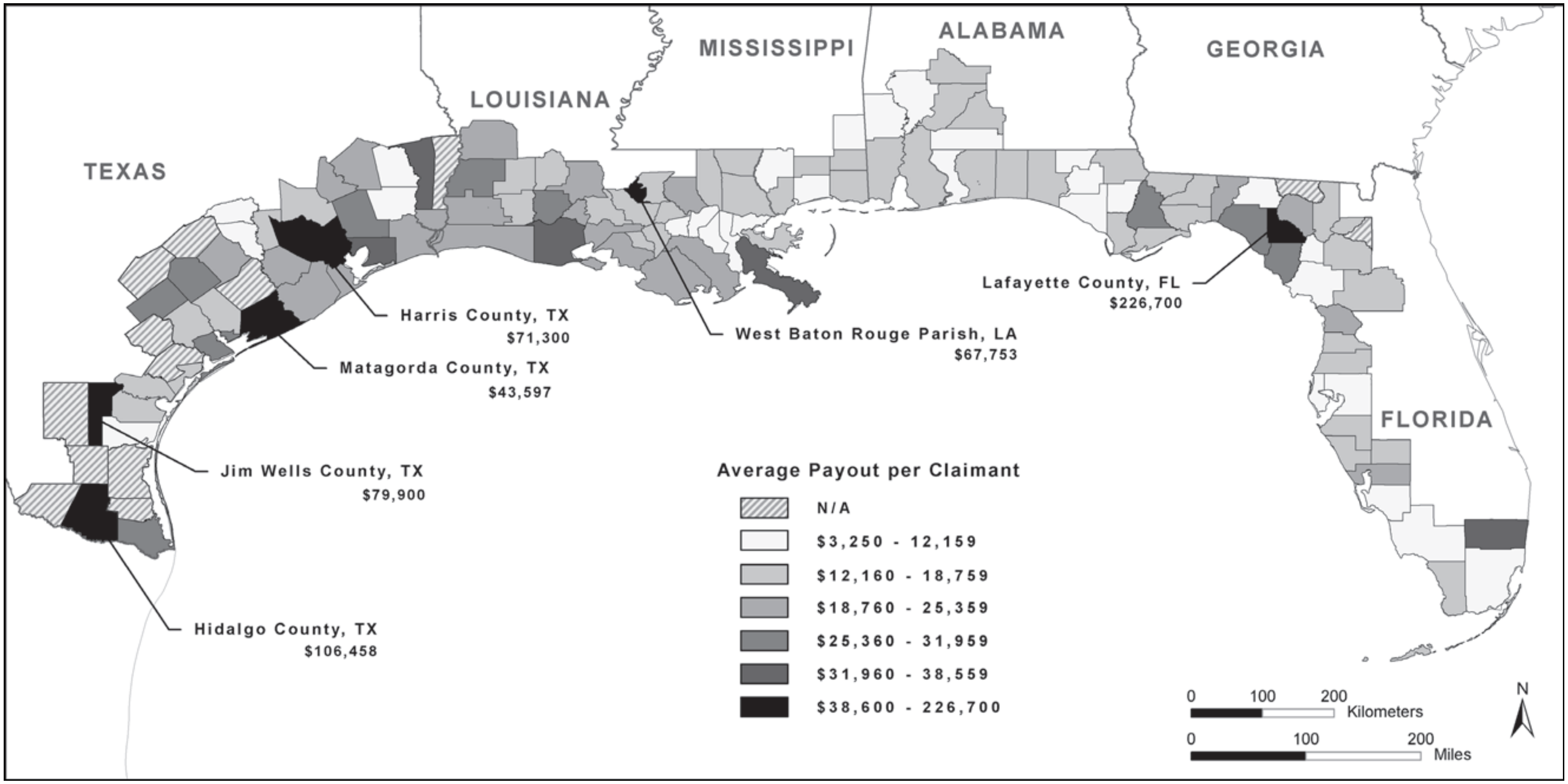

Figure 4-20. Distribution of the Gulf Coast Claims Facility's Claimants and the Average Amount Paid to Each Claimant across Gulf of Mexico Counties and Parishes (Gulf Coast Claims Facility, 2011).

Table 1-1

Emergency 30 CFR 250 Subpart D Interim Final Rule Provisions

Regulation	Summary	Existing Requirement	New Requirement	Cost
30 CFR §250.415(f)	Evaluate best practices in API RP 65-Part2	No evaluation required	Requires the operator to evaluate the best practices according to API RP 65-Part 2 and submit a written description for the evaluation.	No meaningful cost
			Written description must include the mechanical barriers and cementing practices the operator will use for each casing string.	
			API RP 65 Part 2 addresses cementing practices and factors affecting cementing success.	
30 CFR §250.416(d)	Submittal of schematics of all control systems for BOP stack	Schematic of BOP system showing inside diameter of BOP stack, number and type of preventers, location of choke and kill lines	Schematics of all control systems, including primary controls, secondary controls, and pods for the BOP system must be submitted.	No meaningful cost
			Location of the controls must be included	
30 CFR §250.416(e)	Independent third party verification to ensure blind-shear rams are capable of cutting the drill pipe used	Information that the blind-shear ram is capable of shearing the pipe	Verification that the blind-shear rams installed in the BOP stack are capable of shearing the drill pipe in the hole under maximum anticipated surface pressure.	Independent third-party certification will require a small cost per well
		No independent third-party certification required	Independent third party must be a technical classification society or an API licensed manufacturing, inspection, certification firm, or licensed professional engineering firm.	Will add moderate costs
			Independent third-party must not be the OEM.	
30 CFR §250.418(i)	Submit qualifications of independent third parties with APD	No independent third-party certification required	Description of qualifications in accordance with §250.416 (e)	No meaningful cost

Table 1-1. Emergency 30 CFR 250 Subpart D Interim Final Rule Provisions (continued).

Regulation	Summary	Existing Requirement	New Requirement	Cost
30 CFR §250.420(a)(6)	Professional Engineer verification of well casing and cementing program	No PE verification required	PE will verify there are two independent barriers	Small cost per well if performed by an independent third party
			Verify the casing cementing design is appropriate for the purpose it was intended under expected wellbore conditions	No cost if PE certification is done in house
				Assumed that some majors would verify in-house; smaller operators will use third party
30 CFR §250.420(b)(3)	Dual mechanical barriers	No requirement	Operator must install dual mechanical barriers in addition to cement in the final casing string and document to BOEMRE. Dual float valves, or one float valve and a mechanical plug.	Estimated that 80% of wells already use dual mechanical barriers
				Installation of dual mechanical barriers is estimated to take 21 hours
				Will add significant costs to regulation
30 CFR §250.423(b)(2)	Pressure test on the casing seal assembly	Perform a pressure test on all casing strings (except drive/structural) according to 250.423 (a)	Additional pressure test for the intermediate and production casing strings on the casing seal assembly to ensure proper installation of the casing in the subsea wellhead.	Pressure tests are already required, no extra equipment time
		No requirement to ensure proper installation of the casing in the subsea wellhead		Each pressure test only takes a few minutes
				No meaningful cost
30 CFR §250.423(c)	Negative pressure test	No negative pressure test required	Perform a negative pressure test to ensure proper installation of intermediate and production casing strings	Negative pressure test will take 90 minutes for each required string of casing
				Will result in significant costs for the regulation

Table 1-1. Emergency 30 CFR 250 Subpart D Interim Final Rule Provisions (continued).

Regulation	Summary	Existing Requirement	New Requirement	Cost
30 CFR §250.442(e)	Maintain ROV and a trained crew	ROV's used for visual inspection every 3 days; 250.446(b)	Required to maintain an ROV and trained crew on each floating rig on a continuous basis.	All rigs are assumed to have an ROV on board. This regulation will not add additional costs.
			ROV must be capable of shutting in the well during emergency situations	Regulation does not require a timed test, therefore current ROV's will be capable of performing all required functions.
30 CFR §250.442(f)	Provide an autoshear and deadman system for dynamically positioned rigs	No autoshear/deadman system requirement	All dynamically positioned rigs must have an autoshear and deadman system	Industry standard for dynamically positioned rigs to have autoshear/deadman systems No meaningful cost
30 CFR §250.442(g)	Barriers on BOP control panels to prevent accidental disconnect functions	No two-handed requirement	Incorporate enable buttons on control panels to ensure 2-handed operations for all critical functions.	No meaningful cost
30 CFR §250.442(h)	Label subsea BOP control panel	No labeling requirement	Clearly label all control panels, such as hydraulic control panels and ROV interface on the BOP	No meaningful cost
30 CFR §250.442(i)	Develop management system for BOP	No management requirement	Develop and use a management system for operating the BOP system	No meaningful cost
			Written procedures for operating the BOP stack and LMRP	
			Minimum knowledge requirements for personnel authorized to operate and maintain critical BOP components	
30 CFR §250.442(j)	Training for BOP equipment	No training requirement	Train BOP personnel in deepwater well control theory and practice in accordance with 30 CFR 250, Subpart O	No meaningful cost
30 CFR §250.446(a)	Document maintenance and inspections to BOP system	No documentation requirement	BOP maintenance and inspections must meet or exceed provisions of Sections 17.10 and 18.10	No meaningful cost

Table 1-1. Emergency 30 CFR 250 Subpart D Interim Final Rule Provisions (continued).

Regulation	Summary	Existing Requirement	New Requirement	Cost
30 CFR §250.449(j)	Subsea function test for ROV intervention on a subsea BOP stack	No initial test on the seafloor	All ROV intervention functions must be tested during the stump test and one set of rams during the initial test on the seafloor	Initial test on the seafloor is not industry standard
		Stump test for subsea BOP stack	ROV hot stabs must be function tested and capable of actuating at least 1 set of pipe rams, 1 set of blind-shear rams and unlatching the LMRP	ROV seafloor test is estimated to take about 24 hours Will add significant costs
			Operator must examine all surface and subsea well-control equipment to ensure that it is properly maintained and capable of shutting in the well during emergency operations	
30 CFR §250.449(k)	Autoshear/ deadman function test	No required function test	The autoshear and deadman systems must be function tested during the stump test and during the initial test on the seafloor.	No meaningful cost
30 CFR §250.451(i)	Emergency activation of blind or casing shear rams	No required action	If the blind-shear or casing shear rams are activated in a well control situation, the BOP must be retrieved and fully inspected and tested	Emergency situation only, will incur significant loss of rig time
30 CFR §250.456(j)	District Manager approval for displacing kill-weight drilling fluid	No approval requirement	Approval required from District Manager before displacing kill-weight drilling fluid from the wellbore	No meaningful cost
			Submit reasons for displacing and provide detailed procedures of displacement process.	
			Follow procedures in 250.456	
30 CFR §250.516(d)(8)	Subsea function test for ROV intervention on a subsea BOP stack	Stump test BOP stack before installation	All ROV intervention functions must be tested during the stump test and 1 set of rams during the initial test on the seafloor	Will add costs for well completions operations
			ROV hot stabs must be function tested and capable of actuating at least 1 set of pipe rams, 1 set of blind-shear rams and unlatching the LMRP	
			Operator must examine all surface and subsea well-control equipment to ensure that it is properly maintained and capable of shutting in the well during emergency operations	

Table 1-1. Emergency 30 CFR 250 Subpart D Interim Final Rule Provisions (continued).

Regulation	Summary	Existing Requirement	New Requirement	Cost
30 CFR §250.616(h)(1)	Subsea function test for ROV intervention on a subsea BOP stack	Stump test BOP stack before installation	All ROV intervention functions must be tested during the stump test and 1 set of rams during the initial test on the seafloor	Will add costs for well workover operations
			ROV hot stabs must be function tested and capable of actuating at least 1 set of pipe rams, 1 set of blind-shear rams and unlatching the LMRP	
			Operator must examine all surface and subsea well-control equipment to ensure that it is properly maintained and capable of shutting in the well during emergency operations	

Source: *Federal Register*, 2010.

Table 1-2

Overview of the Assignment of Regulations between the Bureau of Ocean Energy Management and the Bureau of Safety and Environmental Enforcement

Current Part	New Location	Note*
Title 30—Mineral Resources		
Part 203 – Relief or Reduction in Royalty Rates	Retained in its entirety in BSEE, Chapter II.	The BSEE will oversee the administration of royalty relief awarded after lease issuance as an operational responsibility. However BOEM will set the terms and conditions of any future leases issued with royalty relief provisions.
Part 219 – Distribution and Disbursement of Royalties, Rentals, and Bonuses	Moved in its entirety to BOEM, Chapter V, Part 519.	The BOEM will perform revenue share calculations for OCS receipts shared under the Gulf of Mexico Energy Security Act (GOMESA). The ONRR will continue to distribute the revenue shares to Gulf producing States and Coastal Political Subdivisions.
Title 30 Subchapter B—Offshore		
Part 250 – Oil and Gas and Sulphur Operations in the Outer Continental Shelf (OCS)	Responsibilities divided between BOEM and BSEE.	Both bureaus have responsibilities that are related to operations on OCS leases. These responsibilities were divided between the two bureaus as detailed in Table B.
Part 251 – Geological and Geophysical (G&G) Explorations of the OCS	Responsibilities divided between BOEM and BSEE.	The BOEM will be responsible for issuing the permits and notices and overseeing the activities under the approved permit, as these are prelease, resource assessment-related activities. The BSEE will be responsible for issuing permits for test drilling activities under their responsibilities for operations. Further details are provided in Table C.
Part 252 – OC Oil and Gas Information Program	Both BOEM and BSEE will have this part in its entirety.	Part 252 regulates how and when the date and information is released by the OCS Oil and Gas Information Program. Since both bureaus will collect, maintain, and use data and information collected under this program, both are responsible for managing the data and determining how and when the data and information are released. Further details are provided in Table D.
Part 253 – Oil Spill Financial Responsibility for Offshore Facilities	Moved to BOEM in its entirety, Chapter V, Part 553.	The BOEM is responsible for all activities related to financial assurance. Oil-spill financial responsibility requirements are mandated by the Oil Pollution Act of 1990 that applies to oil handling activities at any offshore facility (whether or not involved in oil production) seaward of the coastline. Further details are provided in Table E.
Part 254 – Oil-Spill Response Requirements for Facilities Located Seaward of the Coast Line	Retained in its entirety in BSEE.	All oil-spill related activities, except for financial responsibility, will fall under BSEE, under its responsibility for oil-spill response. Further details are provided in Table F.
Part 256 – Leasing of Sulphur or Oil and Gas in the OCS	Responsibilities divided between BOEM and BSEE.	The BOEM has primary responsibility for leasing and leasing-related activities. Some responsibilities related to operations and production will be in both bureaus. Suspension-related requirements will go to BSEE. Further details are provided in Table G.
Part 259 – Mineral Leasing: Definitions	Moved to BOEM in its entirety, Chapter V, Part 559.	The BOEM is responsible for leasing activities. Further details are provided in Table H.

Table 1-2 Overview of the Assignment of Regulations between the Bureau of Ocean Energy Management and the Bureau of Safety and Environmental Enforcement (continued).

Current Part	New Location	Note*
Part 260 – OCS Oil and Gas Leasing	Moved to BOEM in its entirety, Chapter V, Part 560.	The BOEM is responsible for leasing activities. Further details are provided in Table I.
Part 270 – Nondiscrimination in the OCS	Both BOEM and BSEE will have this part in its entirety.	Both BOEM and BSEE are responsible for ensuring that lessees and operators comply with section 604 of the OCSLA of 1978, which provides that "no person shall, on the grounds of race, creed, color, national origin, or sex, be excluded from receiving or participating in any activity, sale, or employment, conducted pursuant to the provisions of the OCSLA." Further details are provided in Table J.
Part 280 – Prospecting for Minerals Other Than Oil, Gas, and Sulphur on the OCS	Moved to BOEM in its entirety, Chapter V, Part 580.	This part regulates prospecting activities or scientific research activities on the OCS in Federal waters related to hard minerals on unleased lands or on lands under lease to a third party. These activities fall under BOEM responsibilities for managing the development of offshore resources and activities on unleased land or on lands leased to a third party. Further details are provided in Table K.
Part 281 – Leasing of Minerals Other Than Oil, Gas, and Sulphur in the OCS	Moved to BOEM in its entirety, Chapter V, Part 581.	This part regulates leasing for minerals other than oil, gas, and sulphur in the OCS. Leasing activities are a BOEM responsibility. Further details are provided in Table L.
Part 282 – Operations in the OCS for Minerals Other Than Oil, Gas, and Sulphur	Responsibilities divided between BOEM and BSEE.	Both BOEM and BSEE have responsibilities for operations conducted under a mineral lease for OCS minerals other than oil, gas, or sulphur. These responsibilities were divided between the two bureaus as detailed in Table M.
Part 285 – Renewable Energy and Alternate Uses of Existing Facilities on the OCS	Moved in its entirety to BOEM, Chapter V, Part 585.	At this time, the renewable energy program will be managed under BOEM. At a later date, the renewable energy program will be reorganized and a determination will be made regarding what functions will be administered by which agency.
Title 30 Subchapter C—Appeals		
Part 290 – Appeal Procedures	Both BOEM and BSEE will have this part in its entirety.	Appeal procedures apply to decisions and orders issued by both BOEM and BSEE. Further details are provided in Table O.
Part 291 – Open and Nondiscriminatory Access to Oil and Gas Pipelines under the OCS Lands Act	Retained in its entirety in BSEE.	This part deals with access to pipelines. All aspects of pipelines, including operations are under the responsibility of BSEE. Further details are provided in Table P.

* Tables B through P are found in the *Federal Register* (2011).

Table 2-1

Presidential and Secretarial Inquiries Resulting from the *Deepwater Horizon* Event and Spill

Initiator and Date	Purpose	Expected Outputs
April 30, 2010 President Obama	Reported if additional precautions and technologies should be required to improve the safety of oil and gas operations on the OCS.	The so-called "30-day Report" or "Safety Measures Report" was delivered to the Secretary on May 27, 2010 (USDOI, 2010a).
April 30, 2010 Secretary Salazar	Created OCS Safety Oversight Board (Board) to provide recommendations for improving and strengthening DOI's overall management, regulation, and oversight of OCS operations, including undertaking further audits or reviews, and reviewing existing authorities and procedures.	The Board delivered its report to the Secretary on September 1. It was made public with an implementation plan on September 8, 2010 (USDOI, 2010b).
May 11, 2010 Secretary Salazar	Impaneled a review by the National Academy of Engineering (NAE) of the root causes of the *Deepwater Horizon* event and provide recommendations	The NAE panel forecasts delivery of their final report that presents the Committee's final analysis, including findings and/or recommendations, by June 1, 2011 (pre-publication version); a final published version will follow by December 30, 2011 (NAE and NRC, 2011).
May 21, 2010 President Obama	Created the National Commission on the BP *Deepwater Horizon* Oil Spill and Offshore Drilling to develop findings and recommendations within 6 months.	The Commission delivered the Final Report to the President on January 11, 2011 (Oil Spill Commission, 2011).
May 25, 2010 Secretary Salazar	Requested that the DOI's Office of the Inspector General investigate any deficiencies in BOEMRE policies and practices that may have contributed to the *Deepwater Horizon* event.	The DOI's Office of the Inspector General released its report on December 7, 2010 (USDOI, Office of the Inspector General, 2010).

Table 3-1

Projected Oil and Gas in the Gulf of Mexico OCS

	Proposed Action	OCS Program (2007-2046)
Western Planning Area		
Reserve/Resource Production		
Oil (BBO)	0.222-0.423	6.629-8.060
Gas (Tcf)	1.495-2.647	52.211-59.961
Central Planning Area		
Reserve/Resource Production		
Oil (BBO)	0.801-1.624	21.933-24.510
Gas (Tcf)	3.332-6.560	90.155-102.761

BBO = billion barrels of oil
Tcf = trillion cubic feet

Table 3-2

Offshore Scenario Information Related to a Proposed Action in the Central Planning Area

	Offshore Subareas[1]							
	0-60 m	60-200 m	200-400 m	400-800 m	800-1,600 m	1,600-2,400 m	>2,400 m	Total CPA[2]
Wells Drilled								
Exploration and Delineation Wells	17-23	9-14	6-14	9-17	11-24	7-16	6-13	65-121
Development and Production Wells	62-85	23-33	76-132	65-102	58-112	37-73	20-39	338-576
Producing Oil Wells	14-19	6-9	38-66	32-52	30-58	19-38	10-21	149-263
Producing Gas Wells	40-55	14-20	28-48	22-36	20-39	13-26	7-13	144-237
Production Structures								
Installed	20-25	2-3	2-3	2-3	1-4	2-3	3	32-44
Removed Using Explosives	14-17	2	2	0-1	0	0	0	23-32
Total Removed	18-23	2-3	2-3	2-3	1-4	2-3	3	30-42
Length of Installed Pipelines (km)[3]	50-850	NA	NA	NA	NA	NA	NA	130-2,075
Service-Vessel Trips (1,000's round trips)	22-27	3-5	5-9	5-8	19-69	34-52	49-50	137-220
Helicopter Operations (1,000 operations)	714-1,185	71-169	36-169	36-169	36-226	36-169	75-154	1,004-2,241

[1] See Figure 3-1.

[2] Subareas totals may not add up to the planning area total because of rounding.

[3] Projected length of pipelines does not include length in State waters.

NA = not available.

Table 3-3

Deepwater Rig Counts, Day Rates, and Annual Drill Rates in the Gulf of Mexico*

Rig Type	Number of Rigs	Loaded Day Rate
Drillship	11	$1,000,000
Deep Semisubmersible	21	$923,953
Low Semisubmersible	4	$715,792
MODU Total or Weighted Average	36	$924,060
Platform	10	$400,000

* Current to August 2010.

Table 3-4

Oil Spilled from Pipelines on the Federal OCS, 2002-2009

Regulator	Area	Total Oil Spilled (bbl)	Oil Spilled due to Hurricanes (bbl)	Proportion of Total due to Hurricanes (%)
BOEM	Federal OCS	5,522	5,179	94
DOT	Federal OCS	5,667	3,272	58
DOT	State Waters	9,903	9,622	97

Source: USDOI, BOEM and DOT data.

Table 3-5

Mean Number and Sizes of Spills Estimated to Occur
in OCS Offshore Central Planning Area Waters from an Accident Related to Rig/Platform
and Pipeline Activities Supporting a CPA Proposed Action Over a 40-Year Time Period

Spill Size Group	Spill Rate (Spills/BBO) [1]	Number of Spills Estimated for a CPA Proposed Action	Estimated Median Spill Size (bbl) [1]
0-1.0 bbl	2,020	1,620-3,300	<0.024
1.1-9.9 bbl	57.4	40-100	3.0
10.0-49.9 bbl	17.4	10-30	
50.0-499.9 bbl	11.3	9-20	130
500.0-999.9 bbl	1.63	1-3	
≥1,000 bbl	1.13	1-2	2,200

Notes: The number of spills estimated is derived by application of the historical rate of spills per volume crude oil handled (1996-2010) (USDOI, BOEMRE, 2011) to the projected production for a proposed action in the CPA (Table 3-1). The actual number of spills that may occur in the future could vary from the estimated number. A spill size group for ≥10,000 bbl was not included in this table, because the catastrophic Deepwater Horizon oil spill (4.9 million bbl) was the only spill in this size range during 1996-2010, and thus meaningful statistics (such as median spill size) could not be calculated.

[1]Source: USDOI, BOEMRE, 2011, and calculations based on data therein. The spill rates presented are a sum of rates for U.S. OCS platforms/rigs and pipelines.

Table 3-6

Properties and Persistence by Oil Component Group

Properties and Persistence	Light-weight	Medium-weight	Heavy-weight
Hydrocarbon compounds	Up to 10 carbon atoms	10-22 carbon atoms	>20 carbon atoms
API º	>31.1º	31.1º-22.3 º	<22.3 º
Evaporation rate	Rapid (within 1 day) and complete	Up to several days; not complete at ambient temperatures	Negligible
Solubility in water	High	Low (at most a few mg/L)	Negligible
Acute toxicity	High due to monoaromatic hydrocarbons (BTEX)	Moderate due to diaromatic hydrocarbons (naphthalenes—2 ring PAH's)	Low except due to smothering (i.e., heavier oils may sink)
Chronic toxicity	None, does not persist due to evaporation	PAH components components (e.g., naphthalenes—2 ring PAH's)	PAH components (e.g., phenanthrene, anthracene—3 ring PAH's)
Bioaccumulation potential	None, does not persist due to evaporation	Moderate	Low, may bioaccumulate through sediment sorption
Compositional majority	Alkanes and cycloalkanes	Alkanes that are readily degraded (specify, as done for others)	Waxes, asphaltenes, and polar compounds (not significantly bioavailable or toxic)
Persistence	Low due to evaporation	Alkanes readily degrade, but the diaromatic hydrocarbons are more persistent	High; very low degradation rates and can persist in sediments as tarballs or asphalt pavements

Sources: Michel, 1992; Canadian Center for Energy Information, 2010.

Table 3-7

Estimated Number of Spills that Could Happen in Gulf Coastal Waters from an Accident Related to Activities Supporting a Proposed Action

Size Category	Assumed Size	WPA Proposed Action	CPA Proposed Action
Total		15-34	49-126
≤1 bbl	1 bbl	12-29	44-114
>1 bbl and <50 bbl	3 bbl	1-2	2-5
≥50 bbl and <1,000 bbl	150 bbl	1-2	2-6
≥1,000 bbl	3,000 bbl	<1-1	<1-1

Note: The estimated number of spills is obtained from the count of coastal spills for 2001 proportioned to reflect that OCS oil comprised 19 percent of the oil crossing into GOM coastal waters in 2001. Intrastate oil and refined product transport were not included. The low estimate in the range was obtained from Dickey (official communication, 2006) and the high estimate was obtained from aggregated national data available on the Internet (USDOT, Coast Guard, 2001).

Sources: Dickey, official communication, 2006; USDOT, Coast Guard, 2001; National Ocean Economics Program, 2006; USDOE, Energy Information Administration, 2006.

Table 3-8

Primary Cleanup Options Used during the *Deepwater Horizon* Response

	Fresh Oil	Sheens	Mousse	Tarballs	Burn Residue
On-Water Response	Disperse, skim, burn	Light sheens very difficult to recover, heavier sheens picked up with sorbent boom or sorbent pads	Skim	Snare boom	Manual removal
On-Land Response	Sorbent pads, manual recovery, flushing with water, possible use of chemical shoreline cleaning agents	Light sheens very difficult to recover, heavier sheens picked up with sorbent boom or sorbent pads	Sorbent pads, manual recovery	Snare boom, manual removal, beach cleaning machinery	Manual removal

Source: USDOC, NOAA, 2010a.

Table 3-9

Pipelines* Damaged after 2004-2008 Hurricanes Passing through the WPA and CPA

Hurricane	Total Damage Reports	Pipe and Movement	Platform Connection	Riser	Mudflow	Outside Impact	Unknown
Ivan	168	38	20	67	16	9	18
Katrina	299	61	139	66	1	9	14
Rita	243	31	94	89	0	8	21
Gustav/Ike	314	14	2	273	2	7	16

* Not discriminated by diameter.

Sources: Energo Engineering, 2010; Atkins et al., 2007.

Table 3-10

Causes of Hurricane-Related Pipeline Spills Greater Than 50 Barrels

Hurricane	Amount Spilled (bbl)	Cause
Ivan	1,720	Mudflow
Ivan	671	Movement
Ivan	126	Platform
Ivan	200	Platform
Ivan	250	Platform
Ivan	260	Platform
Ivan	95	Movement
Ivan	123	Movement
Katrina	960	Movement
Katrina	50	Platform
Katrina	55	Riser
Katrina	132	Mudslide
Katrina	50	Movement
Rita	75	Riser
Rita	100	Outside Force
Rita	862	Outside Force/Platform
Rita	67	Platform
Rita	108	Riser
Ike	69	Movement
Ike	108	Riser
Ike	56	Platform
Ike	1,316	Outside Force
Ike	209	Riser
Ike	268	Riser

Source: USDOI, BOEM data.

Table 3-11

Total Producing Wells, Total Oil, and Total Gas Production in the Nine Coastal Parishes of Louisiana in 2009

Parish	Total Producing Wells	Total Oil Produced (bbl)	Total Gas Produced (Mcf)
St. Bernard	114	666,757	12,662,442
Plaquemines	1,734	16,870,508	74,737,520
Jefferson	221	1,202,961	11,199,616
Lafourche	539	5,769,795	35,366,426
Terrebonne	569	5,984,437	93,070,163
St. Mary	345	3,400,486	40,127,959
Iberia	172	2,891,805	48,567,357
Vermilion	249	3,062,983	63,928,992
Cameron	323	3,278,189	57,276,938
TOTAL	4,266	43,127,921	436,940,000

Mcf = 1,000 ft^3
bbl = 42 U.S. gal

Source: SONRIS lite database (Louisiana Dept. of Natural Resources, 2010).

Table 3-12

Designated Ocean Dredged-Material Disposal Sites in the Cumulative Impact Area

ODMDS Name	Location Coordinates		Water Depth	Size	Authorized Material, Last Time Used and Amount Disposed
	Latitude	Longitude			
Pensacola Nearshore	30°17'24"N 30°17'00"N 30°15'36"N 30°15'15"N	87°18'30"W 87°19'50"W 87°17'48"W 87°19'18"W	~36 ft, ~11m	2.48 mi^2, 642 ha, 1,587 ac	Medium-grained sand, <10% fines. 1987; 157,100 yd^3
Pensacola Offshore	30°08'50"N 30°08'50"N 30°07'05"N 30°07'05"N	87°19'30"W 87°16'30"W 87°16'30"W 87°19'30"W	65-80 ft 20-24m	6 mi^2, 1,554 ha, 3,840 ac	Primarily fine-grained. 2005; 63,000 yd^3
Mobile	30°10'00"N 30°10'24"N 30°09'24"N 30°08'30"N 30°08'30"N	88°07'42"W 88°05'12"W 88°04'42"W 88°05'12"W 88°08'12"W	~46 ft, ~14m	4.8 mi^2, 1,243 ha, 3,072 ac	Dredged material meeting USEPA Ocean Dumping Criteria. 2008; 2,235,993 yd^3
Pascagoula	30°12'06"N 30°11'42"N 30°08'30"N 30°08'18"N	88°44'30"W 88°33'24"W 88°37'00"W 88°41'54"W	38-52 ft, 11.5-19m	18.5 mi^2, 4,791 ha, 11,840ac	Suitable material from the Mississippi Sound and vicinity. 2008; 1,489,100 yd^3
Gulfport West	30°12'00"N 30°12'00"N 30°11'00"N 30°07'00"N 30°06'36"N 30°10'30"N	89°00'30"W 88°59'30"W 89°00'00"W 88°56'30"W 88°57'00"W 89°00'36"W	~27 ft, ~8.2m	5.2 mi^2, 1,346 ha, 3,328 ac	Dredged material meeting USEPA Ocean Dumping Criteria. 2005; 390,000 yd^3
Gulfport East	30°11'10"N 30°11'12"N 30°07'36"N 30°07'24"N	88°58'24"W 88°57'30"W 88°54'24"W 88°54'48"W	~30 ft, ~9.1m	2.47 mi^2, 640 ha, 1,581 ac	Meet USEPA Ocean Dumping Criteria. 1996; 323,300 yd^3
Mississippi River - Gulf Outlet	29°22'00"N 29°23'00"N 29°24'30"N	88°56'30"W 88°54'30"W 88°52'30"W	20-40 ft, 6-12m	6.03 mi^2, 1,562 ha, 3,859 ac	Dredged material from the vicinity of Mississippi River Gulf Outlet. 2005; 909,100 yd^3
Mississippi River - Southwest Pass	28°53'58"N 28°53'45"N 28°53'13"N 28°53'11"N	89°25'31"W 89°25'09"W 89°25'28"W 89°24'49"W	8-106 ft, 2.7-32.2m	3.44 mi^2, 891 ha, 2,202 ac	Dredged material from the vicinity of the Southwest Pass Channel. 2008; 6,890,400 yd^3
Barataria Bay Waterway	29°13'30"N 29°13'54"N 29°14'21"N	89°53'30"W 89°53'48"W 89°54'06"W	8-20 ft, 2.4-6.1m	1,4 mi^2, 362 ha, 896 ac	Dredged material from the vicinity of Barataria Bay Waterway. 1988; 775,000 yd^3
Houma Navigation Canal (Cat Island Pass)	28°58'09"N 28°58'57"N 28°57'57"N	90°29'30"W 90°31'30"W 90°31'54"W	6-30 ft, 1.8-9.1m	2.08 mi^2, 539 ha, 1,331 ac	Dredged material from the vicinity of Cat Island Pass, Louisiana. 1997; 117,400 yd^3

Table 3-12. Designated Ocean Dredged-Material Disposal Sites in the Cumulative Impact Area (continued).

ODMDS Name	Location Coordinates		Water Depth	Size	Authorized Material, Last Time Used and Amount Disposed
	Latitude	Longitude			
Atchafalaya Bar Channel	29°07'00"N 29°08'00"N 29°09'00"N	91°31'30"W 91°29'00"W 91°27'00"W	~16 ft, ~4.8m	9.14 mi^2, 2,367 ha, 5,850 ac	Dredged material from the bar channel of the Atchafalaya River. 2008; 9,545,800 yd^3
Calcasieu River & Pass	29°30'00"N 29°30'51"N 29°30'00"N	93°10'18"W 93°10'00"W 93°09'27"W	36-46 ft, 11 to 14 m	5.8 mi^2, 1,502 ha, 3,712 ac	Dredged material from the vicinity of the Calcasieu River and Pass Project. 2008; 364,700 yd^3
Sabine-Neches Waterway No. 1 & 2	29°27'30"N 29°27'30"N 29°26'38"N 29°26'38"N	93°37'00"W 93°36'45"W 93°36'45"W 93°37'00"W	25.7-42.6 ft, 9-13m	6.6 mi^2, 1709 ha, 4,224 ac	Dredged material from the Sabine-Neches area. 2006; 1,524,200 yd^3
Sabine-Neches Waterway No. 3 & 4	29°35'52"N 29°35'52"N 29°35'00"N 29°35'00"N	93°41'45"W 93°41'30"W 93°41'30"W 93°41'45"W	16.4-33 ft, 5-10m	8.9 mi^2, 2,305 ha, 5,696 ac	Dredged material from the Sabine-Neches area. 2008; 1,691,900 yd^3
Galveston Harbor & Channel	29°20'22"N 29°19'32"N 29°19'23"N 29°20'13"N	94°37'11"W 94°36'56"W 94°37'06"W 94°37'21"W	33-51 ft, 10-15.5m	6.6 mi^2, 1,709 ha, 4,224 ac	Dredged material from the Galveston, Texas, area. 2008; 2,395,800 yd^3
Freeport Harbor, New Work	28°54'28"N 28°54'35"N 28°55'07"N 28°54'60"N	95°13'40"W 95°13'28"W 95°14'01"W 95°14'13"W	54-61 ft, 16.4-18.6m	2.64 mi^2, 684 ha, 1,690 ac	Dredged material from the Freeport Harbor Entrance and Jetty Channels, Texas. 1992; 46,800 yd^3
Matagorda Ship Channel	28°24'27"N 28°24'33"N 28°25'10"N 28°25'04"N	96°16'04"W 96°15'52"W 96°16'30"W 96°16'42"W	25-40 ft, 7.5-12.2m	0.56 mi^2, 145 ha, 358 ac	Dredged material from the Matagorda Ship Channel, Texas. 2006; 336,700 yd^3
Corpus Christi Ship Channel	27°50'10"N 27°50'20"N 27°50'48"N 27°50'38"N	96°59'17"W 96°59'09"W 96°59'57"W 97°00'05"W	35-50 ft, 10.6-15.2m	0.63 mi^2, 163 ha, 403 ac	Dredged material from the Corpus Christi Ship Channel, Texas. 2007; 954,600 yd^3
Port Mansfield	26°32'11"N 26°31'58"N 26°31'58"N 26°32'11"N	97°13'44"W 97°13'44"W 97°14'42"W 97°14'42"W	35-50 ft, 10.6-15.2m	0.42 mi^2, 109 ha, 269 ac	Dredged material from the Port Mansfield Entrance Channel, Texas. 1986; 104,200 yd^3
Brazos Island Harbor	26°02'18"N 26°02'18"N 26°02'05"N 26°02'05"N	96°06'30"W 97°07'26"W 97°07'26"W 96°06'30"W	55-65 ft, 16.7-19.8m	0.42 mi^2, 109 ha, 269 ac	Dredged material from the Brazos Island Harbor Entrance Channel, Texas. 1997; 350,900

~ approximately.

Sources: National Archives and Records Administration, 2010; U.S. Dept. of the Army, COE, 2011.

Table 3-13

Projected OCS Sand Borrowing Needs for Planned Restoration Projects

Restoration Project	Maximum Sand (yd^3)	Source (OCS Area and Block) (if known)
Pelican Island (CWPPRA BA-35)	~5,500,000	West Delta (Sandy Point site)
Raccoon Island (CWPPRA TE-48)	750,000 to 830,000	Ship Shoal 64 & 71
Cameron Parish Shoreline	~10,000,000	Sabine Bank
Point Au Fer Shoreline	N/A	N/A
LCA Terrebonne Basin		
Raccoon Island	~8,340,000	Ship Shoal 88 & 89; South Pelto 12 & 13
Whiskey Island	~7,720,000	Ship Shoal 88 & 89; South Pelto 12 & 13
Trinity and East Islands	~16,260,000	Ship Shoal 88 & 89; South Pelto 12 & 13
Timbalier Island	~10,700,000	Ship Shoal 88 & 89; South Pelto 12 & 13
East Timbalier Island	~11,230,000	N/A
LCA Barataria Basin		
Caminada Headland	~6,000,000	South Pelto 12 &13
TOTAL	~76,500,000	

N/A = not available
~ approximately

Table 3-14

Vessel Calls at U.S. Gulf Coast Ports in 2004 and 2009

Vessel Type	2004 Percent of Total Calls in U.S.	2009 Percent of Total Calls in U.S.
Tanker	52.4	55.8
Container	7.0	9.0
Dry Bulk	42.6	46.8
RO-RO (Roll-on Roll-off)	7.0	9.9
Gas	59.8	62.6
Combo	56.2	75.6
General	28.8	39.0
All Types	31.2	34.1

Source: USDOT, MARAD, 2009.

Table 3-15

Designated Louisiana Service Bases Identified in Applications for Pipelines, Exploration, and Development Plans between 2003 and 2008 and Miles of Navigation Canal Bordered by Saline, Brackish Water, and Freshwater Wetlands

Shore Base	Number of Pipeline Applications with Designated Service Base		Number of Exploration and Development Plans with Designated Service Base		Miles Bordering Salt and Brackish Wetlands	Miles Bordering Fresh Wetlands
	2003-2008	Percent	2003-2008	Percent		
Fourchon	303	31.5	618	44.4	0**	0**
Cameron	247	25.7	383	27.5	0	0
Intracoastal City	102	10.6	94	6.7	6.4	0
Venice	96	10.0	139	9.9	Miss. River	0
Morgan City	68	7.1	52	3.7	Miss. River	0
Leeville	37	3.9	18	1.3	0	0
Grand Isle	29	3.0	2	0.1	0	0
Dulac	20	2.1	8	0.6	1.7	0
Berwick	14	1.5	19	1.4	Miss. River	0
Lake Charles	12	1.2	1	0.1	3.4	0
Freshwater City	10	1.0	18	1.3	0	0
Houma	8	0.8	18	1.3	5.3	6.6
Amelia	2	0.2	7	0.5	0	0
Galliano	1	0.1	7	0.5	0	0
Boothville	3	0.3	6	0.4	Miss. River	0
Abbeville	7	0.7	0	0.0	0	0
Grand Chenier	2	0.2	1	0.1	0	0
Grand Total	961	99.9	1,391	99.8	16.8	6.6

*= compiled by BOEM staff using operator-designated service bases from OCS plans and pipeline applications.
**= "0" indicates the service base has no surrounding wetlands in the category.

Table 3-16

Coastal Impact Assistance Program Allocations for all Eligible States ($)

Recipient	FY 2007	FY 2008	FY 2009	FY 2010	Total
Alabama	25,551,607.04	25,551,607.04	19,728,257.36	19,524,845.48	90,356,316.92
State Share	16,608,544.58	16,608,544.58	12,823,367.28	12,691,149.56	58,731,606.00
County Share	8,943,062.46	8,943,062.46	6,904,890.08	6,833,695.92	31,624,710.92
Alaska	2,425,000.00	2,425,000.00	37,471,876.48	37,085,568.47	79,407,444.95
State Share	1,576,250.00	1,576,250.00	24,356,719.71	24,105,619.51	51,614,839.22
Borough Share	848,750.00	848,750.00	13,115,156.77	12,979,948.97	27,792,605.74
California	7,444,441.75	7,444,441.75	4,923,124.98	4,872,363.83	24,684,372.31
State Share	4,838,887.13	4,838,887.13	3,200,031.24	3,167,036.49	16,044,841.99
County Share	2,605,554.61	2,605,554.61	1,723,093.74	1,705,327.34	8,639,530.30
Louisiana	127,547,898.57	127,547,898.57	120,911,588.83	119,663,560.77	495,670,946.74
State Share	82,906,134.07	82,906,134.07	78,592,532.74	77,781,314.50	322,186,115.38
Parish Share	44,641,764.50	44,641,764.50	42,319,056.09	41,882,246.27	173,484,831.36
Mississippi	30,939,850.55	30,939,850.55	23,819,815.26	23,574,217.72	109,273,734.08
State Share	20,110,902.86	20,110,902.86	15,482,879.92	15,323,241.52	71,027,927.16
County Share	10,828,947.69	10,828,947.69	8,336,935.34	8,250,976.20	38,245,806.92
Texas	48,591,202.09	48,591,202.09	35,645,337.09	35,279,443.73	168,107,185.00
State Share	31,584,281.36	31,584,281.36	23,169,469.11	22,931,638.42	109,269,670.25
County Share	17,006,920.73	17,006,920.73	12,475,867.98	12,347,805.30	58,837,514.74

Table 3-17

Coastal Impact Assistance Program Grants Status for Gulf of Mexico States ($)

Recipient	Total Allocation	Amount Applied For	Amount Awarded	Amount Under Review	Allocation Balance
Alabama	90,356,316.92	26,371,168.00	17,665,845.59	8,705,322.41	63,985,148.92
State	58,731,606.00	13,408,368.07	10,576,735.04	2,831,633.03	45,323,237.93
County	31,624,710.92	12,962,799.93	7,089,110.55	5,873,689.38	18,661,910.99
Louisiana	495,670,946.74	167,570,557.69	151,147,595.40	16,422,962.29	328,100,389.05
State	322,186,115.38	114,414,404.38	109,013,629.00	5,400,775.38	207,771,711.00
Parish	173,484,831.36	53,156,153.31	42,133,966.40	11,022,186.91	120,328,678.05
Mississippi	109,273,734.08	41,527,869.50	32,065,439.00	9,462,430.50	67,745,864.58
State	71,027,927.16	33,239,105.50	30,083,154.00	3,155,951.50	37,788,821.66
County	38,245,806.92	8,288,764.00	1,982,285.00	6,306,479.00	29,957,042.92
Texas	168,107,185.00	25,091,736.63	22,005,691.30	3,086,045.33	143,015,448.36
State	109,269,670.25	19,627,047.36	18,627,047.36	1,000,000.00	89,642,622.89
County	58,837,514.74	5,464,689.27	3,378,643.94	2,086,045.33	53,372,825.47
Total GOM	863,408,182.74	260,561,331.82	222,884,571.29	37,676,760.53	602,846,850.91

Table 3-18

Hurricane Landfalls in the Northern Gulf of Mexico
from 1995 through 2010

Event	Year	Impacted State	Storm Name	Intensity at Landfall
1	1995	AL, FL	Opal	Hurricane Category 3
2	1995	FL	Erin	Hurricane Category 2
3	1997	LA, AL	Danny	Hurricane Category 1
4	1998	FL	Earl	Hurricane Category 1
5	1998	MS, AL	Georges	Hurricane Category 2
6	1999	TX	Bret	Hurricane Category 3
7	2002	LA	Lili	Hurricane Category 1
8	2003	TX	Claudette	Hurricane Category 1
9	2004	MS, AL	Ivan	Hurricane Category 4
10	2005	LA, MS	Cindy	Hurricane Category 1
11	2005	FL, AL	Dennis	Hurricane Category 3
12	2005	LA, MS	Katrina	Hurricane Category 5
13	2005	TX, LA	Rita	Hurricane Category 3
14	2007	TX, LA	Humberto	Hurricane Category 1
15	2008	LA	Gustav	Hurricane Category 2
16	2008	TX, LA	Ike	Hurricane Category 4
17	2008	TX	Dolly	Hurricane Category 1

* No hurricane landfalls in the northern Gulf of Mexico in 2009 or 2010.

Source: USDOC, NOAA, 2010b.

Table 3-19

OCS Facility Damage after the 2004-2008 Hurricanes in the WPA and CPA

Storm	Platforms Exposed to High Winds (≥73 mph)	Platforms		Damaged Pipelines (≥10 in)
		Destroyed	Damaged	
Ivan (2004)	150	7	14	13
Katrina (2005)	3,050*	43	NR	40
Rita (2005)		69	NR	101
Gustav (2008)	677	1	40	NR
Ike (2008)	2,127	60	124	NR

NR = not reported.
*Combined totals for both Hurricanes Katrina and Rita.
Statistics compiled from BOEM's website and press releases.

Table 4-1

National Ambient Air Quality Standards

Pollutant	Primary Standards		Secondary Standards	
	Level	Averaging Time	Level	Averaging Time
Carbon Monoxide	9 ppm (10 mg/m^3) 35 ppm (40 mg/m^3)	8-hour (1) 1-hour (1)	None	
Lead	0.15 µg/m^3 (2) 1.5 µg/m^3	Rolling 3-Month Average Quarterly Average	Same as Primary Same as Primary	
Nitrogen Dioxide	53 ppb (3) 100 ppb	Annual (Arithmetic Average) 1-hour (4)	Same as Primary None	
Particulate Matter (PM_{10})	150 µg/m^3	24-hour (5)	Same as Primary	
Particulate Matter ($PM_{2.5}$)	15.0 µg/m^3 35 µg/m^3	Annual (6) (Arithmetic Average) 24-hour (7)	Same as Primary Same as Primary	
Ozone	0.075 ppm (2008 std) 0.08 ppm (1997 std) 0.12 ppm	8-hour (8) 8-hour (9) 1-hour (10)	Same as Primary Same as Primary Same as Primary	
Sulfur Dioxide	0.03 ppm 0.14 ppm 75 ppb (11)	Annual (Arithmetic Average) 24-hour (1) 1-hour	0.5 ppm None	3-hour (1)

(1) Not to be exceeded more than once per year.
(2) Final rule signed October 15, 2008.
(3) The official level of the annual NO_2 standard is 0.053 ppm, equal to 53 ppb, which is shown here for the purpose of clearer comparison to the 1-hour standard.
(4) To attain this standard, the 3-year average of the 98th percentile of the daily maximum 1-hour average at each monitor within an area must not exceed 100 ppb (effective January 22, 2010).
(5) Not to be exceeded more than once per year on average over 3 years.
(6) To attain this standard, the 3-year average of the weighted annual mean $PM_{2.5}$ concentrations from single or multiple community-oriented monitors must not exceed 15.0 µg/m^3.
(7) To attain this standard, the 3-year average of the 98th percentile of 24-hour concentrations at each population-oriented monitor within an area must not exceed 35 µg/m^3 (effective December 17, 2006).
(8) To attain this standard, the 3-year average of the fourth-highest daily maximum 8-hour average ozone concentrations measured at each monitor within an area over each year must not exceed 0.075 ppm (effective May 27, 2008).
(9) (a) To attain this standard, the 3-year average of the fourth-highest daily maximum 8-hour average ozone concentrations measured at each monitor within an area over each year must not exceed 0.08 ppm.
(b) The 1997 standard—and the implementation rules for that standard—will remain in place for implementation purposes as USEPA undertakes rulemaking to address the transition from the 1997 ozone standard to the 2008 ozone standard.
(c) The USEPA is in the process of reconsidering these standards (set in March 2008).
(10) (a) The USEPA revoked the 1-hour ozone standard in all areas, although some areas have continuing obligations under that standard (“anti-backsliding”).
(b) The standard is attained when the expected number of days per calendar year with maximum hourly average concentrations above 0.12 ppm is ≤1.
(11) (a) Final rule signed June 2, 2010. To attain this standard, the 3-year average of the 99th percentile of the daily maximum 1-hour average at each monitor within an area must not exceed 75 ppb.

Table 4-2

Estimated Abundance of Cetaceans
in the Northern Gulf of Mexico

Species	Common Name	Estimated Number of Individuals
Balaenoptera edeni	Bryde’s whale	15
Physeter macrocephalus	Sperm whale*	1,665
Kogia spp.	Dwarf and Pygmy sperm whale	453
Ziphius cavirostris	Cuvier’s beaked whale	65
Mesoplodon sp.	Blainville’s and Gervais’ beaked whale	57
Feresa attenuata	Pygmy killer whale	323
Pseudorca crassidens	False killer whale	777
Orcinus orca	Killer whale	49
Globicephala sp.	Pilot whale, short-finned	716
Peponocephala electra	Melon-headed whale	2,283
Grampus griseus	Risso’s dolphin	1,589
Tursiops truncatus	Bottlenose dolphin	13,883
Steno bredanensis	Rough-toothed dolphin	unknown
Lagenodelphis hosei	Fraser’s dolphin	unknown
Stenella frontalis	Atlantic spotted dolphin	unknown
Stenella longirostris	Spinner dolphin	1,989
Stenella attenuate	Pantropical spotted dolphin	34,067
Stenella clymene	Clymene dolphin	6,575
Stenella coeruleoalba	Striped dolphin	3,325

*Endangered.
Source: Waring et al., 2009.

Table 4-3

Sea Turtle Taxa of the Northern Gulf of Mexico

Order Testudines (turtles)	Relative Occurrence	ESA Status
Family Cheloniidae (hardshell sea turtles)		
Loggerhead sea turtle (*Caretta caretta*)	C	T
Green sea turtle (*Chelonia mydas*)	C	T/E
Hawksbill sea turtle (*Eretmochelys imbricata*)	R	E
Kemp's ridley sea turtle (*Lepidochelys kempii*)	C	E
Family Dermochelyidae (leatherback sea turtle)		
Leatherback sea turtle (*Dermochelys coriacea*)	U	E

Population status in the northern Gulf is summarized according to the following categories:

COMMON (C): A common species is one that is abundant wherever it occurs in the region (i.e., the northern Gulf). Most common species are widely distributed over the area.

UNCOMMON (U): An uncommon species may or may not be widely distributed but does not occur in large numbers. Uncommon species are not necessarily rare or endangered.

RARE (R): A rare species is one that is present in such small numbers throughout the region that it is seldom seen. Although not threatened with extinction, a rare species may become endangered if conditions in its environment change.

Endangered Species Act (ESA) status is summarized according to listing status under the following categories:

ENDANGERED (E): Species determined to be in imminent danger of extinction throughout all of a significant portion of their range.

THREATENED (T): Species determined likely to become endangered in the foreseeable future.

Table 4-4

Comparison of Oil Spills by Type, Location, Year, and Volume (in U.S. gallons) and Their Relative Impacts to Birds based on Surveys and Modeling[a]

Incident	Type	Location	Year	Volume[b,c]	Bird Surveys[d]	Estimated Mortality[e]	Reference[f]
Ixtoc	Blowout	Mexico	1979	145.6 million	>3,000	No research or models[*]	[1]
Exxon Valdez	Tanker	Alaska, USA	1989	10.8 million	>30,000	100,000-645,000	[2, 3, 4, 5]
Sea Empress	Tanker	Wales, UK	1996	22.1 million	>4,500	No research or models	[6, 7]
M/V *Citrus*	Tanker	Alaska, USA	1996	Unknown	>1,000	1,930	[8]
Erika	Tanker	France	1999	6.1 million	>74,000	80,000-150,000	[9, 10]
Prestige	Tanker	Spain	2002	19.2 million	>9,000	115,000-300,000	[11, 12, 13, 14, 15, 16]
Terra Nova	Rig	Newfoundland, CAN	2004	42,000	No survey	3,593-16,122	[17]
M/V *Selendang Ayu*	Tanker	Alaska, USA	2004	354,218	1,603	Pending[**]	[2, 18]
Black Sea	Tanker	Kerch Strait, RUS	2007	1.47 million	>30,000	No research or models	[19]
Deepwater Horizon	Blowout	Louisiana, USA	2010	210 million	8,000	Pending[**]	[20, 21]

[a] Since the *Exxon Valdez* oil spill in March 1989, but including the *Ixtoc I* blowout in the Bay of Campeche, Mexico (1979; Jernelöv, 2010). Refer to Tables 1-5 in Helm et al. (2008) for additional information. Includes oil spills associated with tankers, barges, wells, rigs-platforms, and blowouts in which bird mortality data are available. This list of spills is not exhaustive but reflects a representative cross-section of oil-spill events across the world over the last ≥20 years. For a more comprehensive review of oil spills, locations, spill volumes, and bird mortality, refer to Burger (1993, Table 1), Castege et al. (2007, Table 2), Helm et al. (2008, Tables 1-6), and Tan et al. (2010, Table 1).

[b] Volume estimates are in gallons.

[c] Volume estimates were in some cases converted from figures cited in a specific reference using the conversion of metric tons to gallons of 7.3 bbl/ton and 42 gal/bbl (Wilhelm et al., 2007, p. 540). In other cases, the figures were pulled from the Tables in Helm et al. (2008). NOTE: Spill volume tends to be a poor predictor of bird mortality associated with an oil spill (Burger, 1993), although it should be considered for inclusion in any models to estimate total bird mortality, preferably with some metric of species composition and abundance (preferably density) pre-spill (Wilhelm et al., 2007).

[d] Figures cited in specific references usually as a part of the damage assessment process including beached-bird surveys, boat or ship-based surveys, or aerial surveys to collect dead or oiled birds. It has been well documented that, in most cases, survey efforts to collect bird carcasses represents a small fraction of the total mortality for a given oil-spill event. That is, the recovery rate of oiled carcasses is biased low; Burger (1993) and Wiese and Jones (2001), using different methodologies, arrived at recovery rate estimates of only 20%. Piatt and Ford (1996) derived a recovery mean rate estimate of only 17% (range 0.0%-59.0%) based on 17 different studies spanning 21 years (1970-1991).

[e] Final estimated mortality typically includes results from drift and carcass experiments plus modeling efforts to account for birds oiled, but ‘unavailable’ to be detected; that is, a correction for detection and scavenging bias, deposition and persistence rates, and the effects of wind, currents, weather, topography, and habitat. Refer to Flint and Fowler (1998), Flint et al. (1999), Castège et al. (2007), Wilhelm et al. (2007), Byrd et al. (2009), and other references herein for additional information regarding biases associated with mortality estimates from carcass surveys only.

[f] Most of the references used herein are from the peer-reviewed scientific literature.

Table 4-4. Comparison of Oil Spills by Type, Location, Year, and Volume (in U.S. gallons) and Their Relative Impacts to Birds based on Surveys and Modeling[a] (continued).

[*] Literature searches on the Internet revealed only two avian-related references as a result of the *Ixtoc I* oil spill: Chapman, 1981 and 1984.
[**] Pending results of the NRDA process and litigation regarding damage claims against litigants; see also Helm et al., 2006 and 2008.
[1] Jernelöv, 2010.
[2] Helm et al., 2006.
[3] Helm et al., 2008.
[4] Ford et al., 1996.
[5] Piatt and Ford, 1996.
[6] Banks et al., 2008.
[7] Law and Kelley, 2004.
[8] Flint et al., 1999.
[9] Cadiou et al., 2004.
[10] Castège et al., 2004.
[11] Castège et al., 2007.
[12] Alonso-Alvarez et al., 2007.
[13] Munilla and Velando, 2010.
[14] Velando et al., 2005a.
[15] Velando et al., 2005b.
[16] Camphuysen et al., 2002.
[17] Wilhelm et al., 2007.
[18] Byrd et al., 2009.
[19] Tan et al., 2010.
[20] USDOI, FWS, 2010.
[21] Oil Spill Commission, 2010.

Table 4-5

Relative Oiling Ranks for Various Avian Species Groupings Collected Post-*Deepwater Horizon* Event in the Gulf of Mexico[a]

Species Group	# Representative Spp.[1]	# Collected	# Oiled	Oiling Rate (% ± SE)[2]	Oiling Rank[3]
Diving[*]	5	182	102	0.50 ± 0.19	1
Seabirds[*]	25	5946	2512	0.37 ± 0.05	2
Shorebirds[*]	13	97	24	0.13 ± 0.06	6
Passerines[*]	21	77	17	0.20 ± 0.07	5
Marsh/Wading[*]	21	424	117	0.24 ± 0.05	4
Waterfowl[*]	11	56	16	0.37 ± 0.13	3
Raptors[*]	6	16	3	0.05 ± 0.05	7

a Data obtained from the U.S. Fish and Wildlife Service (FWS) as summarized a table dated November 30, 2010. The data used in this table are verified as per the FWS QA/QC processes. Disclaimer: All data should be considered provisional, incomplete, and subject to change. For more information, see USDOI, FWS, 2010.

* Species Group: As defined in the text of this Supplemental EIS. As of November 30, 2010, 8,000 individuals of 102 species had been collected and identified by FWS. Six new species were added since the November 16th summary. NOTE: The Top 5 most-impacted species are all representative of the "seabirds" group, with an oiling rate (0.44) above the combined average of all species, including "unknowns" and "other" (0.27).

1 Represents the actual number of birds identified to the species level for each of the Species Groups; reflects sample size for determining mean Oiling Rate. This number should be fairly representative of the suite of species available to be oiled. However, this number is dependent on efforts to correctly assign species to unidentified birds or unknowns, which is also a function of the search effort. The search effort has likely declined dramatically since the *Deepwater Horizon* was plugged/capped.

2 Oiling Rate: For each species, an oiling rate was calculated by dividing the "total" number of oiled individuals (∑ alive + dead) /∑ of individuals collected for a given species/row. These rates were then used to calculate summary statistics. In general, it has been well documented that the number of birds collected after a spill event represents a small fraction of the total oiled population (direct mortality) due to various factors: species-specific differences in vulnerability to spilled oil; species-specific differences in distribution, habitat use, and behavior; species-specific differences in abundance; species-specific differences in carcass deposition rates, persistence rates, and detection probabilities; overall search effort and temporal and spatial variation in search effort; and carcass loss due to predation, habitat, weather, tides, and currents (Piatt et al., 1990a and 1990b; Ford et al., 1996; Piatt and Ford, 1996; Fowler and Flint, 1997; Flint and Fowler, 1998; Flint et al., 1999; Castege et al., 2007; Byrd et al., 2009; Flint et al., 2010). For example, Piatt and Ford (1996, Table 1) estimated a mean carcass recovery rate of only 17% for a number of previous oil-bird impact studies. Burger (1993) and Wiese and Jones (2001) estimated recovery rates of 20%, with the latter study based on a drift-block design to estimate carcass recovery rate from beached-bird surveys. Note: Spill volume tends to be a poor predictor of bird mortality associated with an oil spill (Burger, 1993), although it should be considered for inclusion in any models to estimate total bird mortality, preferably with some metric of species composition and abundance (preferably density) pre-spill (Wilhelm et al., 2007). For this table, the value obtained for passerines and raptors is almost certainly biased high due to the small sample sizes (several cases where only 1-2 birds/species) for individual species and due to the influence of high estimates for oiling (100%). For the other Species Groups, e.g., shorebirds, the value obtained is likely biased low due the larger number of species with several instances where only one bird was collected and it did not meet the criteria to be designated as oiled. There was a significant difference ($F = 20.80$, $df = 1, 12$; $P = 0.0006$) in oiling rates among species.

3 Oiling Rank: Reflects the relative rank of a given Species Group as a function of the mean Oiling Rate. As expected, diving birds and seabirds had the highest oiling rate of any of the Species Groups (King and Sanger, 1979; Wiens et al., 1984; Piatt et al., 1990a; Williams et al., 1995) due to their reliance on offshore habitat for foraging and as a substrate for resting, preening, and other maintenance behaviors.

Table 4-6

Birds Collected and Summarized by the U.S. Fish and Wildlife Service Post-*Deepwater Horizon* Event in the Gulf of Mexico[a, b]

Common Name	Species Group*	Grand Total	Visibly Oiled		Total	Not Visibly Oiled		Total	Unknown Oiling		Total	Oiling Rate[1,2]
			Dead	Alive		Dead	Alive		Dead	Alive		
American Coot	Marsh/Wading	5	2	2	4	0	0	0	1	0	1	0.80
American Oystercatcher	Shorebird	17	7	3	10	3	3	6	1	0	1	0.59
American Redstart	Passerine	1	0	0	0	1	0	1	0	0	0	0.00
American White Pelican	Seabird	17	2	0	2	2	6	8	7	0	7	0.12
Audubon's Shearwater	Seabird	6	1	1	2	2	2	4	0	0	0	0.33
Barn Owl	Raptor	1	0	0	0	1	0	1	0	0	0	0.00
Barn Swallow	Passerine	1	1	0	1	0	0	0	0	0	0	1.00
Belted Kingfisher	Passerine	2	0	0	0	1	1	2	0	0	0	0.00
Black-crowned Night Heron	Marsh/Wading	22	6	3	9	7	5	12	1	0	1	0.41
Black Oystercatcher	Shorebird	1	0	0	0	1	0	1	0	0	0	0.00
Black Skimmer	**Seabird**	**263**	**51**	**16**	**67**	**141**	**14**	**155**	**41**	**0**	**41**	**0.25**
Black Tern	Seabird	12	1	0	1	7	3	10	1	0	1	0.08
Black-bellied Whistling Duck	Waterfowl	2	0	0	0	0	2	2	0	0	0	0.00
Black-necked Stilt	Shorebird	3	0	0	0	3	0	3	0	0	0	0.00
Blue-winged Teal	Waterfowl	3	0	0	0	3	0	3	0	0	0	0.00
Boat-tailed Grackle	Passerine	2	0	0	0	1	1	2	0	0	0	0.00
Brown Pelican	**Seabird**	**911**	**136**	**210**	**346**	**225**	**146**	**371**	**194**	**0**	**194**	**0.38**
Brown-headed Cowbird	Passerine	1	0	0	0	0	1	1	0	0	0	0.00
Bufflehead	Waterfowl	1	0	1	1	0	0	0	0	0	0	1.00
Canada Goose	Waterfowl	4	0	1	1	1	2	3	0	0	0	0.25
Caspian Tern	Seabird	20	7	2	9	5	4	9	2	0	2	0.45
Cattle Egret	Marsh/Wading	32	1	1	2	21	4	25	5	0	5	0.06
Clapper Rail	Marsh/Wading	128	27	5	32	63	12	75	21	0	21	0.25
Common Loon	Diving	106	33	27	60	22	20	42	4	0	4	0.57
Common Moorhen	Marsh/Wading	4	1	0	1	3	0	3	0	0	0	0.25
Common Nighthawk	Passerine	1	0	0	0	0	1	1	0	0	0	0.00
Common Tern	Seabird	32	13	9	22	8	1	9	1	0	1	0.69
Common Yellowthroat	Passerine	2	0	0	0	2	0	2	0	0	0	0.00
Cooper's Hawk	Raptor	1	0	0	0	0	1	1	0	0	0	0.00
Cory's Shearwater	Seabird	1	0	0	0	0	1	1	0	0	0	0.00
Double-crested Cormorant	Diving	25	2	1	3	13	7	20	2	0	2	0.12
Eastern Kingbird	Passerine	2	1	0	1	1	0	1	0	0	0	0.50
Eastern Meadowlark	Passerine	1	0	0	0	1	0	1	0	0	0	0.00

Table 4-6. Birds Collected and Summarized by the U.S. Fish and Wildlife Service Post-*Deepwater Horizon* Event in the Gulf of Mexico[a, b] (continued).

Common Name	Species Group[*]	Grand Total	Visibly Oiled		Total	Not Visibly Oiled		Total	Unknown Oiling		Total	Oiling Rate[1,2]
			Dead	Alive		Dead	Alive		Dead	Alive		
Eurasian Collared-Dove	Passerine	1	0	0	0	1	0	1	0	0	0	0.00
European Starling	Passerine	2	0	1	1	1	0	1	0	0	0	0.50
Forster's Tern	Seabird	52	16	8	24	13	9	22	6	0	6	0.46
Fulvous Whistling Duck	Waterfowl	1	0	0	0	0	1	1	0	0	0	0.00
Glossy Ibis	Marsh/Wading	2	0	0	0	1	0	1	1	0	1	0.00
Great Blue Heron	Marsh/Wading	50	5	2	7	23	16	39	4	0	4	0.14
Great Egret	Marsh/Wading	33	6	6	12	10	3	13	8	0	8	0.36
Great-horned Owl	Raptor	1	0	0	0	1	0	1	0	0	0	0.00
Greater Shearwater	Seabird	28	7	4	11	12	4	16	1	0	1	0.39
Green Heron	Marsh/Wading	18	2	0	2	9	6	15	1	0	1	0.11
Gull-billed Tern	Seabird	8	0	0	0	2	4	6	2	0	2	0.00
Herring Gull	Seabird	42	8	8	16	9	13	22	4	0	4	0.38
Horned Grebe	Diving	1	0	1	1	0	0	0	0	0	0	1.00
House Sparrow	Passerine	2	0	0	0	1	1	2	0	0	0	0.00
Killdeer	Shorebird	3	0	0	0	3	0	3	0	0	0	0.00
King Rail	Marsh/Wading	1	0	0	0	0	1	1	0	0	0	0.00
Laughing Gull	**Seabird**	**3339**	**968**	**341**	**1309**	**1341**	**365**	**1706**	**323**	**1**	**324**	**0.39**
Least Bittern	Marsh/Wading	6	0	0	0	4	2	6	0	0	0	0.00
Least Tern	Seabird	110	45	6	51	40	6	46	13	0	13	0.46
Lesser Black-backed Gull	Seabird	5	1	1	2	0	1	1	2	0	2	0.40
Lesser Scaup	Waterfowl	1	0	0	0	0	0	0	1	0	1	0.00
Little Blue Heron	Marsh/Wading	6	0	0	0	4	1	5	1	0	1	0.00
Long-billed Dowitcher	Shorebird	1	0	0	0	0	1	1	0	0	0	0.00
Magnificant Frigatebird	Seabird	9	3	2	5	1	1	2	2	0	2	0.56
Mallard	Waterfowl	31	5	4	9	15	7	22	0	0	0	0.29
Manx Shearwater	Seabird	1	1	0	1	0	0	0	0	0	0	1.00
Masked Booby	Seabird	12	4	3	7	1	4	5	0	0	0	0.58
Mottled Duck	Waterfowl	6	0	0	0	5	0	5	1	0	1	0.00
Mourning Dove	Passerine	17	2	1	3	8	6	14	0	0	0	0.18
Neotropic Cormorant	Diving	3	0	0	0	1	0	1	2	0	2	0.00
Northern Cardinal	Passerine	3	0	0	0	3	0	3	0	0	0	0.00
Northern Gannet	**Seabird**	**632**	**221**	**187**	**408**	**89**	**103**	**192**	**31**	**1**	**32**	**0.65**
Northern Mockingbird	Passerine	4	0	0	0	3	1	4	0	0	0	0.00
Osprey	Raptor	11	2	1	3	5	3	8	0	0	0	0.27
Pied-billed Grebe	Diving	47	14	24	38	5	3	8	1	0	1	0.81
Piping Plover	Shorebird	1	0	0	0	1	0	1	0	0	0	0.00
Purple Gallinule	Marsh/Wading	1	0	0	0	1	0	1	0	0	0	0.00

Table 4-6. Birds Collected and Summarized by the U.S. Fish and Wildlife Service Post-*Deepwater Horizon* Event in the Gulf of Mexico[a, b] (continued).

Common Name	Species Group*	Grand Total	Visibly Oiled		Total	Not Visibly Oiled		Total	Unknown Oiling		Total	Oiling Rate[1,2]
			Dead	Alive		Dead	Alive		Dead	Alive		
Purple Martin	Passerine	5	1	0	1	3	1	4	0	0	0	0.20
Red-breasted Merganser	Waterfowl	4	1	1	2	1	1	2	0	0	0	0.50
Reddish Egret	Marsh/Wading	4	1	1	2	1	1	2	0	0	0	0.50
Red-shouldered Hawk	Raptor	1	0	0	0	0	1	1	0	0	0	0.00
Red-tailed Hawk	Raptor	1	0	0	0	1	0	1	0	0	0	0.00
Red-winged Blackbird	Passerine	1	0	0	0	1	0	1	0	0	0	0.00
Ring-billed Gull	Seabird	2	0	1	1	1	0	1	0	0	0	0.50
Rock Dove (pigeon)	Passerine	19	2	2	4	4	9	13	2	0	2	0.21
Roseate Spoonbill	Marsh/Wading	18	7	2	9	3	1	4	5	0	5	0.50
Royal Tern	**Seabird**	**348**	**116**	**66**	**182**	**95**	**49**	**144**	**22**	**0**	**22**	**0.52**
Ruddy Duck	Waterfowl	1	1	0	1	0	0	0	0	0	0	1.00
Ruddy Turnstone	Shorebird	18	1	3	4	8	5	13	1	0	1	0.22
Sanderling	Shorebird	32	4	2	6	17	6	23	3	0	3	0.19
Sandwich Tern	Seabird	90	26	19	45	23	13	36	9	0	9	0.50
Seaside Sparrow	Passerine	6	4	0	4	2	0	2	0	0	0	0.67
Semipalm. Sandpiper	Shorebird	2	1	0	1	0	0	0	1	0	1	0.50
Short-billed Dowitcher	Shorebird	1	0	0	0	1	0	1	0	0	0	0.00
Snowy Egret	Marsh/Wading	30	10	8	18	7	3	10	2	0	2	0.60
Sooty Shearwater	Seabird	1	0	0	0	0	1	1	0	0	0	0.00
Sooty Tern	Seabird	4	0	1	1	2	1	3	0	0	0	0.25
Sora	Marsh/Wading	6	2	1	3	1	0	1	2	0	2	0.50
Spotted Sandpiper	Shorebird	1	0	0	0	1	0	1	0	0	0	0.00
Surf Scoter	Waterfowl	2	1	1	2	0	0	0	0	0	0	1.00
Tri-colored Heron	Marsh/Wading	34	9	5	14	7	2	9	11	0	11	0.41
Virginia Rail	Marsh/Wading	4	0	0	0	3	1	4	0	0	0	0.00
White Ibis	Marsh/Wading	11	1	1	2	4	3	7	2	0	2	0.18
White-winged Dove	Passerine	2	0	0	0	1	1	2	0	0	0	0.00
Willet	Shorebird	15	2	1	3	7	3	10	2	0	2	0.20
Wilson's Plover	Shorebird	2	0	0	0	1	0	1	1	0	1	0.00
Wilson's Storm Petrel	Seabird	1	0	0	0	0	1	1	0	0	0	0.00
Yellow-billed Cuckoo	Passerine	2	2	0	2	0	0	0	0	0	0	1.00
Yellow-crowned Night Heron	Marsh/Wading	9	0	0	0	7	2	9	0	0	0	0.00
Unid. Blackbird	Passerine	1	0	0	0	0	1	1	0	0	0	0.00
Unid. Cormorant	Diving	14	3	0	3	10	0	10	1	0	1	0.21
Unid. Dowitcher	Shorebird	5	2	0	2	1	2	3	0	0	0	0.40
Unid. Duck	Waterfowl	4	0	0	0	2	1	3	1	0	1	0.00
Unid. Egret	Marsh/Wading	11	2	0	2	7	0	7	2	0	2	0.18

Table 4-6. Birds Collected and Summarized by the U.S. Fish and Wildlife Service Post-*Deepwater Horizon* Event in the Gulf of Mexico[a, b] (continued).

Common Name	Species Group[*]	Grand Total	Visibly Oiled		Total	Not Visibly Oiled		Total	Unknown Oiling		Total	Oiling Rate[1,2]
			Dead	Alive		Dead	Alive		Dead	Alive		
Unid. Flycatcher	Passerine	1	1	0	1	0	0	0	0	0	0	1.00
Unid. Grackle	Passerine	1	1	0	1	0	0	0	0	0	0	1.00
Unid. Grebe	Diving	6	4	0	4	2	0	2	0	0	0	0.67
Unid. Gull	Seabird	253	79	3	82	131	7	138	33	0	33	0.32
Unid. Hawk	Raptor	1	0	0	0	1	0	1	0	0	0	0.00
Unid. Heron	Marsh/Wading	14	5	0	5	6	1	7	2	0	2	0.36
Unid. Loon	Diving	9	2	2	4	4	1	5	0	0	0	0.44
Unid. Mockingbird	Passerine	2	0	0	0	1	1	2	0	0	0	0.00
Unid. Owl	Raptor	1	0	0	0	1	0	1	0	0	0	0.00
Unid. Passerine	Passerine	1	0	0	0	1	0	1	0	0	0	0.00
Unid. Pelican	Seabird	26	5	1	6	15	1	16	4	0	4	0.23
Unid. Pigeon	Passerine	17	2	1	3	6	7	13	1	0	1	0.18
Unid. Rail	Marsh/ Wading	4	1	0	1	3	0	3	0	0	0	0.25
Unid. Raptor	Raptor	1	0	0	0	1	0	1	0	0	0	0.00
Unid. Sandpiper	Shorebird	4	0	0	0	2	2	4	0	0	0	0.00
Unid. Shearwater	Seabird	4	0	0	0	3	0	3	1	0	1	0.00
Unid. Shorebird	Shorebird	3	2	0	2	0	0	0	1	0	1	0.67
Unid. Skimmer	Seabird	6	0	0	0	6	0	6	0	0	0	0.00
Unid. Sparrow	Passerine	3	0	0	0	1	0	1	2	0	2	0.00
Unid. Swallow	Passerine	1	0	0	0	1	0	1	0	0	0	0.00
Unid. Tern	Seabird	129	37	1	38	72	1	73	18	0	18	0.29
Unknown spp.		561	51	2	53	420	3	423	85	0	85	0.09
Other		119	33	4	37	58	16	74	8	0	8	0.31
Column Totals		8,000	2,024	1,011	3,035	3,108	948	4056	907	2	909	0.27

[a] Data obtained from the U.S. Fish and Wildlife Service (FWS) as a summarized table dated November 30, 2010. The data used in this table are verified as per the FWS QA/QC processes. Disclaimer: All data should be considered provisional, incomplete, and subject to change. For more information, see USDOI, FWS, 2010.

[b] As of November 30, 2010, 102 avian species had been identified through the *Deepwater Horizon* post-spill monitoring and collection process. Overall oiling rate across species including "others" and "unknowns" was 0.27. Oiling rate for the Top 5 (see bold rows in table) most-impacted avian species was 0.44 and included representatives from *only* the seabird group. In descending order based on the number collected: laughing gull (3,339 collected, 0.39 oiling rate); brown pelican (911 collected, 0.38 oiling rate); northern gannet (632 collected, 0.65 oiling rate); royal tern (348 collected, 0.52 oiling rate); and black skimmer (263 collected, 0.25 oiling rate).

[*] Species Group: As defined in the text of this Supplemental EIS.

[1] Oiling Rate: For each species, an oiling rate was calculated by dividing the "total" number of oiled individuals (∑ alive + dead) /∑ of individuals collected for a given species/row. In general, it has been well documented that the number of birds collected after a spill event *represents a small fraction* of the total oiled population (direct mortality) due to various factors: species-specific differences in vulnerability to spilled oil; species-specific differences in distribution, habitat use, and behavior; species-specific differences in abundance; species-specific differences in carcass deposition rates, persistence rates, and detection probabilities; overall search effort and temporal and spatial variation in search effort; and carcass loss due to predation, habitat, weather, tides, and currents (Piatt et al., 1990a and 1990b; Ford et al., 1996; Piatt and Ford, 1996; Fowler and Flint, 1997; Flint and

Table 4-6. Birds Collected and Summarized by the U.S. Fish and Wildlife Service Post-*Deepwater Horizon* Event in the Gulf of Mexico[a, b] (continued).

Fowler, 1998; Flint et al., 1999; Castege et al., 2007; Byrd et al., 2009; Flint et al., 2010). For example, Piatt and Ford (1996, Table 1) estimated a mean carcass recovery rate of only 17% for a number of previous oil-bird impact studies. Burger (1993) and Wiese and Jones (2001) estimated recovery rates of 20%, with the latter study based on a drift-block design to estimate carcass recovery rate from beached-bird surveys. Note: Spill volume tends to be a poor predictor of bird mortality associated with an oil spill (Burger 1993), although it should be considered for inclusion in any models to estimate total bird mortality, preferably with some metric of species composition and abundance (preferably density) pre-spill (Wilhelm et al., 2007).

[2] For additional information on oiling rates by Species Group and additional statistics, see Table 4-5.

Table 4-7

Mississippi Department of Marine Resources: Summary of Fish Kills Observed along the Gulf Coast

Date	Area	Dissolved Oxygen	Fish
May 5, 2010	Bayou Chicot, LA	<1.0 mg/L	3.3 million juvenile menhaden*
May 5, 2010	Lake Mars Boat Ramp, Belle Fontaine, MS	2 mg/L	1.9 million menhaden*
May 11-12, 2010	Mississippi beaches	5-5.7 mg/L	27 hardhead catfish
July 8, 2010	Bayou Caddy, MS	1.7 mg/L	97 with 11 species†
August 1, 2010	Long Beach Harbor, MS	NA	1,900 with 23 species‡
August 3, 2010	Mississippi Sound south of Deer Island	NA	500,000 menhaden* (broken net)
August 5, 2010	Pass Christian Harbor, MS	6.7 mg/L	NA

* Abundance of menhaden are estimates from the kill site.
† Species include trout, croaker, sheepshead, mullet, flounder, drum, catfish, and pinfish.
‡ Species include brown shrimp, crabs, stingrays, kingfish, silver perch, shrimp, eel, lookdown, least puffer, lizardfish, cusk-eel, black cheek, tonguefish, bay whiff, and Atlantic spadefish.
NA = not available.
mg/L = milligrams per liter.

Source: Devers, official communication, 2010.

Table 4-8

Economic Significance of Commercial Fishing in the Gulf of Mexico

State	Landings Revenue	Sales Impacts	Job Impacts	CFQ
Alabama	44,317	445,449	9,750	0.33
Florida	169,711	5,657,246	108,695	0.99
Louisiana	272,884	2,033,587	43,711	2.50
Mississippi	43,696	390,702	8,575	1.96
Texas	176,098	2,013,272	42,541	0.32
Total	706,706	10,540,256	213,272	--

CFQ = commercial fishing quotient.

Source: USDOC, NOAA, 2010c.

Table 4-9

Top Species Caught by Recreational Fishers in the Gulf Coast States

Number of Fish									
Species/Year	2001	2002	2003	2004	2005	2006	2007	2008	2009
Atlantic Croaker	4,186,990	3,589,525	3,488,464	4,342,264	2,659,716	3,905,810	3,979,556	4,245,495	5,331,132
Black Drum	1,509,119	1,586,284	1,523,614	1,686,081	1,115,153	1,346,737	1,233,862	1,728,173	1,672,719
Blackfin Tuna	50,581	35,051	38,601	73,301	60,501	64,825	83,375	92,763	91,581
Cobia	175,045	163,606	127,512	125,923	108,746	108,656	117,448	161,636	88,721
Dolphins	555,466	364,917	609,001	434,879	316,110	315,264	430,367	368,457	251,429
Gag	2,386,672	2,996,920	3,878,651	4,197,440	2,938,891	2,084,588	3,254,196	4,746,177	2,924,329
Gray Snapper	3,511,496	3,798,482	6,073,935	4,530,800	5,851,190	4,039,090	5,571,680	7,669,142	4,401,510
Great Amberjack	477,424	315,674	346,070	254,283	201,443	161,534	199,429	245,344	207,226
King Mackerel	575,699	488,142	398,234	447,247	380,793	967,378	429,562	376,508	596,232
Little Tuny	265,456	423,424	197,927	362,243	153,204	293,337	333,310	193,546	179,928
Pinfishes	14,675,911	11,664,212	8,848,476	13,813,893	10,274,164	10,324,881	11,762,014	15,942,884	11,591,996
Red Drum	8,261,019	7,351,899	8,587,461	8,387,639	7,492,498	9,838,039	9,030,204	9,700,431	8,063,967
Red Grouper	1,880,567	2,197,298	2,298,287	3,632,743	1,862,289	1,012,572	1,198,064	3,312,054	3,410,731
Red Snapper	2,654,554	3,196,853	2,934,322	3,217,643	2,732,425	3,527,145	3,872,259	2,624,982	2,910,337
Sand Seatrout	4,342,805	4,129,064	4,062,981	3,326,749	2,524,347	4,334,134	4,587,006	5,853,369	6,502,913
Sheepshead	3,126,988	3,253,252	3,945,716	4,669,176	3,961,753	2,992,718	2,397,513	3,229,301	3,189,143
Southern Flounder	902,531	622,566	911,039	917,938	692,293	738,351	802,929	691,132	757,326
Southern Kingfish	2,660,631	1,404,170	1,733,446	2,206,406	1,988,897	1,848,665	1,608,861	1,727,889	1,670,001
Spanish Mackerel	4,321,962	3,882,193	3,715,281	4,303,273	2,518,250	4,946,966	3,817,443	4,132,207	2,988,112
Spotted Seatrout	20,582,815	22,664,920	28,785,103	28,851,638	29,679,185	36,435,823	30,611,531	32,564,976	29,352,993
Striped Mullet	2,293,741	1,340,382	1,866,563	1,257,205	1,323,021	1,303,076	1,162,019	1,231,121	969,123
White Grunt	6,779,775	5,529,179	4,831,100	5,133,524	3,687,435	1,694,738	2,157,816	4,036,236	2,490,431
Pounds									
Species/Year	2001	2002	2003	2004	2005	2006	2007	2008	2009
Atlantic Croaker	677,890	287,934	490,887	306,179	280,489	553,449	600,690	598,106	508,967
Black Drum	2,341,032	2,531,258	2,857,730	3,057,965	1,922,411	2,531,999	2,276,953	2,907,574	2,870,621
Blackfin Tuna	526,547	294,526	580,484	830,021	525,045	863,090	286,572	868,698	660,264
Cobia	1,129,714	791,793	1,101,782	1,227,464	1,208,989	1,072,033	1,012,921	913,566	534,810
Dolphins	2,496,877	2,227,922	2,530,400	2,011,021	1,222,221	1,183,392	2,028,360	1,327,670	1,358,031
Gag	3,854,869	3,781,229	3,278,245	4,693,183	3,510,799	1,936,492	2,534,137	3,071,762	1,594,303
Gray Snapper	1,412,589	1,324,563	1,893,108	2,044,198	1,964,576	1,975,178	1,512,298	2,065,549	1,604,298
Great Amberjack	1,153,786	1,847,882	2,416,947	2,251,265	1,358,653	1,282,616	989,630	1,213,319	1,484,002
King Mackerel	2,865,226	3,043,569	2,763,371	2,434,372	1,635,507	3,374,852	2,606,005	1,894,691	3,324,003
Little Tuny	587,429	873,813	590,683	1,108,632	310,877	619,746	813,722	385,382	578,719
Pinfishes	1,560,872	1,677,357	1,739,776	3,811,171	1,215,008	742,368	1,683,034	3,510,949	2,831,692
Red Drum	13,419,400	11,575,766	13,113,186	14,290,334	10,242,490	14,215,737	13,988,083	13,910,457	11,898,383
Red Grouper	1,415,307	1,744,180	1,359,015	3,235,764	1,431,359	980,311	1,039,597	896,377	926,111
Red Snapper	3,737,264	4,369,698	3,921,340	4,162,485	3,322,074	3,232,025	3,769,388	3,128,771	3,613,267
Sand Seatrout	1,905,500	1,723,872	1,556,192	1,121,936	879,417	1,557,953	1,701,233	1,930,689	2,389,301
Sheepshead	4,385,765	3,775,195	5,002,901	6,487,492	5,288,789	4,013,009	3,836,123	4,670,992	4,388,254
Southern Flounder	1,082,858	630,928	823,083	834,794	645,835	780,468	810,986	749,674	851,999
Southern Kingfish	993,027	581,779	683,569	783,204	657,967	616,415	608,426	629,250	710,651
Spanish Mackerel	3,549,609	3,202,118	2,614,570	2,907,069	1,583,811	2,655,099	2,542,007	2,788,369	1,962,775
Spotted Seatrout	12,514,780	9,684,768	11,881,531	11,880,671	11,761,193	18,057,746	13,817,897	15,180,141	14,500,754
Striped Mullet	2,330,227	1,523,427	2,194,545	1,525,980	1,536,234	1,600,983	1,245,425	1,418,025	900,037
White Grunt	2,352,568	2,019,945	1,785,777	1,751,156	1,602,724	680,403	701,343	1,325,970	1,013,062

Notes: Fish that are released alive are included in the landings data but not in the weight data.
This table presents the sum of fishing data for Louisiana, Mississippi, Alabama, and West Florida.

Source: USDOC, NOAA, 2010d.

Table 4-10

Percentage of Species Landings that are Ocean Based

Number of Fish									
Species/Year	2001	2002	2003	2004	2005	2006	2007	2008	2009
Atlantic Croaker	14.44	10.97	13.76	27.27	10.77	11.41	12.42	6.85	5.54
Black Drum	10.11	9.76	11.49	11.39	16.10	9.48	4.41	4.66	5.41
Blackfin Tuna	100.00	100.00	100.00	100.00	96.64	100.00	100.00	100.00	100.00
Cobia	64.14	72.50	74.56	79.25	83.60	86.83	81.25	73.28	71.72
Dolphins	98.92	100.00	100.00	100.00	100.00	99.72	99.49	99.21	100.00
Gag	82.69	75.01	76.77	81.08	83.59	71.17	63.72	71.40	61.45
Gray Snapper	49.48	32.43	41.52	42.93	36.45	49.40	40.26	48.61	32.00
Great Amberjack	96.21	99.63	99.51	99.74	99.18	98.85	100.00	99.44	100.00
King Mackerel	97.34	96.94	99.20	95.87	93.48	62.50	94.85	93.83	93.00
Little Tuny	97.84	96.08	99.76	99.80	99.10	92.75	87.64	86.66	87.22
Pinfishes	36.89	31.37	48.33	30.53	43.72	44.88	26.31	37.73	24.59
Red Drum	18.34	13.25	14.44	13.50	21.46	17.50	12.96	12.48	7.45
Red Grouper	98.33	99.38	98.22	97.36	98.12	98.60	97.14	91.04	83.08
Red Snapper	99.32	99.67	99.49	99.20	98.38	98.21	97.97	96.82	98.39
Sand Seatrout	22.81	14.26	11.90	24.40	19.24	23.00	21.26	13.97	12.28
Sheepshead	30.22	23.09	19.56	22.49	24.68	28.70	32.45	19.91	13.34
Southern Flounder	14.11	15.62	5.44	15.59	12.10	8.26	12.23	6.21	4.68
Southern Kingfish	48.30	43.11	33.38	29.19	26.33	39.34	28.73	36.84	18.05
Spanish Mackerel	69.03	53.39	68.10	73.05	63.10	67.63	55.73	70.40	51.93
Spotted Seatrout	23.52	25.12	20.03	18.99	22.97	20.61	23.59	17.20	15.36
Striped Mullet	18.47	13.28	13.20	13.04	28.14	38.07	15.12	21.97	9.98
White Grunt	79.12	86.20	85.07	87.96	91.14	90.42	78.79	85.87	69.51
Pounds									
Species/Year	2001	2002	2003	2004	2005	2006	2007	2008	2009
Atlantic Croaker	10.99	12.90	18.98	11.59	3.21	6.63	8.58	5.00	2.37
Black Drum	16.37	21.47	10.60	17.86	9.56	7.15	6.12	6.30	12.54
Blackfin Tuna	100.00	100.00	100.00	100.00	91.49	100.00	100.00	100.00	100.00
Cobia	87.14	80.65	84.22	92.18	95.30	92.92	87.02	87.07	75.04
Dolphins	99.00	100.00	100.00	100.00	100.00	100.00	100.00	99.57	100.00
Gag	97.52	96.43	95.77	96.10	93.16	94.32	89.21	90.92	81.40
Gray Snapper	75.80	75.27	74.21	80.80	84.10	75.51	70.68	71.76	59.57
Great Amberjack	100.00	100.00	99.97	100.00	99.71	100.00	100.00	100.00	100.00
King Mackerel	99.08	96.50	99.46	98.06	98.58	82.52	96.19	97.61	96.20
Little Tuny	100.00	100.00	99.58	99.98	100.00	95.96	70.54	94.12	92.99
Pinfishes	41.84	34.38	56.40	26.93	48.10	54.05	19.22	25.85	22.79
Red Drum	18.82	15.84	16.08	19.52	15.07	15.14	14.94	10.93	7.22
Red Grouper	99.30	99.73	99.71	99.86	100.00	100.00	98.89	97.43	98.25
Red Snapper	99.85	99.83	99.81	98.32	99.45	98.97	96.89	98.31	98.53
Sand Seatrout	21.90	13.65	11.51	26.39	20.30	24.21	19.14	14.25	15.06
Sheepshead	43.70	30.20	26.82	26.65	34.75	39.45	47.43	23.60	13.88
Southern Flounder	16.88	16.23	6.27	14.58	9.26	7.55	9.00	6.98	3.98
Southern Kingfish	51.32	41.90	28.09	27.11	30.90	33.24	28.64	42.04	15.56
Spanish Mackerel	70.72	63.52	70.76	76.73	69.40	67.47	61.28	68.15	56.71
Spotted Seatrout	25.10	28.31	16.25	17.92	20.36	15.85	19.12	14.32	14.31
Striped Mullet	24.07	10.45	7.14	14.07	22.48	31.63	12.10	27.41	6.60
White Grunt	89.48	90.69	91.05	89.34	93.79	94.64	83.12	90.31	83.39

Notes: Fish that are released alive are included in the landings data but not in the weight data.
This table presents the sum of fishing data for Louisiana, Mississippi, Alabama, and West Florida.
The NMFS divides fishing data into inland, State, and Federal categories. Ocean based is defined as the sum of State and Federal categories.

Source: USDOC, NOAA, 2010d.

Table 4-11

Recreational Fishing Participation 2009

State	Coastal	Noncoastal	Out of State	Total
West Florida	1,551,478	0	1,670,603	3,222,081
East Florida	1,098,575	0	1,741,339	2,839,914
Alabama	205,365	151,379	208,775	565,519
Mississippi	125,048	36,496	50,328	211,872
Louisiana	668,576	108,086	139,120	915,782

Source: USDOC, NOAA, 2010d.

State	Resident	Nonresident	Total
Florida	1,881	885	2,767
Texas	2,308	218	2,527
Alabama	600	206	806
Mississippi	465	80	546
Louisiana	590	112	702

Source: USDOI, FWS, and USDOC, Census Bureau, 2006.

Table 4-12

Angler Trips in the Gulf of Mexico during Certain Months of 2009 and 2010

	2009					2010			
	Jan/Feb	Mar/April	May/June	July/Aug		Jan/Feb	Mar/April	May/June	July/Aug
Total Trips									
Alabama	134,887	309,545	454,940	405,356		84,493	275,061	392,199	354,099
Florida	2,205,141	2,588,254	3,963,196	3,422,240		1,760,394	1,947,677	3,517,096	3,082,397
Louisiana	583,195	561,112	1,058,162	838,820		367,898	559,726	901,671	583,342
Mississippi	127,336	148,993	222,623	251,448		90,718	174,983	334,441	159,674
Total	3,050,559	3,607,904	5,698,921	4,917,864		2,303,503	2,957,447	5,145,407	4,179,512
Inland									
Alabama	90,030	201,215	271,504	225,383		90,030	55,150	147,288	237,353
Florida	1,432,011	1,579,247	2,227,167	2,077,674		1,432,011	1,445,472	1,307,968	2,101,879
Louisiana	568,870	552,088	990,311	718,606		568,870	357,404	546,930	880,636
Mississippi	121,012	145,411	201,851	241,075		121,012	90,067	171,824	326,780
Total	2,211,923	2,477,961	3,690,833	3,262,738		2,211,923	1,948,093	2,174,010	3,546,648
State									
Alabama	44,218	93,732	80,117	114,938		29,006	113,399	116,297	180,098
Florida	662,919	927,192	1,423,612	1,105,167		242,215	548,438	1,176,779	949,626
Louisiana	5,302	1,728	38,986	61,425		7,068	10,970	14,779	11,386
Mississippi	1,150	273	7,627	10,191		651	3,042	7,661	--
Total	713,589	1,022,925	1,550,342	1,291,721		278,940	675,849	1,315,516	1,141,110
Federal									
Alabama	639	14,597	103,320	65,035		336	14,374	38,548	313
Florida	110,211	81,815	312,418	239,399		72,707	91,271	238,438	170,106
Louisiana	9,023	7,296	28,865	58,788		3,427	1,826	6,256	6,986
Mississippi	5,175	3,309	13,144	182		--	--	--	--
Total	125,048	107,017	457,747	363,404		76,470	107,471	283,242	177,405

Note: This table presents the sum of fishing data for Louisiana, Mississippi, Alabama, and West Florida.

Source: USDOC, NOAA, 2010d.

Table 4-13

Angler Trips in the Gulf of Mexico by Location and Mode in 2009

State	Area	Number of Trips	% State Total
Alabama	Shore Ocean (< 3 nmi)	354,043	20.6
	Shore Inland	407,982	23.8
	Charter Ocean (<3 nmi)	9228	0.5
	Charter Ocean (>3 nmi)	36672	2.1
	Charter Inland	10759	0.6
	Private/Rental Ocean (<3 nmi)	154301	9.0
	Private/Rental Ocean (>3 nmi)	165012	9.6
	Private/Rental Inland	579033	33.7
	Total	1,717,030	
West Florida	Shore Ocean (< 9 nmi)	2,511,933	16.2
	Shore Inland	3,942,920	25.4
	Charter Ocean (<9 nmi)	195,688	1.3
	Charter Ocean (>9 nmi)	259,622	1.7
	Charter Inland	112,007	0.7
	Private/Rental Ocean (<9 nmi)	2,602,581	16.8
	Private/Rental Ocean (>9 nmi)	616,371	4.0
	Private/Rental Inland	5,276,236	34.0
	Total	15,517,358	
Louisiana	Shore Ocean (< 3 nmi)	37,324	0.9
	Shore Inland	731,676	18.3
	Charter Ocean (<3 nmi)	3,283	0.1
	Charter Ocean (>3 nmi)	18,031	0.5
	Charter Inland	135,654	3.4
	Private/Rental Ocean (<3 nmi)	75,482	1.9
	Private/Rental Ocean (>3 nmi)	102,196	2.6
	Private/Rental Inland	2,896,326	72.4
	Total	3,999,972	
Mississippi	Shore Ocean (< 3 nmi)	330	0.0
	Shore Inland	307,856	29.0
	Charter Ocean (<3 nmi)	2,831	0.3
	Charter Ocean (>3 nmi)	330	0.0
	Charter Inland	7,680	0.7
	Private/Rental Ocean (<3 nmi)	18,602	1.8
	Private/Rental Ocean (>3 nmi)	26,095	2.5
	Private/Rental Inland	698,752	65.8
	Total	1,062,476	
Gulf Total	Shore Ocean (< 3 nmi)	2,903,630	13.0
	Shore Inland	5,390,434	24.2
	Charter Ocean (<3 nmi)	211,030	0.9
	Charter Ocean (>3 nmi)	314,655	1.4
	Charter Inland	266,100	1.2
	Private/Rental Ocean (<3 nmi)	2,850,966	12.8
	Private/Rental Ocean (>3 nmi)	909,674	4.1
	Private/Rental Inland	9,450,347	42.4
	Total	22,296,836	

Notes: This table presents the sum of fishing data from Louisiana, Mississippi, Alabama, and West Florida
State waters in Florida extend 9 nautical miles from the coast rather than the typical 3 nautical miles.

Source: USDOC, NOAA, 2010d.

Table 4-14

Economic Impact of Recreational Fishing in the Gulf of Mexico in 2008

	Expenditures*	Sales*	Value Added*	Employment
Alabama	480,587	455,093	235,481	4,719
West Florida	6,332,287	5,650,068	3,075,710	54,589
Mississippi	410,007	382,778	148,837	2,930
Louisiana	2,727,225	2,297,078	1,156,796	25,590
Texas	2,594,714	3,288,135	1,656,545	25,544
Total	12,544,820	12,073,152	6,273,369	113,372

*Data on expenditures, sales, and value added are presented in thousands of dollars.

Source: USDOC, NOAA, 2010c.

Table 4-15

Fish Species Caught by Recreational Anglers during Certain Months of 2009 and 2010

Species/Year	2009				2010			
Months	Jan/Feb	Mar/April	May/June	July/Aug	Jan/Feb	Mar/April	May/June	July/Aug
Number of Fish								
Atlantic Croaker	145,458	809,858	1,816,279	1,625,287	50,971	386,179	1,944,042	1,044,961
Black Drum	161,376	164,735	325,061	224,853	227,071	225,385	364,503	275,733
Blackfin Tuna	27,354	4,581	3,530	26,771	949	1,932	4,657	13,858
Cobia	584	4,475	40,360	34,150	871	14,029	28,830	15,197
Dolphins	12,011	14,355	130,214	84,491	2,113	19,700	136,119	26,805
Gag	395,418	296,874	811,646	478,649	230,505	220,433	634,532	366,454
Gray Snapper	485,160	635,363	934,055	1,451,321	313,131	222,635	407,943	714,142
Great Amberjack	31,396	12,326	104,533	45,653	68,638	55,138	146,875	42,207
King Mackerel	19,359	63,883	202,625	188,375	5,607	32,121	146,680	40,138
Little Tuny	19,291	9,276	32,635	38,169	3,955	8,159	15,674	51,860
Pinfishes	1,371,965	1,391,786	2,470,196	4,232,636	533,986	701,588	4,025,971	3,181,734
Red Drum	982,472	747,513	1,361,522	1,484,450	925,532	1,198,622	1,577,535	1,452,287
Red Grouper	437,521	250,878	1,198,225	691,905	62,283	147,913	771,742	397,990
Red Snapper	84,572	106,800	1,458,523	1,018,133	161,625	120,570	619,128	172,683
Sand Seatrout	269,556	638,973	2,068,415	1,612,595	111,317	630,783	1,851,837	859,674
Sheepshead	1,272,356	901,817	135,120	169,281	746,819	997,496	179,120	110,364
Southern Flounder	36,231	57,573	143,744	213,087	18,603	85,698	267,215	315,046
Southern Kingfish	76,964	289,755	500,087	405,015	133,317	149,150	500,078	131,282
Spanish Mackerel	81,393	472,775	1,059,242	612,279	12,449	592,166	691,469	1,132,884
Spotted Seatrout	3,771,209	2,719,521	8,622,412	5,350,897	1,539,569	1,719,419	5,585,438	4,486,243
Striped Mullet	198,193	31,379	109,002	322,672	31,735	8,328	260,327	413,764
White Grunt	518,784	236,420	448,748	554,624	160,520	252,943	729,231	602,460
Pounds								
Atlantic Croaker	11,715	57,628	173,870	166,893	12,044	24,010	200,460	107,664
Black Drum	272,586	352,421	531,320	546,397	298,282	660,342	306,550	386,283
Blackfin Tuna	202,746	21,076	30,382	265,762	10,708	0	73,709	79,780
Cobia	0	65,580	133,791	297,808	15,919	193,213	171,895	88,019
Dolphins	77,512	90,040	630,635	476,560	10,000	47,840	380,042	120,936
Gag	87,005	146,676	566,695	246,203	171,685	198,240	560,661	179,243
Gray Snapper	152,724	162,960	446,707	618,699	32,209	73,124	189,543	282,467
Great Amberjack	187,900	73,076	693,653	459,602	75,765	314,726	542,118	109,240
King Mackerel	111,522	214,979	983,633	1,136,665	38,517	176,646	972,566	208,339
Little Tuny	68,459	41,731	87,565	165,513	11,933	44,784	41,341	213,463
Pinfishes	258	313,523	747,119	1,375,430	747,218	206,004	347,535	513,628
Red Drum	817,402	1,345,542	2,748,252	2,309,682	1,184,906	2,269,014	2,288,800	2,079,421
Red Grouper	21,369	53,245	307,916	411,885	14,533	37,661	214,075	146,487
Red Snapper	0	0	1,683,450	1,929,816	0	0	396,817	286,040
Sand Seatrout	148,892	220,669	765,417	492,922	54,110	230,046	639,504	387,178
Sheepshead	1,685,580	1,480,944	201,108	222,947	666,634	1,464,578	197,581	60,044
Southern Flounder	29,987	59,601	147,221	233,972	13,772	105,545	282,568	332,260
Southern Kingfish	39,828	125,402	216,637	228,593	68,592	57,467	159,080	47,474
Spanish Mackerel	109,864	320,961	683,805	431,326	8,241	359,894	462,765	501,242
Spotted Seatrout	1,445,014	1,134,580	5,358,179	2,776,994	478,076	811,950	3,312,727	1,805,049
Striped Mullet	124,267	4,899	67,245	330,619	44,936	7,566	265,989	686,934
White Grunt	272,297	115,689	140,164	180,879	94,253	125,841	231,324	253,337

Notes: Fish that are released alive are included in the landings data but not in the weight data.
This table presents the sum of fishing data for Louisiana, Mississippi, Alabama, and West Florida.

Source: USDOC, NOAA, 2010d.

Table 4-16a

Employment in the Leisure/Hospitality Industry in Selected Geographic Regions

Region	2001	2002	2003	2004	2005	2006	2007	2008	2009
Panel A—Economic Impact Area									
TX-1	45,553	46,979	48,490	49,165	50,446	53,281	54,654	54,551	53,691
TX-2	14,055	14,113	14,241	14,728	14,670	16,153	16,564	16,883	16,702
TX-3	195,214	203,090	207,245	214,025	219,203	231,840	241,110	240,231	240,366
LA-1	13,682	14,065	14,300	14,725	15,339	14,747	14,563	14,295	14,246
LA-2	17,653	17,451	18,560	19,817	20,787	21,072	21,517	21,364	20,588
LA-3	37,902	38,048	40,752	42,229	43,483	44,533	44,810	46,037	44,157
LA-4	80,990	80,677	81,243	85,093	47,641	64,812	68,531	68,605	67,438
MS-1	31,485	32,752	33,714	33,297	18,024	29,191	29,680	27,702	26,938
AL-1	23,785	23,937	24,488	24,464	25,481	26,463	26,850	26,516	26,034
FL-1	34,829	36,139	36,520	39,956	41,133	41,887	41,688	40,001	41,003
FL-2	17,934	19,733	18,860	21,588	21,861	22,478	22,913	22,502	21,699
FL-3	123,248	130,250	132,256	137,302	145,005	145,894	149,448	146,368	142,393
FL-4	238,090	251,658	256,472	268,487	274,635	280,874	283,748	283,359	280,380
TX EIA Total	254,822	264,182	269,976	277,918	284,319	301,274	312,328	311,665	310,759
LA EIA Total	150,227	150,241	154,855	161,864	127,250	145,164	149,421	150,301	146,429
MS EIA Total	31,485	32,752	33,714	33,297	18,024	29,191	29,680	27,702	26,938
AL EIA Total	23,785	23,937	24,488	24,464	25,481	26,463	26,850	26,516	26,034
FL EIA Total	414,101	437,780	444,108	467,333	482,634	491,133	497,797	492,230	485,475
EIA Total	874,420	908,892	927,141	964,876	937,708	993,225	1,016,076	1,008,414	995,635
Panel B—Coastal									
TX	57,637	59,250	60,873	61,983	63,069	67,625	68,195	67,388	68,025
LA	88,235	87,640	88,431	92,703	56,242	73,405	77,567	77,580	75,958
MS	30,052	31,295	32,172	31,625	16,152	26,926	27,444	25,575	25,080
AL	21,231	21,690	22,249	22,250	23,099	24,186	24,437	24,319	23,990
FL	377,323	399,122	404,048	423,855	437,761	445,948	450,414	445,164	441,068
Coastal Total	574,478	598,997	607,773	632,416	596,323	638,090	648,057	640,026	634,121
Panel C—Statewide									
TX	818,164	840,506	854,733	877,284	900,646	943,581	982,437	995,445	982,122
LA	191,394	192,342	198,195	206,298	171,674	189,822	194,614	194,905	189,527
MS	116,714	120,243	121,528	122,557	110,430	123,402	125,192	121,033	115,924
AL	148,989	149,172	154,287	158,390	163,390	168,558	171,697	168,413	166,237
FL	772,721	808,429	817,571	866,269	893,043	912,409	932,012	922,534	896,923
State Total	2,047,982	2,110,692	2,146,314	2,230,798	2,239,183	2,337,772	2,405,952	2,402,330	2,350,733

1) Economic Impact Areas are defined in Figure 2-2.
2) The Coastal category refers to counties within EIA's that are directly along the coast of the U.S.
3) The Statewide category refers to the number of employees within the borders of the entire state.
4) The leisure/hospitality industry is defined according to the North American Industrial Classification System (NAICS).
5) The employment figure for any given year corresponds to the total number of employees in December of that year.

Source: U.S. Dept. of Labor, Bureau of Labor Statistics, 2010.

Table 4-16b

Monthly Employment in the Leisure/Hospitality Industry during 2010

Region	Jan	Feb	March	April	May	June	July	Aug	Sep
Panel A—Economic Impact Area									
TX-1	53,780	54,864	56,434	56,712	57,682	57,817	56,989	56,821	56,106
TX-2	16,372	16,535	16,879	17,357	17,488	17,953	17,744	17,668	17,234
TX-3	233,323	236,395	242,381	245,096	248,306	250,958	248,351	248,857	246,488
LA-1	14,195	14,203	14,435	14,500	14,698	14,774	14,632	14,402	14,487
LA-2	20,441	20,790	21,107	21,666	21,934	21,640	21,319	21,259	21,210
LA-3	42,988	43,485	44,710	44,925	45,606	45,695	45,320	45,556	45,492
LA-4	68,343	68,806	70,051	70,708	70,570	71,257	70,173	70,590	70,982
MS-1	26,404	26,645	27,211	27,583	27,879	28,290	28,052	27,981	27,570
AL-1	25,435	25,925	27,140	28,316	28,962	29,503	28,836	28,571	27,961
FL-1	40,374	42,431	46,703	48,351	49,119	50,806	49,889	48,372	46,160
FL-2	21,621	22,074	22,478	22,868	22,011	21,550	21,238	21,504	22,090
FL-3	142,690	145,777	149,670	150,654	149,325	148,017	145,285	145,267	145,346
FL-4	280,126	285,916	291,067	290,144	284,324	279,782	272,745	272,263	270,061
TX EIA total	303,475	307,794	315,694	319,165	323,476	326,728	323,084	323,346	319,828
LA EIA total	145,967	147,284	150,303	151,799	152,808	153,366	151,444	151,807	152,171
MS EIA total	26,404	26,645	27,211	27,583	27,879	28,290	28,052	27,981	27,570
AL EIA total	25,435	25,925	27,140	28,316	28,962	29,503	28,836	28,571	27,961
FL EIA total	484,811	496,198	509,918	512,017	504,779	500,155	489,157	487,406	483,657
EIA total	986,092	1,003,846	1,030,266	1,038,880	1,037,904	1,038,042	1,020,573	1,019,111	1,011,187
Panel B—Coastal									
TX	66,575	67,809	70,159	71,833	72,737	73,916	72,832	72,110	70,337
LA	76,571	77,167	78,666	79,306	79,329	79,933	78,923	79,373	79,764
MS	24,585	24,803	25,313	25,675	25,972	26,376	26,249	26,153	25,750
AL	23,425	23,908	25,020	26,192	26,734	27,202	26,551	26,324	25,732
FL	440,714	451,034	464,086	465,718	460,000	456,131	445,905	443,901	438,708
Coastal total	631,870	644,721	663,244	668,724	664,772	663,558	650,460	647,861	640,291
Panel C—Statewide									
TX	955,907	971,203	993,927	1,007,287	1,025,007	1,035,662	1,024,465	1,026,375	1,017,550
LA	187,935	189,633	193,519	195,715	196,978	197,360	194,930	195,358	195,476
MS	113,199	114,644	117,222	119,567	120,425	121,213	119,571	120,795	119,569
AL	160,117	160,637	165,671	169,475	171,307	172,834	170,998	171,144	168,839
FL	893,174	915,016	937,711	942,916	934,556	926,893	910,396	907,547	901,179
State total	2,310,332	2,351,133	2,408,050	2,434,960	2,448,273	2,453,962	2,420,360	2,421,219	2,402,613

1) Economic Impact Areas (EIA's) are defined in Figure 2-2.
2) The Coastal category refers to counties within EIA's that are directly along the coast of the U.S.
3) The Statewide category refers to the number of employees within the borders of the entire state.
4) The leisure/hospitality industry is defined according to the North American Industrial Classification System.

Source: U.S. Dept. of Labor, Bureau of Labor Statistics, 2011.

Table 4-17a

Total Wages Earned by Employees in the Leisure/Hospitality Industry in Selected Geographic Regions

Region	2001	2002	2003	2004	2005	2006	2007	2008	2009
Panel A—Economic Impact Area									
TX-1	516,185	544,244	566,896	586,252	627,083	685,028	739,142	746,670	766,750
TX-2	148,743	155,321	158,437	168,256	175,260	190,740	209,082	221,889	237,274
TX-3	3,018,006	3,184,819	3,269,332	3,482,253	3,711,467	4,067,402	4,341,536	4,559,854	4,635,997
LA-1	179,049	190,839	196,760	207,015	252,162	250,432	251,148	257,990	263,543
LA-2	176,741	186,845	195,892	219,352	243,347	280,120	295,347	308,107	314,147
LA-3	446,102	452,046	487,564	498,022	543,970	597,138	633,241	654,806	667,398
LA-4	1,318,417	1,378,771	1,429,488	1,493,019	1,409,983	1,246,477	1,505,206	1,633,224	1,595,567
MS-1	591,065	591,974	608,043	618,987	617,535	453,168	621,439	616,442	560,510
AL-1	281,331	287,381	300,006	305,922	321,934	347,512	371,712	388,644	390,968
FL-1	470,616	508,316	528,008	599,949	655,141	721,483	761,247	738,910	743,731
FL-2	182,944	209,213	210,758	232,143	249,152	270,339	294,144	293,528	291,417
FL-3	1,849,168	1,956,066	2,046,441	2,224,235	2,418,168	2,576,029	2,752,991	2,906,630	2,795,652
FL-4	4,219,638	4,391,881	4,669,982	5,131,115	5,650,225	5,981,862	6,304,312	6,493,402	6,344,752
TX EIA Total	3,682,934	3,884,384	3,994,665	4,236,761	4,513,810	4,943,170	5,289,760	5,528,413	5,640,021
LA EIA Total	2,120,309	2,208,501	2,309,704	2,417,408	2,449,462	2,374,167	2,684,942	2,854,127	2,840,655
MS EIA Total	591,065	591,974	608,043	618,987	617,535	453,168	621,439	616,442	560,510
AL EIA Total	281,331	287,381	300,006	305,922	321,934	347,512	371,712	388,644	390,968
FL EIA Total	6,722,366	7,065,476	7,455,189	8,187,442	8,972,686	9,549,713	10,112,694	10,432,470	10,175,552
EIA Total	13,398,005	14,037,716	14,667,607	15,766,520	16,875,427	17,667,730	19,080,547	19,820,096	19,607,706
Panel B—Coastal									
TX	706,679	737,035	761,880	790,346	834,820	927,109	986,605	994,817	1,027,931
LA	1,401,025	1,459,632	1,512,219	1,578,886	1,503,750	1,359,770	1,631,966	1,764,631	1,734,276
MS	579,122	579,914	595,776	605,542	602,391	433,995	600,226	594,626	539,240
AL	259,024	265,870	279,872	284,844	299,662	324,127	347,209	363,802	367,039
FL	6,309,393	6,624,756	6,991,895	7,687,112	8,410,661	8,955,648	9,456,949	9,762,721	9,522,041
Coastal Total	9,255,243	9,667,207	10,141,642	10,946,730	11,651,284	12,000,649	13,022,955	13,480,597	13,190,527
Panel C—Statewide									
TX	12,226,217	12,630,640	12,936,441	13,601,748	14,407,978	15,653,469	16,677,752	17,490,862	17,674,963
LA	2,674,740	2,762,055	2,886,189	3,028,338	3,069,485	3,013,979	3,336,193	3,530,708	3,511,171
MS	1,714,340	1,746,899	1,778,922	1,840,583	1,872,402	1,789,900	1,990,974	2,024,034	1,915,700
AL	1,682,365	1,730,048	1,800,093	1,882,015	1,998,089	2,124,157	2,244,583	2,344,058	2,345,332
FL	13,388,764	13,677,833	14,336,358	15,686,585	17,089,645	18,132,360	19,354,496	19,990,305	19,103,860
State Total	31,686,426	32,547,475	33,738,003	36,039,269	38,437,599	40,713,865	43,603,998	45,379,967	44,551,026

1) Economic Impact Areas (EIA's) are defined in Figure 2-2.
2) The Coastal category refers to counties within EIA's that are directly along the coast of the U.S.
3) The Statewide category refers to the number of employees within the borders of the entire state.
4) The leisure/hospitality industry is defined according to the North American Industrial Classification System.
5) Wages are presented in thousands of dollars.

Source: U.S. Dept. of Labor, Bureau of Labor Statistics, 2010.

Table 4-17b

Quarterly Wages in the Leisure/Hospitality Industry in 2009 and 2010

	2009				2010		
Region	Q1	Q2	Q3		Q1	Q2	Q3
Panel A—Economic Impact Area							
TX-1	186,485	190,705	196,907		189,011	200,118	202,891
TX-2	55,947	59,888	60,406		56,807	62,136	62,005
TX-3	1,101,383	1,156,040	1,172,061		1,101,259	1,182,646	1,205,761
LA-1	66,498	62,427	68,772		67,858	63,177	69,412
LA-2	76,903	79,958	78,659		74,803	82,036	82,804
LA-3	146,758	147,760	151,476		146,165	155,619	157,535
LA-4	399,037	375,763	372,045		422,006	393,554	389,661
MS-1	139,067	139,486	144,690		137,586	138,553	144,858
AL-1	90,350	101,085	102,964		90,985	105,881	107,282
FL-1	165,362	199,059	208,098		161,938	201,780	203,336
FL-2	72,448	73,443	71,806		68,942	72,564	72,652
FL-3	704,036	685,052	661,734		683,879	706,460	704,891
FL-4	1,644,155	1,582,097	1,455,292		1,614,884	1,639,368	1,543,834
TX EIA total	1,343,815	1,406,633	1,429,374		1,347,077	1,444,900	1,470,657
LA EIA total	689,196	665,908	670,952		710,832	694,386	699,412
MS EIA total	139,067	139,486	144,690		137,586	138,553	144,858
AL EIA total	90,350	101,085	102,964		90,985	105,881	107,282
FL EIA total	2,586,001	2,539,651	2,396,930		2,529,643	2,620,172	2,524,713
EIA total	4,848,429	4,852,763	4,744,910		4,816,123	5,003,892	4,946,922
Panel B—Coastal							
TX	242,514	258,365	266,840		245,102	271,683	274,253
LA	413,709	389,122	386,512		439,668	412,408	408,835
MS	133,736	134,172	139,231		132,549	133,384	139,556
AL	84,665	95,019	96,792		85,260	99,780	100,742
FL	2,423,701	2,377,078	2,234,861		2,371,990	2,454,904	2,360,412
Coastal total	3,298,325	3,253,756	3,124,236		3,274,569	3,372,159	3,283,798
Panel C—Statewide							
TX	4,309,905	4,381,324	4,412,854		4,261,565	4,470,937	4,596,176
LA	864,759	851,017	856,394		884,745	883,392	890,067
MS	466,911	482,749	482,404		456,300	486,254	495,765
AL	548,550	592,439	600,567		549,179	608,297	608,426
FL	4,816,481	4,795,973	4,515,640		4,769,647	4,895,534	4,791,884
State total	11,006,606	11,103,502	10,867,859		10,921,436	11,344,414	11,382,318

1) Economic Impact Areas (EIA’s) are defined in Figure 2-2.
2) The Coastal category refers to counties within EIA's that are directly along the coast of the U.S.
3) The Statewide category refers to the number of employees within the borders of the entire state.
4) The leisure/hospitality industry is defined according to the North American Industrial Classification System.
5) Wages are presented in thousands of dollars.

Source: U.S. Dept. of Labor, Bureau of Labor Statistics, 2011.

Table 4-18

Total Tourism Spending in Gulf Coast States
(millions of dollars)

State	2000	2001	2002	2003	2004	2005	2006	2007	2008
Texas	36,753	35,106	34,238	34,589	37,065	40,790	44,707	44,428	50,874
Louisiana	9,227	9,266	9,262	9,418	9,964	8,248	6,718	9,021	9,642
Mississippi	5,282	5,227	5,345	5,489	5,755	5,939	5,633	6,060	6,329
Alabama	5,487	5,423	5,368	5,627	6,051	6,639	6,998	7,405	7,723
Florida	60,296	56,166	54,544	56,265	61,118	64,544	66,165	68,820	70,521

Source: U.S. Travel Association, 2010.

Table 4-19

Coastal Travel, Tourism, and Recreation Estimates in 2004

State	Employees	Payroll	Establishments
Texas	13,712	$366,374	1,626
Louisiana	4,362	$158,357	544
Mississippi	12,188	$192,864	148
Alabama	1,078	$35,407	212
Florida	31,166	$721,440	2,398
Gulf Total	62,506	$949,711	4,928

Source: Kaplan and Whitman, unpublished.

Table 4-20

Number of Beaches and Beach Participation in Gulf States

State	Number of Beaches[1]	Beach Visitation[2, 3]
Texas	168	4,929,000
Louisiana	28	578,000
Mississippi	20	956,000
Alabama	25	1,527,000
Florida	634	21,989,000

[1] USEPA, 2008.
[2] U.S. Dept of Agriculture, Forest Service, 2010.
[3] Beach visitation only refers to visitors originating from within the U.S.

Table 4-21

Shipwrecks in the Gulf of Mexico's Central Planning Area

Map Area	No. of Reported Wrecks	Historic Wrecks (verified)
Bay Marchand	3	1
Breton Sound	11	0
Chandeleur	8	0
East Cameron	49	1
Eugene Island	98	1
Ewing Bank	5	1
Green Canyon	15	2
Grand Isle	33	3
Lund	11	0
Mississippi Canyon	49	11
Mobile	56	2
Main Pass	65	0
South Pelto	16	0
Sabine Pass (LA)	15	0
South Marsh Island	33	1
South Pass	36	1
Ship Shoal	95	3
South Timbalier	90	2
Viosca Knoll	23	4
Vermilion	62	0
West Cameron	121	1
West Delta	62	0
Walker Ridge	3	0
TOTAL	959	34

Table 4-22

OCS and Non-OCS Program Spill Rates

OCS Program Spill Rates	
<1,000 bbl	
≤1 bbl	2,020 spills/BBO handled
≥1 and <50 bbl	75 spills/BBO handled
≥50 bbl and <1,000 bbl	13 spills/BBO handled
≥1,000 bbl	
Facility	0.25 spills/BBO handled
Pipeline	0.88 spills/BBO handled
Shuttle Tanker	0.34 spills/BBO handled
At Sea	0.08 spills/BBO handled
In Port	0.26 spills/BBO handled
Barge	0.62 spills/BBO handled
Non-OCS Program Spill Rates	
≤1,000 bbl	rate based on yearly occurrence information
≥1,000 bbl	
Tanker Worldwide	0.32 spills/BBO handled
At Sea	0.14 spills/BBO handled
In Port	0.18 spills/BBO handled
Tanker in U.S. Waters	0.34 spills/BBO handled
At Sea	0.08 spills/BBO handled
In Port	0.26 spills/BBO handled
Barge in U.S. Coastal, Offshore, and Inland Waters	0.62 spills/BBO handled
Pipeline	rate based on yearly occurrence information

BBO = billion barrels of oil.

Source: USDOI, BOEMRE, 2011.

Table 4-23

Classification of the Gulf Economic Impact Areas

State	Area	Labor Market	County/Parish
Alabama	AL-1	Mobile	Baldwin
			Clarke
			Conecuh
			Escambia
			Mobile
			Monroe
			Washington
			Wilcox
Mississippi	MS-1	Biloxi-Gulfport	George
			Greene
			Hancock
			Harrison
			Jackson
			Pearl River
			Stone
Louisiana	LA-1	Lake Charles	Allen
			Beauregard
			Calcasieu
			Cameron
			Jefferson Davis
			Vernon

State	Area	Labor Market	County
Texas	TX-1	Brownsville	Cameron
			Hidalgo
			Starr
			Willacy
		Corpus Christi	Aransas
			Brooks
			Duval
			Jim Wells
			Kenedy
			Kleberg
			Nueces
			Refugio
			San Patricio
	TX-2	Brazoria	Brazoria
			Matagorda
			Wharton
		Victoria	Calhoun
			Colorado
			Dewitt
			Fayette
			Goliad
			Gonzales
			Jackson
			Lavaca
			Victoria

State	Area	Labor Market	County
Florida	FL-1	Panama City	Bay
			Franklin
			Gulf
		Pensacola	Escambia
			Okaloosa
			Santa Rosa
			Walton
	FL-2	Tallahassee	Calhoun
			Gadsden
			Holmes
			Jackson
			Jefferson
			Leon
			Liberty
			Wakulla
			Washington
		Lake City	Columbia
			Hamilton
			Lafayette
			Madison
			Suwannee
			Taylor

Table 4-23. Classification of the Gulf Economic Impact Areas (continued).

State	Area	Labor Market	County	State	Area	Labor Market	County	State	Area	Labor Market	County
									FL-3	Ocala	Citrus
	LA-2	Lafayette	Acadia								Marion
			Evangeline							Gainesville	Alachua
			Iberia		TX-3	Beaumont - Port Arthur	Hardin				Bradford
			Lafayette				Jasper				Dixie
			St. Landry				Jefferson				Gilchrist
			St. Martin				Newton				Levy
			Vermillion				Orange				Union
	LA-3	Baton Rouge	Ascension				Polk			Tampa-St. Petersburg	Hernando
			East Baton Rouge				Tyler				Hillsborough
			Iberville			Houston - Galveston	Austin				Pasco
			Livingston				Chambers				Pinellas
			Tangipahoa				Fort Band		FL-4	Ft. Myers	Collier
			West Baton Rouge				Galveston				Lee
		Houma	Assumption				Harris			Miami	Broward
			Lafourche				Liberty				Miami-Dade
			St. Mary				Montgomery				Monroe
			Terrebonne				San Jacinto			Sarasota	Charlotte
	LA-4	New Orleans	Jefferson				Waller				DeSoto
			Orleans				Washington				Manatee
			Plaquemines								Sarasota
			St. Bernard								
			St. Charles								
			St. James								
			St. John the Baptist								
			St. Tammany								
			Washington								

Table 4-24

Demographic and Employment Baseline Projections for Economic Impact Area TX-1

	2005	2010	2011	2012	2013	2014	2015	2020	2025	2030	2040
Total Population (in thousands)	1,625.42	1,771.25	1,807.15	1,843.24	1,879.50	1,915.95	1,952.51	2,137.01	2,323.71	2,511.01	2,886.77
Age Under 19 Years	36.1%	36.4%	36.4%	36.4%	36.4%	36.4%	36.4%	36.6%	35.7%	34.9%	33.6%
Age 20 to 34	21.0%	20.2%	20.0%	20.0%	19.9%	19.9%	19.8%	18.8%	19.2%	19.6%	20.1%
Age 35 to 49	18.7%	18.0%	17.8%	17.6%	17.4%	17.3%	17.1%	17.1%	16.5%	16.3%	15.9%
Age 50 to 64	13.5%	14.6%	14.8%	14.8%	14.9%	14.9%	14.8%	14.5%	14.3%	13.8%	13.6%
Age 65 and Over	10.7%	10.9%	11.0%	11.2%	11.4%	11.6%	11.9%	13.1%	14.3%	15.4%	16.8%
Median Age of Population (years)	33	34	34	34	35	35	35	36	36	37	38
White Population (in thousands)	18.7%	16.8%	16.4%	16.1%	15.8%	15.5%	15.3%	14.1%	13.1%	12.3%	11.2%
Black Population (in thousands)	1.3%	1.3%	1.3%	1.2%	1.2%	1.2%	1.2%	1.1%	1.1%	1.1%	1.0%
Native American Population (in thousands)	0.2%	0.2%	0.2%	0.2%	0.2%	0.2%	0.2%	0.2%	0.2%	0.2%	0.1%
Asian and Pacific Islander Population (in thousands)	0.9%	0.9%	0.9%	0.9%	0.9%	0.9%	0.9%	0.9%	0.9%	0.9%	0.9%
Hispanic or Latino Population (in thousands)	79.0%	80.9%	81.2%	81.5%	81.9%	82.1%	82.4%	83.7%	84.7%	85.5%	86.8%
Male Population (in thousands)	48.7%	48.8%	48.8%	48.8%	48.8%	48.8%	48.8%	48.8%	48.8%	48.8%	48.8%
Total Employment (in thousands of jobs)	728.91	840.00	864.86	878.23	891.81	905.55	919.48	991.85	1,069.01	1,151.17	1,331.45
Farm Employment	1.7%	1.6%	1.6%	1.5%	1.5%	1.5%	1.4%	1.3%	1.2%	1.1%	0.9%
Forestry, Fishing, Related Activities	1.2%	1.1%	1.1%	1.1%	1.0%	1.0%	1.0%	1.0%	0.9%	0.8%	0.7%
Mining	1.8%	2.4%	2.4%	2.3%	2.3%	2.3%	2.3%	2.1%	2.0%	1.8%	1.6%
Utilities	0.3%	0.3%	0.3%	0.3%	0.3%	0.3%	0.3%	0.2%	0.2%	0.2%	0.2%
Construction	7.2%	6.0%	6.0%	6.0%	5.9%	5.9%	5.9%	5.8%	5.8%	5.7%	5.5%
Manufacturing	4.0%	3.2%	3.1%	3.1%	3.0%	3.0%	3.0%	2.7%	2.5%	2.3%	2.0%
Wholesale Trade	2.8%	2.4%	2.4%	2.3%	2.3%	2.3%	2.3%	2.1%	2.0%	1.9%	1.7%
Retail Trade	12.0%	11.4%	11.4%	11.3%	11.3%	11.3%	11.2%	11.1%	10.9%	10.7%	10.3%
Transportation and Warehousing	3.3%	3.4%	3.4%	3.4%	3.4%	3.4%	3.4%	3.4%	3.3%	3.3%	3.3%
Information Employment	1.2%	1.0%	1.0%	1.0%	1.0%	1.0%	1.0%	1.0%	1.0%	1.0%	0.9%
Finance and Insurance	3.1%	3.4%	3.4%	3.4%	3.4%	3.4%	3.4%	3.4%	3.4%	3.4%	3.4%
Real Estate / Rental and Lease	3.0%	2.9%	2.9%	2.9%	2.9%	2.9%	2.9%	2.9%	3.0%	3.0%	3.0%
Professional and Technical Services	3.4%	3.2%	3.2%	3.2%	3.2%	3.3%	3.3%	3.4%	3.5%	3.7%	3.9%
Management	0.2%	0.2%	0.2%	0.2%	0.2%	0.2%	0.2%	0.3%	0.3%	0.3%	0.3%
Administrative and Waste Services	5.4%	5.6%	5.7%	5.7%	5.8%	5.8%	5.9%	6.1%	6.3%	6.6%	7.0%
Educational Services	0.8%	1.0%	1.0%	1.0%	1.0%	1.0%	1.0%	1.0%	1.0%	1.1%	1.1%
Health Care and Social Assistance	15.6%	17.9%	18.0%	18.2%	18.4%	18.6%	18.7%	19.6%	20.5%	21.4%	23.3%
Arts, Entertainment, and Recreation	1.1%	1.1%	1.1%	1.1%	1.1%	1.1%	1.1%	1.1%	1.1%	1.1%	1.1%
Accommodation and Food Services	7.2%	7.3%	7.3%	7.3%	7.3%	7.3%	7.3%	7.3%	7.3%	7.2%	7.2%
Other Services, Except Public Administration	6.5%	6.3%	6.3%	6.3%	6.3%	6.3%	6.3%	6.3%	6.4%	6.4%	6.4%
Federal Civilian Government	1.7%	1.8%	1.7%	1.7%	1.7%	1.7%	1.7%	1.6%	1.5%	1.4%	1.2%
Federal Military	1.3%	1.1%	1.1%	1.1%	1.0%	1.0%	1.0%	0.9%	0.9%	0.8%	0.7%
State and Local Government	15.1%	15.7%	15.6%	15.6%	15.6%	15.5%	15.5%	15.3%	15.1%	14.9%	14.4%

Table 4-24. Demographic and Employment Baseline Projections for Economic Impact Area TX-1 (continued).

	2005	2010	2011	2012	2013	2014	2015	2020	2025	2030	2040
Total Earnings (in millions of 2005 dollars)	24,168.27	25,503.71	26,303.90	26,962.27	27,636.74	28,327.69	29,035.50	32,841.93	37,134.15	41,972.31	53,564.65
Farm	1.6%	0.5%	0.5%	0.5%	0.5%	0.4%	0.4%	0.4%	0.3%	0.3%	0.2%
Forestry, Fishing, Related Activities	0.7%	0.7%	0.7%	0.7%	0.6%	0.6%	0.6%	0.6%	0.5%	0.5%	0.4%
Mining	3.6%	5.4%	5.3%	5.3%	5.3%	5.3%	5.3%	5.3%	5.3%	5.3%	5.3%
Utilities	0.6%	0.7%	0.7%	0.7%	0.7%	0.7%	0.7%	0.7%	0.7%	0.7%	0.7%
Construction	7.5%	6.2%	6.6%	6.5%	6.4%	6.3%	6.3%	5.9%	5.5%	5.1%	4.4%
Manufacturing	5.9%	4.8%	4.9%	4.8%	4.8%	4.7%	4.6%	4.3%	4.0%	3.6%	3.1%
Wholesale Trade	4.2%	4.0%	4.1%	4.1%	4.0%	4.0%	4.0%	3.8%	3.6%	3.4%	3.1%
Retail Trade	8.8%	7.9%	8.0%	7.9%	7.9%	7.9%	7.8%	7.6%	7.4%	7.1%	6.7%
Transportation and Warehousing	3.6%	3.6%	3.6%	3.6%	3.6%	3.6%	3.6%	3.5%	3.4%	3.4%	3.3%
Information	1.5%	1.2%	1.2%	1.2%	1.2%	1.2%	1.2%	1.2%	1.2%	1.2%	1.2%
Finance and Insurance	3.4%	2.9%	2.9%	2.9%	2.9%	3.0%	3.0%	3.1%	3.2%	3.3%	3.5%
Real Estate / Rental and Lease	1.4%	1.1%	1.1%	1.1%	1.1%	1.1%	1.1%	1.2%	1.2%	1.2%	1.3%
Professional and Technical Services	4.6%	3.9%	3.8%	3.8%	3.9%	3.9%	3.9%	4.1%	4.2%	4.3%	4.6%
Management	0.1%	0.3%	0.2%	0.2%	0.2%	0.2%	0.3%	0.3%	0.3%	0.4%	0.4%
Administrative and Waste Services	3.0%	3.2%	3.2%	3.3%	3.3%	3.3%	3.4%	3.5%	3.7%	3.9%	4.3%
Educational Services	0.6%	0.7%	0.7%	0.7%	0.7%	0.7%	0.7%	0.7%	0.7%	0.7%	0.8%
Health Care and Social Assistance	14.9%	17.9%	18.0%	18.2%	18.4%	18.6%	18.8%	19.8%	20.8%	21.8%	23.8%
Arts, Entertainment, and Recreation	0.4%	0.4%	0.4%	0.4%	0.4%	0.4%	0.4%	0.4%	0.4%	0.3%	0.3%
Accommodation and Food Services	3.4%	3.2%	3.2%	3.2%	3.2%	3.2%	3.2%	3.1%	3.1%	3.1%	3.0%
Other Services, Except Public Administration	4.5%	4.1%	4.1%	4.1%	4.1%	4.1%	4.1%	4.1%	4.1%	4.1%	4.1%
Federal Civilian Government	4.9%	5.6%	5.5%	5.5%	5.4%	5.4%	5.4%	5.2%	5.1%	4.9%	4.6%
Federal Military	2.8%	2.8%	2.8%	2.7%	2.7%	2.7%	2.6%	2.5%	2.4%	2.3%	2.0%
State and Local Government	17.8%	18.8%	18.7%	18.7%	18.7%	18.7%	18.8%	18.8%	18.9%	18.9%	18.8%
Total Personal Income Per Capita (in 2005 dollars)	21,146	22,321	22,304	22,511	22,729	22,955	23,191	24,519	26,103	27,956	32,387
Woods & Poole Economics Wealth Index (U.S. = 100)	68.3	75.0	74.8	74.9	75.0	75.2	75.3	75.9	76.5	77.0	77.8
Persons Per Household (in number of people)	3.3	3.2	3.2	3.2	3.2	3.2	3.2	3.2	3.1	3.1	3.2
Mean Household Total Personal Income (in 2005 dollars)	69,895	79,290	79,758	80,471	81,303	82,071	82,820	87,661	93,266	100,012	116,180
Number of Households (in thousands)	499.93	548.88	560.61	573.81	586.98	600.13	613.23	677.74	740.82	801.64	914.78
Income < $10,000 (thousands of households, 2000 dollars)	15.6%	14.2%	13.9%	13.7%	13.5%	13.3%	13.1%	12.0%	10.6%	9.0%	6.7%
Income $10,000 to $19,999	17.6%	16.0%	15.7%	15.5%	15.2%	15.0%	14.8%	13.6%	12.0%	10.2%	7.6%
Income $20,000 to $29,999	15.0%	13.8%	13.6%	13.4%	13.2%	13.0%	12.8%	11.7%	10.3%	8.8%	6.5%
Income $30,000 to $44,999	18.8%	19.9%	20.0%	20.1%	20.2%	20.3%	20.4%	20.5%	19.8%	17.5%	13.0%
Income $45,000 to $59,999	12.5%	13.7%	14.0%	14.2%	14.4%	14.6%	14.8%	16.0%	17.7%	19.7%	19.7%
Income $60,000 to $74,999	7.7%	8.5%	8.6%	8.7%	8.9%	9.0%	9.1%	9.9%	11.2%	13.1%	17.3%
Income $75,000 to $99,999	6.6%	7.2%	7.3%	7.4%	7.5%	7.7%	7.8%	8.4%	9.5%	11.1%	15.0%
Income $100,000 or more	6.1%	6.7%	6.8%	6.9%	7.1%	7.2%	7.3%	7.9%	8.9%	10.5%	14.2%

Notes: Median age, wealth index, and mean household income is the average of the original Woods & Poole values for the 13 counties in the EIA; income per capita calculated using personal income/total population for the EIA; persons per household calculated using total population/number of households for the EIA.

Source: Woods & Poole Economics, Inc., 2010.

Table 4-25

Demographic and Employment Baseline Projections for Economic Impact Area TX-2

	2005	2010	2011	2012	2013	2014	2015	2020	2025	2030	2040
Total Population (in thousands)	579.99	626.33	634.39	642.51	650.70	658.94	667.23	709.17	751.75	794.43	879.89
Age Under 19 Years	29.7%	29.4%	29.3%	29.3%	29.2%	29.2%	29.1%	29.1%	28.9%	28.5%	27.9%
Age 20 to 34	18.6%	18.9%	19.2%	19.3%	19.4%	19.3%	19.2%	19.1%	19.0%	19.0%	19.4%
Age 35 to 49	22.5%	20.5%	20.0%	19.5%	19.1%	18.9%	18.7%	18.1%	17.9%	18.0%	18.1%
Age 50 to 64	16.8%	18.5%	18.8%	18.9%	19.1%	19.2%	19.2%	18.4%	17.2%	16.0%	15.4%
Age 65 and Over	12.3%	12.6%	12.7%	13.0%	13.2%	13.5%	13.7%	15.3%	17.1%	18.5%	19.2%
Median Age of Population (in years)	39	40	40	39	39	39	39	39	39	39	39
White Population (in thousands)	58.9%	55.1%	54.5%	53.8%	53.2%	52.6%	51.9%	48.8%	45.6%	42.5%	36.5%
Black Population (in thousands)	9.1%	9.9%	10.0%	10.0%	10.1%	10.2%	10.3%	10.7%	11.2%	11.8%	12.9%
Native American Population (in thousands)	0.3%	0.3%	0.3%	0.3%	0.4%	0.4%	0.4%	0.4%	0.4%	0.4%	0.5%
Asian and Pacific Islander Population (in thousands)	2.3%	3.1%	3.2%	3.2%	3.3%	3.3%	3.4%	3.5%	3.7%	3.8%	3.9%
Hispanic or Latino Population (in thousands)	29.4%	31.5%	32.0%	32.6%	33.1%	33.6%	34.1%	36.6%	39.1%	41.6%	46.2%
Male Population (in thousands)	50.4%	50.4%	50.4%	50.4%	50.4%	50.4%	50.4%	50.4%	50.4%	50.3%	50.2%
Total Employment (in thousands of jobs)	287.61	309.97	317.96	321.85	325.78	329.76	333.78	354.48	376.26	399.12	448.26
Farm Employment	7.4%	7.0%	6.9%	6.8%	6.7%	6.7%	6.6%	6.2%	5.8%	5.5%	4.8%
Forestry, Fishing, Related Activities	1.2%	1.2%	1.2%	1.2%	1.2%	1.2%	1.2%	1.2%	1.1%	1.1%	1.1%
Mining	2.4%	3.4%	3.4%	3.4%	3.3%	3.3%	3.3%	3.2%	3.0%	2.9%	2.7%
Utilities	0.6%	0.5%	0.5%	0.5%	0.5%	0.5%	0.5%	0.5%	0.5%	0.4%	0.4%
Construction	9.6%	7.5%	7.5%	7.6%	7.6%	7.7%	7.8%	8.0%	8.3%	8.5%	9.0%
Manufacturing	9.7%	9.2%	9.1%	9.0%	8.9%	8.8%	8.7%	8.2%	7.8%	7.3%	6.5%
Wholesale Trade	2.7%	2.5%	2.5%	2.5%	2.5%	2.5%	2.5%	2.5%	2.5%	2.5%	2.4%
Retail Trade	11.3%	11.0%	11.0%	11.0%	11.0%	11.0%	11.0%	10.9%	10.9%	10.8%	10.7%
Transportation and Warehousing	2.9%	3.0%	3.0%	3.0%	3.0%	3.0%	3.0%	3.1%	3.1%	3.1%	3.2%
Information Employment	0.8%	0.8%	0.8%	0.8%	0.8%	0.8%	0.8%	0.7%	0.7%	0.6%	0.6%
Finance and Insurance	3.4%	3.9%	3.9%	3.9%	3.9%	3.9%	3.9%	3.9%	3.9%	3.9%	3.8%
Real Estate / Rental and Lease	3.4%	3.6%	3.6%	3.6%	3.6%	3.6%	3.7%	3.7%	3.8%	3.9%	4.1%
Professional and Technical Services	3.9%	4.1%	4.1%	4.1%	4.2%	4.2%	4.2%	4.4%	4.6%	4.8%	5.1%
Federal Civilian Government	0.5%	0.5%	0.4%	0.4%	0.4%	0.4%	0.4%	0.4%	0.4%	0.4%	0.3%
Federal Military	0.5%	0.5%	0.5%	0.5%	0.5%	0.5%	0.5%	0.4%	0.4%	0.4%	0.3%
State and Local Government	12.9%	13.4%	13.4%	13.4%	13.4%	13.3%	13.3%	13.3%	13.2%	13.1%	12.8%
Management	0.2%	0.2%	0.2%	0.2%	0.2%	0.2%	0.2%	0.2%	0.2%	0.2%	0.2%
Administrative and Waste Services	4.6%	4.3%	4.3%	4.4%	4.4%	4.5%	4.5%	4.7%	5.0%	5.2%	5.7%
Educational Services	0.9%	1.3%	1.3%	1.3%	1.4%	1.4%	1.4%	1.5%	1.6%	1.7%	2.0%
Health Care and Social Assistance	7.7%	8.9%	8.9%	9.0%	9.1%	9.1%	9.2%	9.6%	10.0%	10.4%	11.3%
Arts, Entertainment, and Recreation	1.2%	1.4%	1.4%	1.4%	1.4%	1.4%	1.4%	1.4%	1.4%	1.3%	1.3%
Accommodation and Food Services	5.6%	5.7%	5.7%	5.7%	5.7%	5.7%	5.7%	5.6%	5.5%	5.5%	5.3%
Other Services, Except Public Administration	6.5%	6.2%	6.3%	6.3%	6.3%	6.3%	6.3%	6.3%	6.3%	6.3%	6.3%

Table 4-25. Demographic and Employment Baseline Projections for Economic Impact Area TX-2 (continued).

	2005	2010	2011	2012	2013	2014	2015	2020	2025	2030	2040
Total Earnings (in millions of 2005 dollars)	10,282.28	10,218.80	10,728.94	10,949.05	11,173.46	11,402.24	11,635.47	12,871.31	14,231.04	15,725.90	19,170.07
Farm Employment	3.5%	1.4%	1.2%	1.2%	1.2%	1.2%	1.1%	1.0%	0.9%	0.8%	0.7%
Forestry, Fishing, Related Activities	0.7%	0.6%	0.6%	0.6%	0.6%	0.6%	0.6%	0.6%	0.6%	0.5%	0.5%
Mining	4.3%	6.0%	5.8%	5.8%	5.8%	5.9%	5.9%	6.1%	6.3%	6.4%	6.8%
Utilities	1.6%	1.5%	1.4%	1.4%	1.4%	1.4%	1.5%	1.5%	1.6%	1.7%	1.8%
Construction	11.7%	9.1%	10.1%	10.1%	10.0%	10.0%	10.0%	9.8%	9.6%	9.5%	9.0%
Manufacturing	20.2%	19.4%	19.6%	19.4%	19.1%	18.9%	18.7%	17.7%	16.8%	15.8%	14.0%
Wholesale Trade	3.5%	3.8%	3.7%	3.7%	3.7%	3.7%	3.7%	3.8%	3.8%	3.8%	3.9%
Retail Trade	8.1%	7.8%	7.7%	7.7%	7.7%	7.7%	7.7%	7.6%	7.5%	7.4%	7.2%
Transportation and Warehousing	3.5%	3.7%	3.7%	3.7%	3.7%	3.7%	3.7%	3.7%	3.7%	3.8%	3.8%
Information Employment	0.8%	0.8%	0.8%	0.8%	0.8%	0.8%	0.8%	0.7%	0.7%	0.7%	0.6%
Finance and Insurance	3.0%	3.2%	3.3%	3.3%	3.4%	3.4%	3.4%	3.5%	3.6%	3.7%	3.8%
Real Estate / Rental and Lease	1.5%	1.7%	1.6%	1.6%	1.7%	1.7%	1.7%	1.8%	1.8%	1.9%	2.1%
Professional and Technical Services	3.9%	4.1%	4.1%	4.1%	4.2%	4.2%	4.3%	4.5%	4.7%	5.0%	5.5%
Management	0.1%	0.2%	0.3%	0.3%	0.3%	0.3%	0.3%	0.3%	0.3%	0.3%	0.4%
Administrative and Waste Services	2.5%	2.6%	2.6%	2.6%	2.7%	2.7%	2.7%	2.9%	3.1%	3.3%	3.7%
Educational Services	0.5%	0.7%	0.7%	0.7%	0.7%	0.7%	0.7%	0.8%	0.8%	0.9%	1.0%
Health Care and Social Assistance	7.5%	8.5%	8.6%	8.7%	8.7%	8.8%	8.9%	9.2%	9.6%	10.0%	10.8%
Arts, Entertainment, and Recreation	0.4%	0.4%	0.4%	0.4%	0.4%	0.4%	0.4%	0.4%	0.4%	0.4%	0.4%
Accommodation and Food Services	2.2%	2.5%	2.4%	2.4%	2.4%	2.4%	2.4%	2.3%	2.3%	2.2%	2.2%
Other Services, Except Public Administration	5.2%	4.9%	4.7%	4.7%	4.7%	4.7%	4.8%	4.8%	4.8%	4.8%	4.7%
Federal Civilian Government	0.9%	1.0%	1.0%	1.0%	1.0%	1.0%	1.0%	1.0%	1.0%	1.0%	1.0%
Federal Military	0.6%	0.7%	0.6%	0.6%	0.6%	0.6%	0.6%	0.6%	0.6%	0.6%	0.5%
State and Local Government	13.9%	15.5%	15.1%	15.1%	15.2%	15.2%	15.2%	15.4%	15.5%	15.5%	15.6%
Total Personal Income Per Capita (in 2005 dollars)	29,643	30,101	30,571	30,892	31,211	31,533	31,862	33,626	35,635	37,920	43,270
Woods & Poole Economics Wealth Index (U.S. = 100)	79.0	80.7	81.0	81.2	81.4	81.6	81.8	82.8	83.8	84.8	86.9
Persons Per Household (in number of people)	2.8	2.8	2.8	2.8	2.7	2.7	2.7	2.7	2.7	2.7	2.8
Mean Household Total Personal Income (in 2005 dollars)	71,979	73,706	75,027	75,915	76,840	77,800	78,796	84,429	91,140	99,046	118,671
Total Number of Households (in thousands)	208.95	226.47	229.54	233.19	236.81	240.39	243.95	261.04	277.09	291.82	317.15
Income < $10,000 (thousands of households, 2000 dollars)	9.6%	8.8%	8.5%	8.4%	8.2%	8.1%	7.9%	7.1%	6.3%	5.5%	4.2%
Income $10,000 to $19,999	12.9%	11.8%	11.6%	11.4%	11.2%	11.0%	10.7%	9.7%	8.7%	7.6%	5.8%
Income $20,000 to $29,999	12.9%	11.9%	11.7%	11.5%	11.3%	11.1%	10.9%	9.8%	8.9%	7.8%	6.0%
Income $30,000 to $44,999	17.5%	16.9%	16.7%	16.5%	16.3%	16.1%	15.9%	14.5%	13.1%	11.5%	8.8%
Income $45,000 to $59,999	14.4%	15.0%	15.2%	15.3%	15.4%	15.6%	15.7%	16.1%	15.7%	14.2%	10.8%
Income $60,000 to $74,999	11.3%	12.1%	12.4%	12.6%	12.8%	13.0%	13.3%	14.6%	16.1%	17.6%	17.2%
Income $75,000 to $99,999	11.0%	11.9%	12.2%	12.4%	12.6%	12.8%	13.0%	14.4%	15.9%	18.1%	24.0%
Income $100,000 or More	10.6%	11.5%	11.8%	12.0%	12.2%	12.4%	12.6%	13.9%	15.4%	17.5%	23.3%

Notes: Median age, wealth index, and mean household income is the average of the original Woods & Poole values for the 12 counties in the EIA; income per capita calculated using personal income/total population for the EIA; persons per household calculated using total population/number of households for the EIA.

Source: Woods & Poole Economics, Inc., 2010.

Table 4-26

Demographic and Employment Baseline Projections for Economic Impact Area TX-3

	2005	2010	2011	2012	2013	2014	2015	2020	2025	2030	2040
Total Population (in thousands)	5,552.60	6,192.43	6,299.99	6,408.25	6,517.13	6,626.68	6,736.63	7,292.42	7,855.87	8,421.37	9,556.30
Age Under 19 years	30.9%	30.8%	30.7%	30.6%	30.6%	30.5%	30.4%	30.2%	29.7%	29.4%	28.8%
Age 20 to 34	22.3%	21.8%	21.8%	21.7%	21.7%	21.6%	21.5%	21.2%	21.4%	21.2%	20.9%
Age 35 to 49	22.7%	21.2%	20.9%	20.6%	20.4%	20.3%	20.2%	19.7%	19.1%	18.9%	19.0%
Age 50 to 64	15.6%	17.1%	17.4%	17.4%	17.5%	17.5%	17.5%	16.9%	16.1%	15.6%	15.1%
Age 65 and over	8.6%	9.1%	9.3%	9.5%	9.8%	10.1%	10.4%	12.0%	13.7%	14.9%	16.2%
Median Age of Population (in years)	37	38	38	38	38	38	38	38	39	39	40
White Population (in thousands)	46.5%	43.0%	42.3%	41.7%	41.1%	40.4%	39.8%	36.8%	33.9%	31.3%	26.4%
Black Population (in thousands)	17.4%	17.4%	17.3%	17.2%	17.0%	16.9%	16.8%	16.3%	15.7%	15.1%	13.9%
Native American Population (in thousands)	0.3%	0.3%	0.4%	0.4%	0.4%	0.4%	0.4%	0.4%	0.4%	0.4%	0.4%
Asian and Pacific Islander Population (in thousands)	5.4%	5.9%	6.1%	6.2%	6.3%	6.4%	6.5%	7.1%	7.6%	8.2%	9.2%
Hispanic or Latino Population (in thousands)	30.4%	33.4%	34.0%	34.6%	35.2%	35.9%	36.5%	39.5%	42.4%	45.1%	50.0%
Male Population (in thousands)	50.0%	50.1%	50.1%	50.1%	50.0%	50.0%	50.0%	49.9%	49.8%	49.7%	49.5%
Total Employment (in thousands of jobs)	3,218.66	3,596.00	3,700.61	3,758.99	3,818.15	3,878.09	3,938.83	4,254.86	4,592.14	4,951.73	5,742.46
Farm Employment	0.6%	0.6%	0.6%	0.6%	0.6%	0.6%	0.6%	0.5%	0.5%	0.4%	0.4%
Forestry, Fishing, Related Activities	0.2%	0.2%	0.2%	0.2%	0.2%	0.2%	0.2%	0.2%	0.2%	0.2%	0.2%
Mining	2.8%	3.5%	3.4%	3.4%	3.4%	3.3%	3.3%	3.1%	2.9%	2.8%	2.5%
Utilities	0.5%	0.6%	0.6%	0.6%	0.5%	0.5%	0.5%	0.5%	0.5%	0.4%	0.4%
Construction	8.0%	7.2%	7.3%	7.3%	7.3%	7.3%	7.4%	7.5%	7.6%	7.8%	8.0%
Manufacturing	7.4%	7.4%	7.3%	7.2%	7.2%	7.1%	7.0%	6.6%	6.2%	5.9%	5.2%
Wholesale Trade	4.5%	4.3%	4.3%	4.3%	4.3%	4.2%	4.2%	4.2%	4.2%	4.2%	4.1%
Retail Trade	10.2%	9.4%	9.4%	9.4%	9.4%	9.4%	9.4%	9.3%	9.3%	9.2%	9.0%
Transportation and Warehousing	4.3%	4.3%	4.3%	4.3%	4.3%	4.3%	4.3%	4.2%	4.2%	4.1%	4.0%
Information Employment	1.5%	1.3%	1.3%	1.3%	1.3%	1.3%	1.3%	1.2%	1.2%	1.1%	1.0%
Finance and Insurance	4.5%	4.5%	4.5%	4.5%	4.5%	4.5%	4.5%	4.5%	4.5%	4.4%	4.4%
Real Estate / Rental and Lease	4.1%	3.9%	3.9%	3.9%	3.9%	3.9%	3.9%	3.9%	3.9%	3.9%	3.9%
Professional and Technical Services	7.8%	8.0%	8.0%	8.0%	8.1%	8.1%	8.2%	8.5%	8.7%	9.0%	9.6%
Management	0.6%	0.7%	0.7%	0.7%	0.7%	0.7%	0.7%	0.7%	0.8%	0.8%	0.8%
Administrative and Waste Services	7.4%	7.1%	7.1%	7.2%	7.2%	7.3%	7.3%	7.6%	7.9%	8.2%	8.8%
Educational Services	1.6%	1.7%	1.7%	1.8%	1.8%	1.8%	1.8%	1.8%	1.9%	1.9%	2.0%
Health Care and Social Assistance	8.2%	9.5%	9.5%	9.6%	9.6%	9.6%	9.7%	9.9%	10.1%	10.3%	10.8%
Arts, Entertainment, and Recreation	1.5%	1.5%	1.5%	1.5%	1.5%	1.5%	1.5%	1.5%	1.5%	1.5%	1.5%
Accommodation and Food Services	6.5%	6.7%	6.7%	6.7%	6.7%	6.7%	6.7%	6.7%	6.7%	6.7%	6.8%
Other Services, Except Public Administration	6.0%	5.8%	5.9%	5.9%	5.9%	5.9%	5.9%	6.0%	6.1%	6.1%	6.2%
Federal Civilian Government	1.0%	0.9%	0.9%	0.9%	0.9%	0.8%	0.8%	0.8%	0.7%	0.7%	0.6%
Federal Military	0.4%	0.4%	0.4%	0.4%	0.4%	0.4%	0.4%	0.4%	0.3%	0.3%	0.3%
State and Local Government	10.3%	10.5%	10.5%	10.4%	10.4%	10.4%	10.4%	10.3%	10.1%	10.0%	9.7%

Table 4-26. Demographic and Employment Baseline Projections for Economic Impact Area TX-3 (continued)

	2005	2010	2011	2012	2013	2014	2015	2020	2025	2030	2040
Total Earnings (in millions of 2005 dollars)	186,536.19	200,395.27	208,221.43	213,342.61	218,582.25	223,942.87	229,427.07	258,795.84	291,672.20	328,441.16	415,393.44
Farm Employment	0.1%	0.1%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Forestry, Fishing, Related Activities	0.1%	0.1%	0.1%	0.1%	0.1%	0.1%	0.1%	0.1%	0.1%	0.1%	0.1%
Mining	12.3%	13.9%	13.7%	13.8%	13.8%	13.9%	13.9%	14.2%	14.4%	14.6%	15.0%
Utilities	1.6%	2.2%	2.1%	2.1%	2.1%	2.1%	2.1%	2.1%	2.1%	2.1%	2.0%
Construction	8.2%	6.8%	7.3%	7.2%	7.2%	7.1%	7.1%	6.9%	6.6%	6.4%	5.9%
Manufacturing	11.7%	11.5%	11.8%	11.7%	11.5%	11.4%	11.3%	10.6%	10.0%	9.4%	8.4%
Wholesale Trade	6.2%	6.1%	6.2%	6.2%	6.2%	6.2%	6.2%	6.2%	6.3%	6.3%	6.3%
Retail Trade	5.2%	4.6%	4.6%	4.6%	4.6%	4.5%	4.5%	4.4%	4.3%	4.2%	4.0%
Transportation and Warehousing	5.6%	5.6%	5.6%	5.6%	5.5%	5.5%	5.5%	5.3%	5.2%	5.1%	4.8%
Information Employment	1.7%	1.4%	1.4%	1.4%	1.4%	1.4%	1.4%	1.3%	1.2%	1.2%	1.1%
Finance and Insurance	5.5%	5.2%	5.2%	5.2%	5.2%	5.2%	5.3%	5.4%	5.4%	5.5%	5.6%
Real Estate / Rental and Lease	2.4%	1.5%	1.5%	1.5%	1.5%	1.5%	1.5%	1.5%	1.6%	1.6%	1.7%
Professional and Technical Services	10.8%	10.8%	10.7%	10.8%	10.8%	10.9%	11.0%	11.4%	11.8%	12.2%	13.0%
Management	0.6%	1.2%	1.2%	1.2%	1.2%	1.2%	1.3%	1.4%	1.5%	1.6%	1.8%
Administrative and Waste Services	4.4%	3.9%	4.0%	4.0%	4.1%	4.1%	4.1%	4.3%	4.6%	4.8%	5.2%
Educational Services	1.0%	1.0%	1.0%	1.0%	1.0%	1.0%	1.0%	1.1%	1.1%	1.1%	1.2%
Health Care and Social Assistance	6.5%	7.2%	7.1%	7.2%	7.2%	7.2%	7.3%	7.4%	7.5%	7.7%	7.9%
Arts, Entertainment, and Recreation	0.7%	0.7%	0.7%	0.7%	0.7%	0.7%	0.7%	0.7%	0.6%	0.6%	0.6%
Accommodation and Food Services	2.3%	2.2%	2.2%	2.2%	2.2%	2.2%	2.2%	2.2%	2.1%	2.1%	2.1%
Other Services, Except Public Administration	3.1%	2.9%	2.8%	2.8%	2.8%	2.8%	2.8%	2.9%	2.9%	2.9%	2.9%
Federal Civilian Government	1.7%	1.7%	1.7%	1.7%	1.6%	1.6%	1.6%	1.6%	1.5%	1.5%	1.4%
Federal Military	0.3%	0.4%	0.4%	0.4%	0.4%	0.4%	0.4%	0.4%	0.3%	0.3%	0.3%
State and Local Government	8.3%	8.9%	8.8%	8.8%	8.8%	8.8%	8.8%	8.8%	8.8%	8.7%	8.6%
Total Personal Income Per Capita (in 2005 dollars)	38,941	38,315	39,041	39,421	39,818	40,231	40,661	43,035	45,798	48,984	56,613
Woods & Poole Economics Wealth Index (U.S. = 100)	85.7	87.4	87.9	87.8	87.6	87.5	87.4	86.9	86.7	86.7	87.2
Persons Per Household (in number of people)	2.8	2.8	2.8	2.8	2.8	2.8	2.8	2.8	2.8	2.8	2.9
Mean Household Total Personal Income (in 2005 dollars)	80,484	82,582	84,242	84,841	85,460	86,115	86,816	91,101	96,652	103,525	121,269
Total Number of Households (in thousands)	1,988.28	2,215.36	2,252.62	2,295.55	2,338.22	2,380.57	2,422.51	2,625.44	2,817.83	2,996.74	3,310.18
Income < $10,000 (thousands of households, 2000 dollars)	8.7%	8.2%	8.0%	7.9%	7.7%	7.6%	7.4%	6.7%	6.0%	5.4%	4.2%
Income $10,000 to $19,999	11.0%	10.4%	10.1%	10.0%	9.8%	9.7%	9.5%	8.6%	7.7%	6.9%	5.5%
Income $20,000 to $29,999	12.0%	11.4%	11.1%	11.0%	10.8%	10.6%	10.4%	9.4%	8.5%	7.6%	6.0%
Income $30,000 to $44,999	16.8%	16.1%	15.8%	15.6%	15.4%	15.1%	14.8%	13.5%	12.2%	11.0%	8.7%
Income $45,000 to $59,999	14.0%	14.4%	14.5%	14.5%	14.6%	14.6%	14.6%	14.2%	13.1%	11.9%	9.4%
Income $60,000 to $74,999	10.8%	11.3%	11.5%	11.7%	11.9%	12.1%	12.3%	13.4%	14.4%	14.9%	13.3%
Income $75,000 to $99,999	11.4%	12.0%	12.3%	12.4%	12.6%	12.9%	13.1%	14.4%	16.0%	17.8%	21.5%
Income $100,000 or more	15.4%	16.3%	16.7%	16.9%	17.2%	17.5%	17.9%	19.7%	22.0%	24.6%	31.3%

Notes: Median age, wealth index, and mean household income is the average of the original Woods & Poole values for the 17 counties in the EIA; income per capita calculated using personal income/total population for the EIA; persons per household calculated using total population/number of households for the EIA.

Source: Woods & Poole Economics, Inc., 2010.

Table 4-27

Demographic and Employment Baseline Projections for Economic Impact Area LA1

	2005	2010	2011	2012	2013	2014	2015	2020	2025	2030	2040
Total Population (in thousands)	334.22	334.72	336.53	338.39	340.27	342.20	344.15	354.20	364.61	375.07	396.08
Age Under 19 years	29.2%	28.5%	28.4%	28.3%	28.3%	28.2%	28.2%	28.1%	27.8%	27.2%	26.0%
Age 20 to 34	21.8%	21.9%	21.9%	21.9%	21.7%	21.4%	20.8%	19.6%	19.1%	19.0%	19.4%
Age 35 to 49	20.9%	18.9%	18.5%	18.3%	18.1%	18.1%	18.4%	18.6%	18.9%	18.2%	17.3%
Age 50 to 64	16.2%	18.1%	18.5%	18.6%	18.8%	18.9%	19.0%	18.4%	17.1%	16.9%	17.8%
Age 65 and over	11.9%	12.6%	12.6%	12.9%	13.2%	13.4%	13.6%	15.2%	17.1%	18.7%	19.6%
Median Age of Population (in years)	35	35	36	36	36	36	36	38	39	40	41
White Population (in thousands)	74.6%	73.9%	73.8%	73.8%	73.7%	73.6%	73.6%	73.2%	72.8%	72.3%	71.4%
Black Population (in thousands)	20.8%	20.7%	20.7%	20.7%	20.7%	20.7%	20.6%	20.5%	20.4%	20.4%	20.3%
Native American Population (in thousands)	0.7%	0.7%	0.7%	0.7%	0.7%	0.7%	0.7%	0.8%	0.8%	0.8%	0.8%
Asian and Pacific Islander Population (in thousands)	1.0%	1.1%	1.1%	1.1%	1.1%	1.2%	1.2%	1.3%	1.4%	1.5%	1.7%
Hispanic or Latino Population (in thousands)	3.0%	3.5%	3.6%	3.7%	3.8%	3.8%	3.9%	4.3%	4.6%	5.0%	5.8%
Male Population (in thousands)	49.9%	49.8%	49.8%	49.8%	49.8%	49.8%	49.8%	49.8%	49.7%	49.7%	49.5%
Total Employment (in thousands of jobs)	171.65	177.73	182.05	183.91	185.81	187.70	189.62	199.43	209.65	220.27	242.80
Farm Employment	1.9%	1.9%	1.9%	1.9%	1.9%	1.9%	1.8%	1.8%	1.7%	1.6%	1.5%
Forestry, Fishing, Related Activities	1.0%	1.0%	1.0%	1.0%	1.0%	1.0%	1.0%	1.0%	1.0%	1.0%	1.1%
Mining	1.1%	1.2%	1.2%	1.2%	1.2%	1.2%	1.2%	1.1%	1.0%	1.0%	0.9%
Utilities	0.4%	0.3%	0.3%	0.3%	0.3%	0.3%	0.3%	0.3%	0.3%	0.3%	0.2%
Construction	8.7%	8.9%	9.0%	9.0%	9.0%	9.1%	9.1%	9.3%	9.4%	9.6%	9.8%
Manufacturing	6.7%	6.7%	6.6%	6.5%	6.4%	6.4%	6.3%	5.9%	5.5%	5.1%	4.5%
Wholesale Trade	2.2%	2.0%	2.0%	2.0%	1.9%	1.9%	1.9%	1.8%	1.7%	1.6%	1.5%
Retail Trade	11.0%	10.4%	10.4%	10.4%	10.4%	10.4%	10.4%	10.3%	10.3%	10.2%	10.0%
Transportation and Warehousing	3.2%	2.8%	2.8%	2.8%	2.8%	2.8%	2.8%	2.8%	2.8%	2.7%	2.7%
Information Employment	1.0%	1.0%	1.0%	1.0%	1.0%	1.0%	1.0%	0.9%	0.9%	0.9%	0.9%
Finance and Insurance	2.5%	2.5%	2.5%	2.5%	2.5%	2.5%	2.4%	2.4%	2.3%	2.2%	2.1%
Real Estate / Rental and Lease	2.4%	2.4%	2.4%	2.4%	2.4%	2.5%	2.5%	2.5%	2.6%	2.6%	2.8%
Professional and Technical Services	4.7%	4.5%	4.5%	4.5%	4.6%	4.6%	4.7%	4.9%	5.1%	5.3%	5.8%
Management	0.7%	0.6%	0.6%	0.6%	0.6%	0.6%	0.6%	0.6%	0.6%	0.6%	0.5%
Administrative and Waste Services	3.8%	4.9%	5.0%	5.0%	5.1%	5.2%	5.3%	5.8%	6.2%	6.8%	7.9%
Educational Services	1.0%	0.9%	0.9%	0.9%	0.9%	0.9%	0.9%	0.9%	0.9%	0.9%	0.8%
Health Care and Social Assistance	9.5%	10.7%	10.8%	10.9%	11.0%	11.1%	11.2%	11.8%	12.4%	12.9%	14.1%
Arts, Entertainment, and Recreation	2.3%	1.2%	1.2%	1.2%	1.2%	1.2%	1.2%	1.1%	1.1%	1.1%	1.0%
Accommodation and Food Services	7.9%	7.6%	7.6%	7.6%	7.6%	7.6%	7.6%	7.7%	7.7%	7.7%	7.6%
Other Services, Except Public Administration	6.2%	5.8%	5.8%	5.8%	5.9%	5.9%	6.0%	6.2%	6.3%	6.5%	6.9%
Federal Civilian Government	2.1%	2.0%	2.0%	2.0%	2.0%	1.9%	1.9%	1.8%	1.7%	1.6%	1.4%
Federal Military	5.7%	5.8%	5.8%	5.7%	5.6%	5.6%	5.5%	5.2%	4.9%	4.6%	4.1%
State and Local Government	14.0%	14.8%	14.8%	14.7%	14.6%	14.5%	14.4%	14.0%	13.6%	13.2%	12.3%

Table 4-27. Demographic and Employment Baseline Projections for Economic Impact Area LA-1 (continued).

	2005	2010	2011	2012	2013	2014	2015	2020	2025	2030	2040
Total Earnings (in millions of 2005 dollars)	6,873.26	7,285.45	7,545.69	7,677.77	7,811.98	7,948.32	8,086.83	8,813.22	9,599.12	10,449.14	12,361.78
Farm Employment	0.5%	0.8%	0.6%	0.6%	0.6%	0.6%	0.6%	0.6%	0.5%	0.5%	0.4%
Forestry, Fishing, Related Activities	0.7%	0.7%	0.7%	0.7%	0.7%	0.7%	0.7%	0.7%	0.7%	0.7%	0.7%
Mining	1.7%	2.3%	1.9%	1.9%	1.9%	1.9%	1.9%	2.0%	2.0%	2.0%	2.1%
Utilities	0.8%	0.7%	0.7%	0.7%	0.7%	0.7%	0.7%	0.7%	0.7%	0.7%	0.7%
Construction	7.6%	10.9%	11.8%	11.7%	11.7%	11.6%	11.6%	11.3%	11.0%	10.7%	10.0%
Manufacturing	14.6%	12.5%	12.7%	12.6%	12.4%	12.3%	12.2%	11.5%	10.8%	10.2%	8.9%
Wholesale Trade	2.7%	2.4%	2.4%	2.4%	2.4%	2.4%	2.4%	2.3%	2.2%	2.2%	2.0%
Retail Trade	6.3%	5.6%	5.6%	5.6%	5.5%	5.5%	5.5%	5.5%	5.4%	5.4%	5.2%
Transportation and Warehousing	3.6%	2.9%	2.9%	2.9%	2.9%	2.9%	2.9%	2.9%	2.8%	2.8%	2.8%
Information Employment	2.6%	2.2%	2.2%	2.2%	2.2%	2.2%	2.2%	2.2%	2.2%	2.3%	2.3%
Finance and Insurance	2.3%	2.1%	2.1%	2.1%	2.1%	2.1%	2.1%	2.1%	2.1%	2.1%	2.1%
Real Estate / Rental and Lease	1.2%	1.1%	1.1%	1.1%	1.2%	1.2%	1.2%	1.3%	1.3%	1.4%	1.6%
Professional and Technical Services	5.4%	5.4%	5.3%	5.4%	5.5%	5.5%	5.6%	6.0%	6.3%	6.7%	7.4%
Management	1.5%	0.6%	0.7%	0.7%	0.7%	0.7%	0.7%	0.7%	0.7%	0.7%	0.7%
Administrative and Waste Services	2.2%	3.0%	3.0%	3.1%	3.2%	3.2%	3.3%	3.7%	4.1%	4.5%	5.5%
Educational Services	0.6%	0.5%	0.5%	0.5%	0.5%	0.5%	0.5%	0.5%	0.5%	0.5%	0.5%
Health Care and Social Assistance	8.7%	9.2%	9.2%	9.3%	9.4%	9.5%	9.7%	10.2%	10.8%	11.4%	12.6%
Arts, Entertainment, and Recreation	1.5%	0.6%	0.6%	0.6%	0.6%	0.6%	0.6%	0.6%	0.6%	0.5%	0.5%
Accommodation and Food Services	3.7%	3.7%	3.7%	3.7%	3.7%	3.7%	3.7%	3.7%	3.7%	3.7%	3.8%
Other Services, Except Public Administration	3.7%	3.0%	3.0%	3.0%	3.1%	3.1%	3.1%	3.2%	3.3%	3.4%	3.7%
Federal Civilian Government	3.8%	4.1%	4.0%	4.0%	4.0%	4.0%	3.9%	3.9%	3.8%	3.7%	3.6%
Federal Military	10.6%	11.4%	11.3%	11.3%	11.2%	11.2%	11.2%	11.0%	10.8%	10.6%	10.1%
State and Local Government	13.8%	14.1%	13.8%	13.8%	13.8%	13.8%	13.7%	13.6%	13.4%	13.2%	12.8%
Total Personal Income Per Capita (in 2005 dollars)	27,573	29,916	30,288	30,714	31,145	31,584	32,032	34,415	37,065	39,997	46,695
Woods & Poole Economics Wealth Index (U.S. = 100)	70.1	84.8	84.6	84.8	85.0	85.2	85.4	86.4	87.4	88.4	90.3
Persons Per Household (in number of people)	2.7	2.7	2.7	2.7	2.7	2.7	2.6	2.6	2.6	2.6	2.6
Mean Household Total Personal Income (in 2005 dollars)	66,070	78,879	79,669	80,570	81,502	82,473	83,478	89,133	95,837	103,681	123,003
Total Number of Households (in thousands)	123.62	124.83	125.65	126.79	127.92	129.02	130.11	135.19	139.77	143.78	150.15
Income < $10,000 (thousands of households, 2000 dollars)	12.1%	10.9%	10.6%	10.5%	10.3%	10.1%	9.9%	8.7%	7.5%	6.4%	4.8%
Income $10,000 to $19,999	14.8%	13.3%	13.0%	12.8%	12.6%	12.3%	12.1%	10.6%	9.2%	7.8%	5.8%
Income $20,000 to $29,999	13.0%	11.6%	11.3%	11.1%	10.9%	10.7%	10.5%	9.2%	7.9%	6.8%	5.0%
Income $30,000 to $44,999	19.5%	18.6%	18.4%	18.2%	17.9%	17.6%	17.4%	15.3%	13.2%	11.3%	8.3%
Income $45,000 to $59,999	15.2%	17.0%	17.4%	17.7%	18.0%	18.3%	18.6%	20.1%	20.1%	18.3%	13.8%
Income $60,000 to $74,999	9.6%	10.8%	11.1%	11.3%	11.5%	11.7%	11.9%	13.7%	16.0%	18.7%	20.4%
Income $75,000 to $99,999	8.9%	9.9%	10.2%	10.3%	10.5%	10.7%	10.9%	12.5%	14.7%	17.4%	23.7%
Income $100,000 or more	6.9%	7.8%	8.0%	8.1%	8.2%	8.4%	8.5%	9.7%	11.4%	13.4%	18.2%

Notes: Median age, wealth index, and mean household income is the average of the original Woods & Poole values for the 6 parishes in the EIA; income per capita calculated using personal income/total population for the EIA; persons per household calculated using total population/number of households for the EIA.

Source: Woods & Poole Economics, Inc., 2010.

Table 4-28

Demographic and Employment Baseline Projections for Economic Impact Area LA-2

	2005	2010	2011	2012	2013	2014	2015	2020	2025	2030	2040
Total Population (in thousands)	558.39	587.88	593.59	599.38	605.23	611.14	617.10	647.47	678.54	709.79	772.62
Age Under 19 years	29.9%	28.9%	28.8%	28.7%	28.5%	28.5%	28.4%	28.2%	27.7%	27.0%	25.6%
Age 20 to 34	21.0%	22.0%	22.1%	22.0%	21.8%	21.5%	21.0%	19.5%	18.7%	18.6%	18.8%
Age 35 to 49	21.6%	19.1%	18.7%	18.4%	18.3%	18.3%	18.5%	19.3%	20.2%	19.5%	18.0%
Age 50 to 64	15.9%	18.0%	18.4%	18.6%	18.8%	18.9%	18.9%	18.4%	16.7%	16.5%	18.4%
Age 65 and over	11.6%	12.0%	12.1%	12.3%	12.6%	12.8%	13.1%	14.7%	16.7%	18.4%	19.1%
Median Age of Population (in years)	35	35	35	35	35	35	36	37	38	39	40
White Population (in thousands)	69.1%	68.3%	68.2%	68.1%	68.0%	67.9%	67.8%	67.2%	66.6%	66.0%	64.6%
Black Population (in thousands)	27.7%	28.0%	28.0%	28.0%	28.1%	28.1%	28.2%	28.4%	28.6%	28.8%	29.4%
Native American Population (in thousands)	0.3%	0.3%	0.3%	0.3%	0.3%	0.3%	0.3%	0.3%	0.3%	0.3%	0.3%
Asian and Pacific Islander Population (in thousands)	1.2%	1.2%	1.3%	1.3%	1.3%	1.3%	1.3%	1.5%	1.6%	1.7%	1.9%
Hispanic or Latino Population (in thousands)	1.7%	2.2%	2.2%	2.3%	2.3%	2.4%	2.4%	2.7%	2.9%	3.2%	3.8%
Male Population (in thousands)	48.6%	48.7%	48.7%	48.7%	48.8%	48.8%	48.8%	48.9%	48.9%	48.9%	48.8%
Total Employment (in thousands of jobs)	297.51	321.93	330.21	334.03	337.89	341.78	345.70	365.76	386.61	408.21	453.71
Farm Employment	1.9%	1.8%	1.8%	1.8%	1.7%	1.7%	1.7%	1.6%	1.5%	1.4%	1.3%
Forestry, Fishing, Related Activities	0.6%	0.5%	0.5%	0.5%	0.5%	0.5%	0.5%	0.5%	0.5%	0.5%	0.5%
Mining	6.9%	8.3%	8.3%	8.3%	8.2%	8.2%	8.2%	8.0%	7.8%	7.6%	7.2%
Utilities	0.2%	0.3%	0.3%	0.3%	0.3%	0.3%	0.2%	0.2%	0.2%	0.2%	0.2%
Construction	6.7%	6.8%	6.8%	6.8%	6.7%	6.7%	6.7%	6.5%	6.3%	6.2%	5.8%
Manufacturing	6.1%	5.9%	5.8%	5.7%	5.6%	5.6%	5.5%	5.1%	4.8%	4.4%	3.8%
Wholesale Trade	3.7%	3.6%	3.6%	3.5%	3.5%	3.5%	3.5%	3.4%	3.4%	3.3%	3.2%
Retail Trade	11.5%	11.2%	11.2%	11.2%	11.1%	11.1%	11.1%	10.9%	10.7%	10.5%	10.0%
Transportation and Warehousing	3.5%	3.0%	3.0%	3.0%	3.0%	3.0%	3.0%	3.0%	3.0%	3.0%	3.0%
Information Employment	1.5%	1.2%	1.2%	1.2%	1.2%	1.2%	1.2%	1.2%	1.2%	1.2%	1.2%
Finance and Insurance	3.4%	3.2%	3.2%	3.2%	3.2%	3.1%	3.1%	3.1%	3.0%	3.0%	2.8%
Real Estate / Rental and Lease	4.0%	3.4%	3.4%	3.4%	3.4%	3.4%	3.4%	3.3%	3.3%	3.3%	3.2%
Professional and Technical Services	4.7%	5.2%	5.2%	5.3%	5.3%	5.3%	5.4%	5.5%	5.6%	5.8%	6.0%
Management	1.1%	0.9%	0.9%	0.9%	0.9%	0.9%	0.9%	0.9%	1.0%	1.0%	1.0%
Administrative and Waste Services	4.6%	4.9%	4.9%	4.9%	4.9%	5.0%	5.0%	5.2%	5.3%	5.4%	5.7%
Educational Services	1.2%	1.5%	1.5%	1.5%	1.5%	1.5%	1.5%	1.5%	1.5%	1.5%	1.5%
Health Care and Social Assistance	11.2%	12.0%	12.1%	12.3%	12.5%	12.6%	12.8%	13.6%	14.4%	15.2%	17.0%
Arts, Entertainment, and Recreation	1.5%	1.4%	1.4%	1.4%	1.4%	1.4%	1.4%	1.5%	1.5%	1.5%	1.6%
Accommodation and Food Services	6.4%	6.4%	6.4%	6.4%	6.4%	6.4%	6.4%	6.5%	6.5%	6.6%	6.6%
Other Services, Except Public Administration	7.0%	7.0%	7.1%	7.1%	7.2%	7.2%	7.3%	7.6%	8.0%	8.3%	9.0%
Federal Civilian Government	0.6%	0.5%	0.5%	0.5%	0.5%	0.5%	0.5%	0.5%	0.4%	0.4%	0.4%
Federal Military	0.9%	0.7%	0.7%	0.7%	0.7%	0.7%	0.7%	0.7%	0.6%	0.6%	0.5%
State and Local Government	10.8%	10.2%	10.2%	10.1%	10.1%	10.0%	9.9%	9.7%	9.4%	9.1%	8.6%

Table 4-28. Demographic and Employment Baseline Projections for Economic Impact Area LA-2 (continued).

	2005	2010	2011	2012	2013	2014	2015	2020	2025	2030	2040
Total Earnings (in millions of 2005 dollars)	11,484.00	12,782.07	13,132.04	13,420.62	13,715.20	14,015.87	14,322.73	15,953.99	17,757.47	19,748.33	24,357.40
Farm Employment	0.8%	1.5%	1.3%	1.3%	1.3%	1.2%	1.2%	1.1%	1.0%	0.9%	0.8%
Forestry, Fishing, Related Activities	0.3%	0.3%	0.3%	0.3%	0.3%	0.3%	0.3%	0.3%	0.2%	0.2%	0.2%
Mining	13.7%	17.7%	17.7%	17.8%	17.9%	18.0%	18.1%	18.7%	19.3%	19.9%	21.0%
Utilities	0.4%	0.4%	0.4%	0.4%	0.4%	0.4%	0.4%	0.4%	0.4%	0.4%	0.4%
Construction	7.1%	6.0%	6.3%	6.2%	6.1%	6.0%	5.9%	5.4%	4.9%	4.5%	3.8%
Manufacturing	7.5%	7.6%	7.7%	7.6%	7.5%	7.4%	7.3%	6.8%	6.3%	5.9%	5.1%
Wholesale Trade	4.7%	4.8%	5.0%	4.9%	4.9%	4.9%	4.9%	4.9%	4.8%	4.7%	4.5%
Retail Trade	7.9%	7.7%	7.8%	7.7%	7.7%	7.6%	7.5%	7.3%	7.0%	6.7%	6.2%
Transportation and Warehousing	4.6%	3.8%	3.7%	3.7%	3.7%	3.7%	3.7%	3.6%	3.6%	3.6%	3.5%
Information Employment	1.7%	1.3%	1.3%	1.3%	1.3%	1.3%	1.3%	1.3%	1.3%	1.3%	1.2%
Finance and Insurance	4.1%	2.9%	3.0%	3.0%	3.0%	3.0%	3.0%	3.0%	3.0%	3.0%	3.0%
Real Estate / Rental and Lease	3.5%	2.6%	2.6%	2.6%	2.7%	2.7%	2.7%	2.7%	2.7%	2.8%	2.8%
Professional and Technical Services	6.0%	6.1%	6.1%	6.1%	6.1%	6.2%	6.2%	6.3%	6.4%	6.5%	6.7%
Management	1.6%	1.4%	1.4%	1.4%	1.4%	1.4%	1.4%	1.5%	1.5%	1.6%	1.7%
Administrative and Waste Services	3.1%	2.9%	2.9%	2.9%	3.0%	3.0%	3.0%	3.1%	3.2%	3.2%	3.4%
Educational Services	0.7%	0.8%	0.8%	0.8%	0.8%	0.8%	0.8%	0.8%	0.8%	0.7%	0.7%
Health Care and Social Assistance	11.3%	11.6%	11.7%	11.8%	12.0%	12.1%	12.2%	12.9%	13.6%	14.3%	15.7%
Arts, Entertainment, and Recreation	0.6%	0.4%	0.5%	0.5%	0.5%	0.5%	0.5%	0.5%	0.5%	0.5%	0.5%
Accommodation and Food Services	2.5%	2.6%	2.7%	2.7%	2.7%	2.6%	2.6%	2.6%	2.6%	2.6%	2.5%
Other Services, Except Public Administration	4.5%	4.1%	4.1%	4.2%	4.2%	4.2%	4.2%	4.4%	4.5%	4.7%	4.9%
Federal Civilian Government	1.2%	1.2%	1.2%	1.2%	1.2%	1.1%	1.1%	1.1%	1.1%	1.0%	0.9%
Federal Military	0.9%	0.9%	0.7%	0.7%	0.7%	0.7%	0.6%	0.6%	0.6%	0.6%	0.6%
State and Local Government	11.3%	11.3%	11.2%	11.1%	11.1%	11.1%	11.0%	10.8%	10.6%	10.4%	9.9%
Total Personal Income (in millions of 2005 dollars)											
Total Personal Income Per Capita (in 2005 dollars)	28,507	30,706	30,852	31,247	31,645	32,047	32,456	34,618	37,001	39,634	45,589
Woods & Poole Economics Wealth Index (U.S. = 100)	72.7	78.6	77.7	77.7	77.8	77.8	77.8	77.8	77.7	77.7	77.5
Persons Per Household (in number of people)	2.7	2.7	2.7	2.7	2.6	2.6	2.6	2.6	2.6	2.6	2.7
Mean Household Total Personal Income (in 2005 dollars)	68,505	75,359	75,338	76,021	76,720	77,445	78,201	82,488	87,604	93,623	108,360
Total Number of Households (in thousands)	208.17	220.47	222.77	225.63	228.48	231.29	234.07	247.40	259.85	271.19	290.47
Income < $10,000 (thousands of households, 2000 dollars)	15.9%	14.1%	13.9%	13.7%	13.4%	13.2%	13.0%	11.8%	10.4%	8.9%	6.5%
Income $10,000 to $19,999	15.2%	13.6%	13.3%	13.1%	12.9%	12.7%	12.6%	11.3%	10.0%	8.6%	6.3%
Income $20,000 to $29,999	12.9%	11.7%	11.5%	11.3%	11.2%	11.0%	10.8%	9.8%	8.7%	7.5%	5.5%
Income $30,000 to $44,999	18.2%	18.4%	18.3%	18.3%	18.2%	18.1%	18.0%	17.0%	15.5%	13.7%	9.9%
Income $45,000 to $59,999	14.1%	15.8%	16.1%	16.3%	16.5%	16.7%	17.0%	18.2%	18.8%	18.9%	16.5%
Income $60,000 to $74,999	9.1%	10.2%	10.4%	10.6%	10.7%	10.9%	11.0%	12.3%	14.0%	16.2%	19.4%
Income $75,000 to $99,999	7.4%	8.3%	8.5%	8.6%	8.8%	8.9%	9.0%	10.1%	11.5%	13.4%	18.4%
Income $100,000 or more	7.1%	7.9%	8.0%	8.2%	8.3%	8.4%	8.5%	9.6%	11.0%	12.8%	17.5%

Notes: Median age, wealth index, and mean household income is the average of the original Woods & Poole values for the 7 parishes in the EIA; income per capita calculated using personal income/total population for the EIA; persons per household calculated using total population/number of households for the EIA.

Source: Woods & Poole Economics, Inc., 2010.

Table 4-29

Demographic and Employment Baseline Projections for Economic Impact Area LA-3

	2005	2010	2011	2012	2013	2014	2015	2020	2025	2030	2040
Total Population (in thousands)	1,039.88	1,126.87	1,140.44	1,154.15	1,167.97	1,181.91	1,195.92	1,266.99	1,339.29	1,411.83	1,557.29
Age Under 19 years	29.7%	28.8%	28.6%	28.4%	28.3%	28.1%	28.1%	27.9%	27.6%	27.2%	26.3%
Age 20 to 34	22.4%	23.1%	23.4%	23.5%	23.5%	23.5%	23.1%	21.7%	20.6%	20.2%	20.3%
Age 35 to 49	21.4%	19.2%	18.7%	18.3%	18.0%	17.9%	17.9%	18.4%	19.4%	19.7%	18.1%
Age 50 to 64	16.2%	17.8%	18.1%	18.2%	18.3%	18.3%	18.3%	17.7%	16.3%	15.5%	17.3%
Age 65 and over	10.3%	11.1%	11.3%	11.6%	11.9%	12.2%	12.5%	14.3%	16.1%	17.5%	18.0%
Median Age of Population (in years)	35	35	35	35	35	36	36	37	38	39	40
White Population (in thousands)	65.7%	64.0%	63.7%	63.5%	63.3%	63.1%	62.9%	61.8%	60.7%	59.6%	57.2%
Black Population (in thousands)	29.6%	30.6%	30.7%	30.8%	30.9%	31.0%	31.1%	31.6%	32.0%	32.5%	33.4%
Native American Population (in thousands)	1.0%	1.0%	1.0%	1.0%	1.0%	1.0%	1.0%	1.1%	1.1%	1.1%	1.1%
Asian and Pacific Islander Population (in thousands)	1.4%	1.4%	1.5%	1.5%	1.5%	1.5%	1.5%	1.6%	1.7%	1.8%	2.0%
Hispanic or Latino Population (in thousands)	2.3%	3.0%	3.1%	3.2%	3.3%	3.4%	3.5%	3.9%	4.4%	5.0%	6.2%
Male Population (in thousands)	48.7%	48.8%	48.8%	48.8%	48.8%	48.8%	48.8%	48.8%	48.9%	48.8%	48.9%
Total Employment (in thousands of jobs)	606.81	663.02	680.63	689.17	697.80	706.51	715.33	760.83	808.81	859.36	968.53
Farm Employment	0.7%	0.7%	0.6%	0.6%	0.6%	0.6%	0.6%	0.6%	0.6%	0.5%	0.5%
Forestry, Fishing, Related Activities	0.8%	0.6%	0.6%	0.6%	0.6%	0.6%	0.6%	0.6%	0.6%	0.6%	0.6%
Mining	1.5%	1.9%	1.9%	1.9%	1.9%	1.8%	1.8%	1.7%	1.6%	1.5%	1.2%
Utilities	0.3%	0.4%	0.4%	0.4%	0.4%	0.4%	0.4%	0.3%	0.3%	0.3%	0.3%
Construction	9.8%	9.3%	9.3%	9.3%	9.4%	9.4%	9.5%	9.6%	9.8%	10.0%	10.3%
Manufacturing	6.8%	6.1%	6.1%	6.0%	5.9%	5.8%	5.7%	5.3%	5.0%	4.6%	4.0%
Wholesale Trade	3.2%	2.8%	2.8%	2.8%	2.8%	2.7%	2.7%	2.6%	2.4%	2.3%	2.1%
Retail Trade	10.9%	10.1%	10.0%	10.0%	10.0%	10.0%	10.0%	9.9%	9.7%	9.6%	9.3%
Transportation and Warehousing	4.4%	4.6%	4.5%	4.5%	4.5%	4.5%	4.5%	4.4%	4.3%	4.3%	4.1%
Information Employment	1.4%	1.2%	1.2%	1.2%	1.2%	1.2%	1.2%	1.1%	1.1%	1.1%	1.0%
Finance and Insurance	3.5%	3.3%	3.3%	3.3%	3.3%	3.3%	3.3%	3.2%	3.1%	3.1%	2.9%
Real Estate / Rental and Lease	3.6%	3.7%	3.7%	3.7%	3.7%	3.7%	3.7%	3.8%	3.8%	3.8%	3.8%
Professional and Technical Services	4.8%	5.6%	5.6%	5.7%	5.7%	5.7%	5.8%	6.0%	6.1%	6.3%	6.6%
Management	1.0%	1.1%	1.1%	1.1%	1.1%	1.1%	1.1%	1.0%	1.0%	0.9%	0.8%
Administrative and Waste Services	5.8%	6.1%	6.1%	6.2%	6.3%	6.4%	6.5%	7.1%	7.6%	8.2%	9.4%
Educational Services	1.1%	1.5%	1.5%	1.5%	1.5%	1.5%	1.5%	1.6%	1.7%	1.9%	2.1%
Health Care and Social Assistance	8.8%	10.0%	10.1%	10.1%	10.2%	10.3%	10.3%	10.6%	10.9%	11.2%	11.7%
Arts, Entertainment, and Recreation	1.3%	1.4%	1.4%	1.4%	1.4%	1.4%	1.4%	1.4%	1.5%	1.5%	1.5%
Accommodation and Food Services	6.6%	6.7%	6.7%	6.8%	6.8%	6.8%	6.8%	6.9%	7.0%	7.1%	7.3%
Other Services, Except Public Administration	6.7%	6.6%	6.7%	6.7%	6.7%	6.8%	6.8%	7.0%	7.2%	7.4%	7.8%
Federal Civilian Government	0.6%	0.7%	0.7%	0.7%	0.7%	0.7%	0.7%	0.7%	0.6%	0.6%	0.6%
Federal Military	0.8%	0.7%	0.7%	0.7%	0.7%	0.7%	0.7%	0.6%	0.6%	0.6%	0.5%
State and Local Government	15.6%	15.0%	14.9%	14.8%	14.7%	14.5%	14.4%	13.8%	13.3%	12.7%	11.6%

Table 4-29. Demographic and Employment Baseline Projections for Economic Impact Area LA-3 (continued).

	2005	2010	2011	2012	2013	2014	2015	2020	2025	2030	2040
Total Earnings (in millions of 2005 dollars)	24,055.56	27,529.09	28,679.63	29,248.86	29,828.55	30,418.91	31,020.09	34,194.93	37,669.23	41,468.73	50,154.87
Farm Employment	0.3%	0.3%	0.3%	0.3%	0.2%	0.2%	0.2%	0.2%	0.2%	0.2%	0.2%
Forestry, Fishing, Related Activities	0.3%	0.2%	0.2%	0.2%	0.2%	0.2%	0.2%	0.2%	0.2%	0.2%	0.2%
Mining	2.6%	3.7%	3.7%	3.7%	3.7%	3.7%	3.7%	3.7%	3.7%	3.7%	3.7%
Utilities	0.7%	0.6%	0.6%	0.6%	0.6%	0.6%	0.6%	0.6%	0.6%	0.6%	0.6%
Construction	10.3%	11.0%	12.0%	11.9%	11.9%	11.8%	11.7%	11.4%	11.1%	10.8%	10.1%
Manufacturing	12.4%	11.2%	11.3%	11.2%	11.1%	10.9%	10.8%	10.1%	9.5%	8.9%	7.7%
Wholesale Trade	4.4%	3.7%	3.8%	3.7%	3.7%	3.7%	3.7%	3.6%	3.5%	3.4%	3.2%
Retail Trade	7.2%	6.4%	6.4%	6.3%	6.3%	6.3%	6.3%	6.2%	6.1%	6.0%	5.8%
Transportation and Warehousing	6.0%	6.7%	6.7%	6.7%	6.7%	6.6%	6.6%	6.6%	6.5%	6.4%	6.3%
Information Employment	1.7%	1.4%	1.4%	1.4%	1.4%	1.4%	1.4%	1.4%	1.4%	1.4%	1.4%
Finance and Insurance	4.3%	3.6%	3.5%	3.5%	3.5%	3.5%	3.5%	3.6%	3.7%	3.8%	4.0%
Real Estate / Rental and Lease	2.1%	1.8%	1.7%	1.7%	1.7%	1.8%	1.8%	1.8%	1.9%	2.0%	2.1%
Professional and Technical Services	6.0%	6.9%	6.8%	6.9%	6.9%	7.0%	7.0%	7.3%	7.6%	7.9%	8.4%
Management	1.4%	1.9%	1.9%	2.0%	2.0%	2.0%	2.0%	2.0%	2.0%	2.0%	2.0%
Administrative and Waste Services	3.5%	3.9%	3.8%	3.9%	4.0%	4.1%	4.2%	4.7%	5.2%	5.7%	7.0%
Educational Services	0.6%	0.6%	0.6%	0.6%	0.7%	0.7%	0.7%	0.7%	0.8%	0.8%	1.0%
Health Care and Social Assistance	9.2%	9.4%	9.3%	9.3%	9.4%	9.5%	9.6%	9.9%	10.3%	10.6%	11.2%
Arts, Entertainment, and Recreation	0.7%	0.5%	0.4%	0.4%	0.4%	0.4%	0.4%	0.4%	0.5%	0.5%	0.5%
Accommodation and Food Services	2.7%	2.6%	2.5%	2.6%	2.6%	2.6%	2.6%	2.6%	2.6%	2.7%	2.7%
Other Services, Except Public Administration	4.1%	3.6%	3.5%	3.5%	3.6%	3.6%	3.6%	3.7%	3.8%	3.9%	4.1%
Federal Civilian Government	1.2%	1.5%	1.5%	1.5%	1.5%	1.5%	1.5%	1.5%	1.6%	1.6%	1.7%
Federal Military	0.9%	0.9%	0.7%	0.7%	0.7%	0.7%	0.7%	0.7%	0.7%	0.7%	0.7%
State and Local Government	17.5%	17.8%	17.4%	17.3%	17.3%	17.2%	17.2%	16.9%	16.6%	16.3%	15.6%
Total Personal Income Per Capita (in 2005 dollars)	30,731	32,203	32,690	33,093	33,505	33,924	34,352	36,628	39,151	41,951	48,338
Woods & Poole Economics Wealth Index (U.S. = 100)	79.2	85.3	85.7	85.7	85.8	85.9	86.0	86.4	86.8	87.2	88.0
Persons Per Household (in number of people)	2.7	2.7	2.7	2.7	2.7	2.6	2.6	2.6	2.6	2.6	2.6
Mean Household Total Personal Income (in 2005 dollars)	77,923	83,219	84,664	85,438	86,256	87,115	88,016	93,155	99,279	106,460	124,061
Total Number of Households (in thousands)	385.14	421.32	426.92	433.61	440.27	446.88	453.43	485.13	515.26	543.37	593.15
Income < $10,000 (thousands of households, 2000 dollars)	12.4%	11.3%	11.1%	10.9%	10.7%	10.6%	10.4%	9.3%	8.2%	7.1%	5.3%
Income $10,000 to $19,999	13.2%	12.1%	11.8%	11.7%	11.5%	11.3%	11.1%	10.0%	8.8%	7.6%	5.7%
Income $20,000 to $29,999	12.1%	11.1%	10.8%	10.7%	10.5%	10.4%	10.2%	9.2%	8.1%	7.0%	5.2%
Income $30,000 to $44,999	17.5%	16.6%	16.3%	16.1%	15.9%	15.7%	15.5%	14.1%	12.4%	10.8%	8.0%
Income $45,000 to $59,999	14.7%	16.0%	16.3%	16.5%	16.7%	16.9%	17.0%	17.3%	16.7%	15.3%	11.7%
Income $60,000 to $74,999	11.1%	12.1%	12.4%	12.7%	12.9%	13.1%	13.3%	15.0%	17.1%	19.0%	19.1%
Income $75,000 to $99,999	10.0%	10.9%	11.1%	11.3%	11.5%	11.7%	11.9%	13.3%	15.3%	17.7%	24.2%
Income $100,000 or more	9.1%	9.8%	10.0%	10.1%	10.3%	10.4%	10.6%	11.8%	13.4%	15.4%	20.8%

Notes: Median age, wealth index, and mean household income is the average of the original Woods & Poole values for the 10 parishes in the EIA; income per capita calculated using personal income/total population for the EIA; persons per household calculated using total population/number of households for the EIA.

Source: Woods & Poole Economics, Inc., 2010.

Table 4-30

Demographic and Employment Baseline Projections for Economic Impact Area LA-4

	2005	2010	2011	2012	2013	2014	2015	2020	2025	2030	2040
Total Population (in thousands)	1,378.12	1,267.52	1,278.34	1,289.31	1,300.40	1,311.64	1,322.96	1,380.77	1,439.98	1,499.47	1,618.89
Age Under 19 years	28.1%	26.3%	26.2%	26.1%	26.1%	26.1%	26.1%	26.5%	26.3%	25.9%	25.1%
Age 20 to 34	20.7%	20.7%	20.6%	20.5%	20.4%	20.1%	19.9%	18.1%	17.4%	17.5%	18.6%
Age 35 to 49	22.0%	20.1%	19.7%	19.4%	19.2%	19.0%	18.8%	19.1%	19.5%	19.0%	17.2%
Age 50 to 64	17.5%	20.5%	20.8%	20.9%	20.9%	21.0%	20.9%	19.8%	18.0%	17.2%	18.4%
Age 65 and over	11.6%	12.5%	12.7%	13.1%	13.4%	13.8%	14.2%	16.5%	18.8%	20.3%	20.7%
Median Age of Population (in years)	36	36	37	37	37	37	37	38	39	40	41
White Population (in thousands)	54.4%	55.5%	55.3%	55.1%	54.9%	54.8%	54.6%	53.7%	52.8%	51.9%	50.1%
Black Population (in thousands)	37.7%	35.0%	35.0%	35.0%	35.0%	35.1%	35.1%	35.2%	35.3%	35.3%	35.4%
Native American Population (in thousands)	0.4%	0.4%	0.5%	0.5%	0.5%	0.5%	0.5%	0.5%	0.5%	0.5%	0.5%
Asian and Pacific Islander Population (in thousands)	2.4%	2.7%	2.7%	2.8%	2.8%	2.8%	2.9%	3.1%	3.3%	3.5%	3.7%
Hispanic or Latino Population (in thousands)	5.1%	6.4%	6.5%	6.6%	6.7%	6.9%	7.0%	7.5%	8.1%	8.8%	10.2%
Male Population (in thousands)	48.0%	48.2%	48.2%	48.2%	48.2%	48.2%	48.2%	48.2%	48.2%	48.1%	48.2%
Total Employment (in thousands of jobs)	740.50	728.32	745.53	752.64	759.77	766.93	774.11	810.24	846.71	883.43	957.04
Farm Employment	0.3%	0.3%	0.3%	0.3%	0.3%	0.3%	0.3%	0.3%	0.3%	0.3%	0.2%
Forestry, Fishing, Related Activities	0.5%	0.4%	0.4%	0.4%	0.4%	0.4%	0.4%	0.4%	0.4%	0.4%	0.4%
Mining	1.3%	1.5%	1.4%	1.4%	1.4%	1.3%	1.3%	1.2%	1.1%	1.0%	0.8%
Utilities	0.4%	0.4%	0.3%	0.3%	0.3%	0.3%	0.3%	0.3%	0.3%	0.3%	0.3%
Construction	6.2%	7.4%	7.4%	7.5%	7.6%	7.6%	7.7%	8.1%	8.5%	8.9%	9.8%
Manufacturing	5.6%	5.6%	5.5%	5.5%	5.4%	5.3%	5.3%	4.9%	4.6%	4.4%	3.8%
Wholesale Trade	3.6%	3.1%	3.1%	3.1%	3.1%	3.1%	3.1%	3.0%	3.0%	2.9%	2.8%
Retail Trade	10.0%	10.2%	10.2%	10.3%	10.3%	10.3%	10.3%	10.5%	10.6%	10.7%	10.9%
Transportation and Warehousing	4.1%	3.8%	3.7%	3.7%	3.7%	3.7%	3.7%	3.7%	3.6%	3.6%	3.4%
Information Employment	1.6%	1.4%	1.4%	1.4%	1.4%	1.4%	1.4%	1.4%	1.3%	1.3%	1.2%
Finance and Insurance	3.9%	3.5%	3.5%	3.4%	3.4%	3.4%	3.4%	3.3%	3.2%	3.1%	2.9%
Real Estate / Rental and Lease	4.0%	3.9%	3.9%	3.9%	3.9%	4.0%	4.0%	4.0%	4.0%	4.1%	4.1%
Professional and Technical Services	5.7%	6.3%	6.3%	6.3%	6.2%	6.2%	6.2%	6.2%	6.1%	6.1%	5.9%
Management	1.1%	1.1%	1.1%	1.1%	1.1%	1.1%	1.0%	1.0%	1.0%	1.0%	0.9%
Administrative and Waste Services	6.4%	6.1%	6.2%	6.2%	6.3%	6.3%	6.3%	6.5%	6.7%	6.8%	7.1%
Educational Services	3.1%	3.2%	3.2%	3.2%	3.2%	3.1%	3.1%	3.1%	3.0%	3.0%	2.8%
Health Care and Social Assistance	8.8%	9.6%	9.7%	9.7%	9.8%	9.8%	9.9%	10.1%	10.4%	10.7%	11.1%
Arts, Entertainment, and Recreation	2.5%	2.4%	2.4%	2.4%	2.4%	2.5%	2.5%	2.5%	2.6%	2.6%	2.7%
Accommodation and Food Services	8.8%	9.1%	9.0%	8.9%	8.9%	8.8%	8.8%	8.4%	8.1%	7.8%	7.3%
Other Services, Except Public Administration	6.5%	6.3%	6.4%	6.4%	6.4%	6.4%	6.5%	6.6%	6.8%	6.9%	7.1%
Federal Civilian Government	2.1%	1.7%	1.7%	1.7%	1.7%	1.6%	1.6%	1.6%	1.5%	1.4%	1.3%
Federal Military	1.4%	1.1%	1.1%	1.1%	1.1%	1.1%	1.1%	1.0%	1.0%	0.9%	0.8%
State and Local Government	11.9%	11.7%	11.7%	11.7%	11.8%	11.8%	11.8%	11.9%	11.9%	11.9%	12.0%

Table 4-30. Demographic and Employment Baseline Projections for Economic Impact Area LA-4 (continued).

	2005	2010	2011	2012	2013	2014	2015	2020	2025	2030	2040
Total Earnings (in millions of 2005 dollars)	33,666.07	33,632.01	34,709.10	35,337.46	35,974.63	36,620.67	37,275.64	40,686.08	44,326.90	48,203.33	56,678.49
Farm Employment	0.1%	0.1%	0.1%	0.1%	0.1%	0.1%	0.1%	0.1%	0.1%	0.1%	0.1%
Forestry, Fishing, Related Activities	0.2%	0.1%	0.1%	0.1%	0.1%	0.1%	0.1%	0.1%	0.1%	0.1%	0.1%
Mining	4.4%	4.9%	4.8%	4.8%	4.8%	4.7%	4.7%	4.6%	4.5%	4.4%	4.1%
Utilities	1.2%	1.1%	1.1%	1.1%	1.1%	1.1%	1.1%	1.1%	1.2%	1.2%	1.2%
Construction	6.5%	6.2%	6.7%	6.7%	6.7%	6.7%	6.7%	6.7%	6.7%	6.7%	6.6%
Manufacturing	8.6%	9.0%	9.2%	9.1%	9.0%	8.9%	8.8%	8.2%	7.8%	7.3%	6.5%
Wholesale Trade	5.3%	4.9%	5.0%	5.0%	5.0%	5.0%	5.0%	4.9%	4.9%	4.9%	4.8%
Retail Trade	6.2%	5.8%	5.8%	5.8%	5.8%	5.8%	5.8%	5.8%	5.8%	5.8%	5.8%
Transportation and Warehousing	5.1%	4.9%	4.8%	4.8%	4.8%	4.7%	4.7%	4.6%	4.5%	4.4%	4.2%
Information Employment	1.7%	1.5%	1.5%	1.5%	1.5%	1.5%	1.5%	1.5%	1.4%	1.4%	1.4%
Finance and Insurance	5.1%	4.2%	4.2%	4.3%	4.3%	4.3%	4.3%	4.3%	4.3%	4.3%	4.3%
Real Estate / Rental and Lease	2.6%	1.1%	1.2%	1.2%	1.2%	1.2%	1.2%	1.2%	1.3%	1.3%	1.4%
Professional and Technical Services	8.0%	9.0%	8.9%	8.9%	8.9%	8.9%	8.9%	8.9%	8.9%	8.8%	8.8%
Management	1.8%	1.7%	1.6%	1.6%	1.6%	1.7%	1.7%	1.7%	1.7%	1.8%	1.8%
Administrative and Waste Services	4.0%	3.9%	4.0%	4.1%	4.1%	4.1%	4.2%	4.4%	4.6%	4.8%	5.1%
Educational Services	2.2%	2.5%	2.5%	2.5%	2.5%	2.4%	2.4%	2.4%	2.4%	2.4%	2.4%
Health Care and Social Assistance	8.7%	9.8%	9.7%	9.8%	9.9%	9.9%	10.0%	10.3%	10.6%	10.9%	11.6%
Arts, Entertainment, and Recreation	2.1%	2.0%	2.0%	2.0%	2.0%	2.0%	2.0%	2.1%	2.1%	2.2%	2.2%
Accommodation and Food Services	4.4%	4.8%	4.7%	4.6%	4.6%	4.6%	4.5%	4.3%	4.2%	4.0%	3.7%
Other Services, Except Public Administration	3.7%	3.6%	3.6%	3.6%	3.6%	3.6%	3.6%	3.7%	3.8%	3.9%	4.0%
Federal Civilian Government	4.2%	4.0%	3.9%	3.9%	3.9%	3.9%	3.9%	3.9%	3.9%	3.8%	3.8%
Federal Military	1.8%	1.7%	1.7%	1.7%	1.7%	1.7%	1.7%	1.7%	1.7%	1.7%	1.7%
State and Local Government	12.1%	13.0%	12.9%	12.9%	13.0%	13.0%	13.1%	13.4%	13.7%	14.0%	14.5%
Total Personal Income Per Capita (in 2005 dollars)	32,677	35,414	35,829	36,225	36,628	37,038	37,456	39,644	42,012	44,580	50,228
Woods & Poole Economics Wealth Index (U.S. = 100)	79.1	91.9	91.0	90.8	90.7	90.5	90.4	89.9	89.4	88.9	87.7
Persons Per Household (in number of people)	2.6	2.6	2.6	2.6	2.6	2.6	2.5	2.5	2.5	2.5	2.5
Mean Household Total Personal Income (in 2005 dollars)	77,994	87,207	87,276	87,772	88,333	88,946	89,614	93,616	98,555	104,400	118,602
Total Number of Households (in thousands)	530.24	491.36	496.01	501.93	507.80	513.61	519.34	546.73	572.34	595.76	635.83
Income < $10,000 (thousands of households, 2000 dollars)	12.7%	10.8%	10.6%	10.5%	10.3%	10.1%	9.9%	9.2%	8.2%	7.2%	5.5%
Income $10,000 to $19,999	13.5%	11.9%	11.7%	11.5%	11.3%	11.1%	10.9%	10.1%	9.1%	8.0%	6.2%
Income $20,000 to $29,999	12.9%	11.4%	11.2%	11.1%	10.9%	10.8%	10.6%	9.7%	8.7%	7.8%	6.1%
Income $30,000 to $44,999	17.6%	15.5%	15.3%	15.2%	15.0%	14.8%	14.6%	13.6%	12.2%	10.8%	8.4%
Income $45,000 to $59,999	13.7%	15.1%	15.3%	15.4%	15.5%	15.6%	15.7%	15.5%	14.9%	14.0%	11.2%
Income $60,000 to $74,999	10.1%	11.7%	11.9%	12.0%	12.2%	12.4%	12.6%	13.8%	15.2%	16.2%	15.7%
Income $75,000 to $99,999	9.3%	11.3%	11.5%	11.7%	11.9%	12.1%	12.3%	13.6%	15.3%	17.4%	22.5%
Income $100,000 or more	10.2%	12.3%	12.5%	12.6%	12.8%	13.1%	13.3%	14.5%	16.4%	18.6%	24.3%

Notes: Median age, wealth index, and mean household income is the average of the original Woods & Poole values for the 9 parishes in the EIA; income per capita calculated using personal income/total population for the EIA; persons per household calculated using total population/number of households for the EIA.

Source: Woods & Poole Economics, Inc., 2010.

Table 4-31

Demographic and Employment Baseline Projections for Economic Impact Area MS-1

	2005	2010	2011	2012	2013	2014	2015	2020	2025	2030	2040
Total Population (in thousands)	476.88	470.61	474.64	478.72	482.85	487.02	491.23	512.71	534.70	556.77	601.05
Age Under 19 years	28.6%	28.0%	27.9%	27.8%	27.6%	27.6%	27.5%	27.5%	27.3%	26.8%	25.7%
Age 20 to 34	20.2%	20.3%	20.4%	20.5%	20.6%	20.5%	20.2%	19.6%	18.7%	18.5%	19.0%
Age 35 to 49	21.7%	19.8%	19.4%	19.1%	18.8%	18.5%	18.5%	18.3%	18.9%	19.0%	18.0%
Age 50 to 64	17.4%	19.0%	19.3%	19.3%	19.3%	19.4%	19.5%	18.9%	17.6%	16.8%	17.7%
Age 65 and over	12.1%	12.8%	13.0%	13.4%	13.7%	14.0%	14.3%	15.7%	17.5%	18.9%	19.6%
Median Age of Population (in years)	36	36	36	36	37	37	37	37	38	39	40
White Population (in thousands)	75.5%	74.0%	73.8%	73.7%	73.5%	73.4%	73.2%	72.5%	71.8%	71.1%	70.0%
Black Population (in thousands)	19.2%	19.8%	19.8%	19.9%	19.9%	19.9%	20.0%	20.3%	20.5%	20.8%	21.3%
Native American Population (in thousands)	0.5%	0.6%	0.6%	0.6%	0.6%	0.6%	0.6%	0.6%	0.5%	0.5%	0.5%
Asian and Pacific Islander Population (in thousands)	2.0%	2.1%	2.1%	2.2%	2.2%	2.2%	2.2%	2.3%	2.3%	2.3%	2.3%
Hispanic or Latino Population (in thousands)	2.8%	3.6%	3.7%	3.8%	3.8%	3.9%	4.0%	4.4%	4.8%	5.2%	5.9%
Male Population (in thousands)	49.6%	49.6%	49.6%	49.6%	49.6%	49.5%	49.5%	49.5%	49.6%	49.6%	49.6%
Total Employment (in thousands of jobs)	238.83	243.91	249.36	251.56	253.76	255.98	258.22	269.62	281.38	293.52	318.92
Farm Employment	1.4%	1.3%	1.3%	1.3%	1.3%	1.2%	1.2%	1.2%	1.1%	1.0%	0.9%
Forestry, Fishing, Related Activities	0.8%	0.7%	0.7%	0.7%	0.7%	0.7%	0.7%	0.7%	0.7%	0.8%	0.8%
Mining	0.1%	0.2%	0.2%	0.2%	0.2%	0.2%	0.2%	0.2%	0.2%	0.2%	0.2%
Utilities	0.9%	0.7%	0.7%	0.7%	0.7%	0.7%	0.7%	0.7%	0.7%	0.7%	0.7%
Construction	7.5%	7.2%	7.2%	7.2%	7.2%	7.3%	7.3%	7.4%	7.5%	7.7%	7.9%
Manufacturing	9.5%	10.2%	10.2%	10.1%	10.0%	9.9%	9.8%	9.4%	9.0%	8.6%	7.9%
Wholesale Trade	1.4%	1.4%	1.4%	1.4%	1.4%	1.4%	1.4%	1.3%	1.3%	1.2%	1.1%
Retail Trade	10.9%	10.2%	10.1%	10.1%	10.1%	10.1%	10.0%	9.9%	9.8%	9.7%	9.4%
Transportation and Warehousing	2.4%	2.5%	2.5%	2.5%	2.5%	2.5%	2.5%	2.5%	2.6%	2.6%	2.6%
Information Employment	1.4%	0.8%	0.9%	0.9%	0.9%	0.9%	0.9%	0.9%	1.0%	1.0%	1.1%
Finance and Insurance	2.5%	2.6%	2.6%	2.6%	2.6%	2.6%	2.6%	2.6%	2.6%	2.6%	2.6%
Real Estate / Rental and Lease	3.1%	3.5%	3.5%	3.5%	3.6%	3.6%	3.6%	3.8%	3.9%	4.0%	4.3%
Professional and Technical Services	3.8%	4.1%	4.2%	4.2%	4.2%	4.3%	4.3%	4.5%	4.8%	5.0%	5.4%
Management	0.5%	0.4%	0.4%	0.4%	0.4%	0.4%	0.4%	0.3%	0.3%	0.3%	0.3%
Administrative and Waste Services	5.4%	6.0%	6.1%	6.1%	6.2%	6.3%	6.4%	6.8%	7.2%	7.6%	8.4%
Educational Services	0.5%	0.8%	0.8%	0.9%	0.9%	0.9%	0.9%	1.0%	1.1%	1.2%	1.4%
Health Care and Social Assistance	6.2%	6.8%	6.9%	6.9%	6.9%	7.0%	7.0%	7.1%	7.2%	7.3%	7.5%
Arts, Entertainment, and Recreation	2.2%	1.8%	1.8%	1.8%	1.8%	1.8%	1.8%	1.8%	1.8%	1.8%	1.8%
Accommodation and Food Services	12.1%	10.3%	10.3%	10.3%	10.2%	10.2%	10.2%	10.0%	9.8%	9.6%	9.3%
Other Services, Except Public Administration	5.5%	5.5%	5.6%	5.6%	5.6%	5.7%	5.7%	5.9%	6.1%	6.3%	6.7%
Federal Civilian Government	3.9%	4.0%	4.0%	3.9%	3.9%	3.9%	3.8%	3.7%	3.5%	3.4%	3.1%
Federal Military	5.7%	5.3%	5.3%	5.2%	5.2%	5.1%	5.1%	4.8%	4.6%	4.3%	3.9%
State and Local Government	12.3%	13.4%	13.4%	13.4%	13.4%	13.4%	13.3%	13.3%	13.2%	13.1%	13.0%

Table 4-31. Demographic and Employment Baseline Projections for Economic Impact Area MS-1 (continued).

	2005	2010	2011	2012	2013	2014	2015	2020	2025	2030	2040
Total Earnings (in millions of 2005 dollars)	9,318.99	9,816.16	10,180.77	10,354.51	10,530.94	10,710.09	10,892.03	11,844.59	12,872.19	13,979.85	16,456.60
Farm Employment	0.3%	0.0%	0.2%	0.2%	0.2%	0.2%	0.1%	0.1%	0.1%	0.1%	0.1%
Forestry, Fishing, Related Activities	0.5%	0.5%	0.5%	0.5%	0.5%	0.5%	0.5%	0.5%	0.5%	0.5%	0.4%
Mining	0.2%	0.4%	0.3%	0.3%	0.3%	0.3%	0.3%	0.3%	0.3%	0.3%	0.3%
Utilities	2.1%	1.6%	1.6%	1.6%	1.6%	1.6%	1.7%	1.7%	1.8%	1.9%	2.0%
Construction	6.0%	5.4%	6.0%	6.0%	5.9%	5.9%	5.8%	5.7%	5.5%	5.3%	5.0%
Manufacturing	15.4%	17.3%	17.7%	17.5%	17.4%	17.3%	17.1%	16.5%	15.8%	15.1%	13.9%
Wholesale Trade	1.6%	1.6%	1.6%	1.6%	1.6%	1.6%	1.6%	1.5%	1.5%	1.4%	1.3%
Retail Trade	7.0%	6.1%	6.1%	6.0%	6.0%	6.0%	5.9%	5.8%	5.7%	5.5%	5.3%
Transportation and Warehousing	2.3%	2.0%	2.0%	2.0%	2.0%	2.0%	2.0%	2.0%	2.0%	2.0%	2.0%
Information Employment	1.4%	0.8%	0.8%	0.8%	0.8%	0.8%	0.8%	0.9%	0.9%	1.0%	1.1%
Finance and Insurance	2.2%	2.2%	2.2%	2.2%	2.2%	2.2%	2.2%	2.3%	2.4%	2.5%	2.6%
Real Estate / Rental and Lease	1.0%	0.7%	0.8%	0.8%	0.8%	0.8%	0.8%	0.9%	0.9%	1.0%	1.1%
Professional and Technical Services	4.6%	5.1%	5.1%	5.2%	5.3%	5.3%	5.4%	5.7%	6.0%	6.3%	6.9%
Management	0.6%	0.6%	0.6%	0.6%	0.6%	0.6%	0.6%	0.6%	0.6%	0.6%	0.6%
Administrative and Waste Services	3.1%	3.4%	3.4%	3.5%	3.5%	3.6%	3.6%	3.9%	4.2%	4.5%	5.2%
Educational Services	0.3%	0.5%	0.5%	0.5%	0.5%	0.5%	0.5%	0.6%	0.6%	0.7%	0.9%
Health Care and Social Assistance	6.7%	6.9%	6.9%	6.9%	6.9%	7.0%	7.0%	7.1%	7.3%	7.4%	7.6%
Arts, Entertainment, and Recreation	1.5%	1.1%	1.1%	1.1%	1.1%	1.1%	1.0%	1.0%	1.0%	1.0%	0.9%
Accommodation and Food Services	8.0%	5.9%	5.8%	5.8%	5.7%	5.7%	5.7%	5.6%	5.4%	5.3%	5.1%
Other Services, Except Public Administration	3.4%	3.5%	3.4%	3.4%	3.5%	3.5%	3.5%	3.6%	3.8%	3.9%	4.1%
Federal Civilian Government	8.4%	8.8%	8.6%	8.6%	8.6%	8.6%	8.6%	8.6%	8.5%	8.5%	8.4%
Federal Military	10.2%	10.2%	10.1%	10.0%	10.0%	10.0%	9.9%	9.8%	9.6%	9.5%	9.2%
State and Local Government	13.2%	15.3%	15.0%	15.0%	15.1%	15.1%	15.2%	15.4%	15.5%	15.7%	16.1%
Total Personal Income Per Capita (in 2005 dollars)	27,815	29,510	29,900	30,216	30,539	30,868	31,204	32,989	34,961	37,140	42,045
Woods & Poole Economics Wealth Index (U.S. = 100)	68.6	73.6	73.5	73.4	73.4	73.3	73.2	72.8	72.4	72.0	71.2
Persons Per Household (in number of people)	2.6	2.6	2.6	2.6	2.6	2.6	2.6	2.6	2.5	2.5	2.6
Mean Household Total Personal Income (in 2005 dollars)	65,960	67,129	67,940	68,417	68,918	69,445	70,003	73,247	77,212	81,941	93,603
Total Number of Households (in thousands)	180.00	179.76	181.51	183.72	185.92	188.09	190.24	200.49	210.03	218.68	233.44
Income < $10,000 (thousands of households, 2000 dollars)	10.8%	9.8%	9.7%	9.5%	9.4%	9.2%	9.1%	8.4%	7.4%	6.4%	4.6%
Income $10,000 to $19,999	122.2%	122.3%	122.3%	122.3%	122.3%	122.3%	122.3%	122.5%	122.6%	122.8%	122.9%
Income $20,000 to $29,999	103.6%	102.5%	102.4%	102.4%	102.4%	102.4%	102.4%	101.9%	101.3%	101.1%	100.9%
Income $30,000 to $44,999	148.8%	154.6%	155.9%	156.8%	157.6%	158.3%	158.9%	161.1%	162.6%	163.1%	163.2%
Income $45,000 to $59,999	79.1%	92.0%	94.5%	96.5%	98.6%	100.9%	103.3%	115.9%	132.2%	147.5%	162.6%
Income $60,000 to $74,999	65.2%	66.6%	66.8%	66.9%	67.1%	67.3%	67.4%	71.0%	80.1%	94.1%	134.9%
Income $75,000 to $99,999	83.1%	82.9%	82.9%	82.9%	82.9%	82.8%	82.8%	82.7%	82.7%	84.6%	103.1%
Income $100,000 or more	81.1%	81.1%	81.2%	81.2%	81.2%	81.2%	81.2%	81.2%	81.2%	81.0%	81.1%

Notes: Median age, wealth index, and mean household income is the average of the original Woods & Poole values for the 7 counties in the EIA; income per capita calculated using personal income/total population for the EIA; persons per household calculated using total population/number of households for the EIA.

Source: Woods & Poole Economics, Inc., 2010.

Table 4-32

Demographic and Employment Baseline Projections for Economic Impact Area AL-1

	2005	2010	2011	2012	2013	2014	2015	2020	2025	2030	2040
Total Population (in thousands)	691.71	725.48	731.11	736.83	742.62	748.49	754.41	784.68	815.74	846.94	909.54
Age Under 19 years	28.1%	27.4%	27.2%	27.1%	26.9%	26.8%	26.7%	26.5%	26.1%	25.6%	24.6%
Age 20 to 34	19.2%	19.5%	19.6%	19.6%	19.5%	19.3%	19.1%	18.3%	17.7%	17.3%	17.6%
Age 35 to 49	21.1%	19.3%	18.9%	18.6%	18.5%	18.4%	18.4%	18.5%	18.8%	18.6%	17.8%
Age 50 to 64	18.0%	19.5%	19.7%	19.8%	19.8%	19.8%	19.8%	19.0%	17.6%	17.1%	17.9%
Age 65 and over	13.6%	14.4%	14.6%	14.9%	15.3%	15.6%	16.0%	17.7%	19.8%	21.3%	22.1%
Median Age of Population (in years)	38	39	39	40	40	40	40	41	42	42	44
White Population (in thousands)	66.6%	66.0%	65.9%	65.9%	65.8%	65.7%	65.7%	65.3%	64.9%	64.4%	63.7%
Black Population (in thousands)	29.6%	29.4%	29.4%	29.4%	29.3%	29.3%	29.3%	29.3%	29.3%	29.3%	29.1%
Native American Population (in thousands)	0.9%	0.9%	0.9%	0.9%	0.9%	0.9%	0.9%	0.9%	1.0%	1.0%	1.0%
Asian and Pacific Islander Population (in thousands)	1.2%	1.5%	1.5%	1.5%	1.6%	1.6%	1.6%	1.7%	1.9%	2.0%	2.3%
Hispanic or Latino Population (in thousands)	1.6%	2.2%	2.3%	2.3%	2.4%	2.4%	2.5%	2.7%	3.0%	3.3%	4.0%
Male Population (in thousands)	48.2%	48.3%	48.3%	48.3%	48.3%	48.3%	48.4%	48.4%	48.5%	48.5%	48.6%
Total Employment (in thousands of jobs)	363.84	353.63	362.59	366.69	370.81	374.97	379.15	400.55	422.75	445.72	493.98
Farm Employment	1.4%	1.4%	1.4%	1.4%	1.4%	1.4%	1.4%	1.3%	1.2%	1.2%	1.1%
Forestry, Fishing, Related Activities	1.0%	1.0%	1.0%	1.0%	1.0%	1.0%	0.9%	0.9%	0.9%	0.8%	0.8%
Mining	0.3%	0.5%	0.5%	0.5%	0.5%	0.5%	0.5%	0.5%	0.5%	0.5%	0.5%
Utilities	0.4%	0.5%	0.5%	0.5%	0.5%	0.4%	0.4%	0.4%	0.4%	0.4%	0.3%
Construction	8.5%	7.5%	7.6%	7.6%	7.6%	7.6%	7.6%	7.7%	7.7%	7.7%	7.8%
Manufacturing	8.7%	7.6%	7.6%	7.5%	7.4%	7.3%	7.2%	6.9%	6.5%	6.2%	5.5%
Wholesale Trade	3.5%	3.1%	3.0%	3.0%	3.0%	3.0%	2.9%	2.8%	2.7%	2.6%	2.4%
Retail Trade	12.4%	11.9%	11.8%	11.8%	11.7%	11.6%	11.5%	11.1%	10.7%	10.3%	9.5%
Transportation and Warehousing	3.7%	3.9%	3.9%	3.8%	3.8%	3.8%	3.8%	3.6%	3.5%	3.4%	3.2%
Information Employment	1.3%	1.0%	1.0%	1.0%	1.0%	1.0%	1.0%	1.0%	1.0%	0.9%	0.9%
Finance and Insurance	3.4%	3.7%	3.7%	3.7%	3.7%	3.6%	3.6%	3.5%	3.4%	3.2%	3.0%
Real Estate / Rental and Lease	4.4%	4.6%	4.7%	4.7%	4.7%	4.7%	4.8%	4.9%	5.0%	5.2%	5.4%
Professional and Technical Services	4.4%	4.6%	4.7%	4.7%	4.7%	4.8%	4.8%	5.0%	5.2%	5.4%	5.7%
Management	0.2%	0.4%	0.4%	0.4%	0.4%	0.4%	0.4%	0.4%	0.4%	0.4%	0.4%
Administrative and Waste Services	6.4%	6.4%	6.5%	6.5%	6.6%	6.7%	6.7%	7.0%	7.3%	7.6%	8.3%
Educational Services	1.4%	1.6%	1.7%	1.7%	1.7%	1.7%	1.7%	1.8%	1.9%	2.0%	2.2%
Health Care and Social Assistance	8.5%	9.4%	9.4%	9.5%	9.6%	9.6%	9.7%	10.1%	10.4%	10.7%	11.4%
Arts, Entertainment, and Recreation	1.3%	1.5%	1.5%	1.5%	1.5%	1.5%	1.5%	1.5%	1.5%	1.5%	1.5%
Accommodation and Food Services	6.8%	7.6%	7.6%	7.7%	7.7%	7.7%	7.8%	8.0%	8.2%	8.4%	8.9%
Other Services, Except Public Administration	7.7%	7.9%	7.9%	8.0%	8.0%	8.1%	8.1%	8.4%	8.7%	8.9%	9.4%
Federal Civilian Government	0.9%	0.8%	0.8%	0.8%	0.8%	0.8%	0.8%	0.8%	0.7%	0.7%	0.6%
Federal Military	1.3%	1.1%	1.1%	1.1%	1.0%	1.0%	1.0%	1.0%	0.9%	0.8%	0.7%
State and Local Government	12.0%	12.0%	12.0%	11.9%	11.9%	11.9%	11.8%	11.6%	11.4%	11.1%	10.7%

Table 4-32. Demographic and Employment Baseline Projections for Economic Impact Area AL-1 (continued).

	2005	2010	2011	2012	2013	2014	2015	2020	2025	2030	2040
Total Earnings (in millions of 2005 dollars)	12,930.79	13,040.20	13,381.74	13,639.05	13,900.74	14,166.88	14,437.55	15,860.94	17,407.25	19,085.19	22,872.66
Farm Employment	0.8%	0.6%	0.6%	0.6%	0.6%	0.6%	0.6%	0.5%	0.5%	0.5%	0.4%
Forestry, Fishing, Related Activities	1.0%	1.0%	1.0%	0.9%	0.9%	0.9%	0.9%	0.9%	0.8%	0.8%	0.7%
Mining	0.4%	0.6%	0.6%	0.6%	0.6%	0.6%	0.6%	0.7%	0.7%	0.7%	0.8%
Utilities	1.0%	1.4%	1.1%	1.1%	1.1%	1.1%	1.1%	1.2%	1.2%	1.2%	1.2%
Construction	8.9%	7.9%	8.6%	8.5%	8.4%	8.4%	8.3%	8.0%	7.7%	7.4%	6.8%
Manufacturing	13.6%	12.2%	12.6%	12.5%	12.4%	12.3%	12.2%	11.7%	11.2%	10.7%	9.8%
Wholesale Trade	5.1%	4.6%	4.7%	4.7%	4.6%	4.6%	4.6%	4.5%	4.4%	4.3%	4.0%
Retail Trade	8.9%	8.4%	8.5%	8.4%	8.3%	8.3%	8.2%	7.9%	7.5%	7.2%	6.5%
Transportation and Warehousing	4.8%	5.7%	5.6%	5.6%	5.6%	5.5%	5.5%	5.3%	5.1%	4.9%	4.6%
Information Employment	1.6%	1.2%	1.2%	1.2%	1.2%	1.2%	1.2%	1.3%	1.3%	1.3%	1.3%
Finance and Insurance	4.9%	3.9%	3.9%	3.9%	3.9%	3.9%	3.9%	3.9%	3.9%	3.9%	3.8%
Real Estate / Rental and Lease	2.3%	1.7%	1.8%	1.8%	1.8%	1.8%	1.8%	2.0%	2.1%	2.2%	2.5%
Professional and Technical Services	5.5%	6.1%	6.1%	6.2%	6.2%	6.3%	6.4%	6.7%	7.0%	7.3%	7.9%
Management	0.3%	0.6%	0.6%	0.6%	0.6%	0.6%	0.6%	0.7%	0.7%	0.7%	0.8%
Administrative and Waste Services	3.7%	3.6%	3.7%	3.7%	3.7%	3.8%	3.8%	4.1%	4.3%	4.6%	5.1%
Educational Services	0.9%	1.0%	1.0%	1.0%	1.0%	1.0%	1.0%	1.1%	1.1%	1.2%	1.3%
Health Care and Social Assistance	9.8%	11.0%	11.1%	11.2%	11.3%	11.4%	11.5%	11.9%	12.4%	12.9%	13.8%
Arts, Entertainment, and Recreation	0.6%	0.6%	0.6%	0.6%	0.6%	0.6%	0.6%	0.6%	0.6%	0.6%	0.6%
Accommodation and Food Services	3.2%	3.5%	3.5%	3.5%	3.5%	3.6%	3.6%	3.7%	3.7%	3.8%	4.0%
Other Services, Except Public Administration	4.8%	4.9%	4.9%	4.9%	4.9%	5.0%	5.0%	5.2%	5.4%	5.5%	5.8%
Federal Civilian Government	2.2%	2.5%	2.0%	2.0%	2.0%	2.0%	2.0%	2.0%	2.0%	2.0%	2.0%
Federal Military	1.8%	1.8%	1.3%	1.3%	1.3%	1.3%	1.3%	1.3%	1.2%	1.2%	1.2%
State and Local Government	13.8%	15.2%	15.1%	15.1%	15.1%	15.1%	15.2%	15.2%	15.2%	15.2%	15.1%
Total Personal Income Per Capita (in 2005 dollars)	26,961	28,132	28,252	28,605	28,964	29,329	29,701	31,665	33,826	36,202	41,511
Woods & Poole Economics Wealth Index (U.S. = 100)	69.0	71.9	71.2	71.2	71.3	71.3	71.4	71.6	71.8	72.0	72.2
Persons Per Household (in number of people)	2.6	2.6	2.6	2.6	2.5	2.5	2.5	2.5	2.5	2.5	2.5
Mean Household Total Personal Income (in 2005 dollars)	61,397	63,756	63,690	64,304	64,944	65,612	66,308	70,242	74,885	80,263	93,095
Total Number of Households (in thousands)	267.98	283.15	285.62	288.82	292.00	295.14	298.23	312.96	326.65	339.07	360.09
Income < $10,000 (thousands of households, 2000 dollars)	13.3%	11.9%	11.7%	11.6%	11.4%	11.2%	11.0%	10.0%	8.6%	7.4%	5.4%
Income $10,000 to $19,999	14.5%	13.2%	13.0%	12.8%	12.7%	12.5%	12.3%	11.2%	9.7%	8.3%	6.2%
Income $20,000 to $29,999	13.0%	11.9%	11.8%	11.6%	11.5%	11.3%	11.2%	10.2%	8.9%	7.7%	5.7%
Income $30,000 to $44,999	18.8%	18.5%	18.4%	18.2%	18.1%	17.9%	17.8%	16.5%	14.6%	12.6%	9.4%
Income $45,000 to $59,999	14.8%	16.4%	16.6%	16.8%	17.0%	17.2%	17.4%	18.7%	19.5%	18.8%	14.8%
Income $60,000 to $74,999	9.6%	10.6%	10.7%	10.9%	11.0%	11.2%	11.3%	12.5%	14.4%	16.8%	19.9%
Income $75,000 to $99,999	8.4%	9.3%	9.4%	9.5%	9.7%	9.8%	9.9%	11.0%	12.7%	14.9%	20.1%
Income $100,000 or more	7.5%	8.4%	8.5%	8.6%	8.7%	8.9%	9.0%	10.0%	11.6%	13.5%	18.4%

Notes: Median age, wealth index, and mean household income is the average of the original Woods & Poole values for the 8 counties in the EIA; income per capita calculated using personal income/total population for the EIA; persons per household calculated using total population/number of households for the EIA.

Source: Woods & Poole Economics, Inc., 2010.

Table 4-33

Demographic and Employment Baseline Projections for Economic Impact Area FL-1

	2005	2010	2011	2012	2013	2014	2015	2020	2025	2030	2040
Total Population (in thousands)	865.12	896.10	911.70	927.40	943.19	959.08	975.02	1,055.59	1,137.26	1,219.22	1,383.66
Age Under 19 years	26.1%	25.0%	24.8%	24.7%	24.6%	24.5%	24.5%	24.9%	24.7%	24.2%	23.1%
Age 20 to 34	20.5%	21.5%	21.7%	21.8%	21.9%	21.9%	21.5%	19.9%	18.5%	18.2%	18.9%
Age 35 to 49	22.0%	19.5%	19.0%	18.5%	18.1%	17.7%	17.7%	18.2%	19.5%	19.7%	17.0%
Age 50 to 64	17.9%	19.4%	19.6%	19.7%	19.7%	19.8%	19.8%	18.8%	16.9%	15.5%	17.2%
Age 65 and over	13.4%	14.6%	14.8%	15.3%	15.7%	16.1%	16.4%	18.2%	20.4%	22.4%	23.8%
Median Age of Population (in years)	39	39	40	40	40	40	40	40	41	42	43
White Population (in thousands)	79.2%	77.6%	77.4%	77.2%	77.1%	76.9%	76.7%	75.8%	74.9%	74.1%	72.6%
Black Population (in thousands)	13.8%	14.3%	14.3%	14.3%	14.4%	14.4%	14.4%	14.6%	14.7%	14.8%	14.9%
Native American Population (in thousands)	0.9%	0.9%	0.9%	0.9%	0.9%	0.9%	0.9%	0.9%	0.9%	0.9%	0.8%
Asian and Pacific Islander Population (in thousands)	2.4%	2.6%	2.6%	2.6%	2.7%	2.7%	2.7%	2.8%	2.8%	2.8%	2.6%
Hispanic or Latino Population (in thousands)	3.7%	4.6%	4.7%	4.8%	5.0%	5.1%	5.2%	5.9%	6.6%	7.4%	9.0%
Male Population (in thousands)	49.8%	50.0%	50.1%	50.1%	50.2%	50.2%	50.2%	50.4%	50.5%	50.7%	51.1%
Total Employment (in thousands of jobs)	487.45	489.82	504.24	512.13	520.13	528.26	536.52	579.78	626.48	676.88	789.79
Farm Employment	0.5%	0.6%	0.6%	0.6%	0.6%	0.5%	0.5%	0.5%	0.5%	0.4%	0.4%
Forestry, Fishing, Related Activities	0.5%	0.5%	0.5%	0.5%	0.5%	0.5%	0.5%	0.5%	0.5%	0.5%	0.5%
Mining	0.2%	0.2%	0.2%	0.2%	0.2%	0.2%	0.2%	0.2%	0.2%	0.2%	0.1%
Utilities	0.3%	0.3%	0.3%	0.3%	0.3%	0.3%	0.3%	0.3%	0.3%	0.2%	0.2%
Construction	9.0%	5.6%	5.6%	5.7%	5.7%	5.7%	5.7%	5.7%	5.8%	5.8%	5.9%
Manufacturing	3.4%	3.0%	3.0%	3.0%	3.0%	3.0%	2.9%	2.8%	2.7%	2.6%	2.4%
Wholesale Trade	2.6%	2.1%	2.1%	2.1%	2.0%	2.0%	2.0%	1.9%	1.8%	1.8%	1.6%
Retail Trade	12.0%	11.8%	11.8%	11.7%	11.7%	11.7%	11.7%	11.5%	11.4%	11.3%	10.9%
Transportation and Warehousing	1.8%	2.0%	2.0%	2.0%	2.0%	2.0%	2.0%	2.0%	2.0%	1.9%	1.9%
Information Employment	1.9%	1.8%	1.8%	1.8%	1.8%	1.8%	1.8%	1.7%	1.7%	1.7%	1.6%
Finance and Insurance	3.6%	3.9%	3.9%	3.9%	3.9%	3.9%	3.9%	4.0%	4.1%	4.1%	4.2%
Real Estate / Rental and Lease	5.5%	5.6%	5.6%	5.6%	5.7%	5.7%	5.7%	5.7%	5.7%	5.7%	5.7%
Professional and Technical Services	5.2%	5.7%	5.7%	5.8%	5.9%	5.9%	6.0%	6.4%	6.8%	7.1%	8.0%
Management	0.5%	0.4%	0.4%	0.4%	0.4%	0.4%	0.4%	0.4%	0.4%	0.3%	0.3%
Administrative and Waste Services	7.0%	6.4%	6.4%	6.5%	6.5%	6.6%	6.7%	6.9%	7.2%	7.4%	7.9%
Educational Services	1.0%	1.1%	1.1%	1.1%	1.1%	1.2%	1.2%	1.2%	1.3%	1.3%	1.4%
Health Care and Social Assistance	8.9%	10.8%	10.9%	11.0%	11.1%	11.2%	11.3%	11.8%	12.4%	12.9%	14.0%
Arts, Entertainment, and Recreation	1.7%	1.9%	1.9%	1.9%	1.9%	1.9%	1.9%	1.9%	2.0%	2.0%	2.0%
Accommodation and Food Services	8.8%	9.2%	9.2%	9.2%	9.2%	9.2%	9.2%	9.1%	9.1%	9.1%	9.0%
Other Services, Except Public Administration	6.2%	6.3%	6.3%	6.3%	6.3%	6.3%	6.4%	6.5%	6.5%	6.6%	6.7%
Federal Civilian Government	3.5%	3.7%	3.7%	3.7%	3.6%	3.6%	3.5%	3.3%	3.1%	2.9%	2.5%
Federal Military	6.9%	7.3%	7.2%	7.1%	7.0%	6.9%	6.8%	6.2%	5.7%	5.2%	4.4%
State and Local Government	9.1%	9.7%	9.7%	9.6%	9.6%	9.6%	9.5%	9.3%	9.1%	8.9%	8.4%

Table 4-33. Demographic and Employment Baseline Projections for Economic Impact Area FL-1 (continued).

	2005	2010	2011	2012	2013	2014	2015	2020	2025	2030	2040
Total Earnings (in millions of 2005 dollars)	19,144.97	18,366.21	19,090.88	19,571.64	20,064.69	20,570.39	21,089.01	23,888.71	27,067.17	30,676.87	39,438.19
Farm Employment	0.1%	0.2%	0.1%	0.1%	0.1%	0.1%	0.1%	0.1%	0.1%	0.1%	0.1%
Forestry, Fishing, Related Activities	0.2%	0.2%	0.2%	0.2%	0.2%	0.2%	0.2%	0.2%	0.2%	0.2%	0.2%
Mining	0.1%	0.1%	0.1%	0.1%	0.1%	0.1%	0.1%	0.1%	0.1%	0.1%	0.1%
Utilities	0.5%	0.5%	0.5%	0.5%	0.5%	0.5%	0.5%	0.5%	0.5%	0.5%	0.5%
Construction	8.1%	4.4%	4.8%	4.8%	4.7%	4.7%	4.6%	4.4%	4.2%	4.0%	3.7%
Manufacturing	4.8%	4.7%	4.8%	4.8%	4.8%	4.8%	4.7%	4.6%	4.5%	4.4%	4.2%
Wholesale Trade	3.0%	2.4%	2.4%	2.4%	2.4%	2.4%	2.4%	2.3%	2.2%	2.2%	2.0%
Retail Trade	7.9%	7.3%	7.3%	7.3%	7.2%	7.2%	7.2%	7.0%	6.9%	6.7%	6.4%
Transportation and Warehousing	1.8%	2.2%	2.2%	2.2%	2.2%	2.2%	2.2%	2.2%	2.1%	2.1%	2.1%
Information Employment	2.4%	2.0%	2.1%	2.1%	2.1%	2.1%	2.1%	2.1%	2.1%	2.1%	2.1%
Finance and Insurance	3.9%	3.6%	3.6%	3.6%	3.7%	3.7%	3.8%	4.0%	4.2%	4.4%	4.9%
Real Estate / Rental and Lease	3.1%	2.0%	2.0%	2.1%	2.1%	2.1%	2.1%	2.2%	2.3%	2.4%	2.5%
Professional and Technical Services	6.6%	6.8%	6.8%	6.9%	7.0%	7.1%	7.2%	7.7%	8.2%	8.8%	9.9%
Management	0.8%	0.7%	0.7%	0.7%	0.7%	0.7%	0.7%	0.7%	0.7%	0.7%	0.8%
Administrative and Waste Services	4.5%	3.7%	3.8%	3.8%	3.9%	3.9%	3.9%	4.2%	4.4%	4.6%	5.1%
Educational Services	0.7%	0.7%	0.7%	0.7%	0.7%	0.7%	0.7%	0.8%	0.8%	0.9%	0.9%
Health Care and Social Assistance	10.0%	12.0%	12.0%	12.2%	12.3%	12.5%	12.6%	13.3%	14.0%	14.7%	16.2%
Arts, Entertainment, and Recreation	0.6%	0.6%	0.6%	0.5%	0.5%	0.5%	0.5%	0.5%	0.5%	0.5%	0.5%
Accommodation and Food Services	4.6%	4.4%	4.4%	4.4%	4.4%	4.4%	4.3%	4.3%	4.3%	4.3%	4.2%
Other Services, Except Public Administration	4.4%	4.3%	4.2%	4.2%	4.3%	4.3%	4.3%	4.4%	4.4%	4.5%	4.6%
Federal Civilian Government	6.8%	7.8%	7.6%	7.6%	7.5%	7.5%	7.4%	7.1%	6.8%	6.6%	6.0%
Federal Military	14.5%	18.2%	18.0%	17.8%	17.6%	17.4%	17.2%	16.3%	15.4%	14.5%	12.8%
State and Local Government	10.5%	11.2%	11.1%	11.1%	11.0%	11.0%	11.0%	11.0%	10.9%	10.7%	10.4%
Total Personal Income Per Capita (in 2005 dollars)	30,955	31,238	31,611	31,972	32,345	32,728	33,123	35,252	37,665	40,392	46,766
Woods & Poole Economics Wealth Index (U.S. = 100)	86.0	86.1	85.9	86.0	86.0	86.1	86.2	86.6	87.2	87.8	89.2
Persons Per Household (in number of people)	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.4	2.4	2.5
Mean Household Total Personal Income (in 2005 dollars)	70,630	68,775	69,464	70,092	70,758	71,474	72,225	76,569	81,867	88,167	103,926
Total Number of Households (in thousands)	339.50	355.60	362.19	369.74	377.31	384.77	392.23	428.80	464.20	497.98	559.96
Income < $10,000 (thousands of households, 2000 dollars)	8.7%	8.1%	7.9%	7.8%	7.7%	7.5%	7.4%	6.6%	5.7%	4.9%	3.5%
Income $10,000 to $19,999	12.4%	11.6%	11.3%	11.1%	11.0%	10.8%	10.6%	9.4%	8.1%	7.0%	5.1%
Income $20,000 to $29,999	13.8%	12.9%	12.6%	12.4%	12.2%	12.0%	11.8%	10.4%	9.1%	7.8%	5.7%
Income $30,000 to $44,999	19.7%	18.9%	18.6%	18.3%	18.1%	17.8%	17.5%	15.6%	13.6%	11.7%	8.5%
Income $45,000 to $59,999	16.5%	17.4%	17.8%	18.0%	18.2%	18.3%	18.5%	19.1%	18.7%	17.1%	12.7%
Income $60,000 to $74,999	11.2%	12.0%	12.3%	12.5%	12.7%	13.0%	13.2%	15.0%	17.3%	19.3%	20.1%
Income $75,000 to $99,999	9.2%	9.8%	10.1%	10.2%	10.4%	10.6%	10.8%	12.3%	14.2%	16.5%	22.7%
Income $100,000 or more	8.6%	9.2%	9.5%	9.6%	9.8%	10.0%	10.2%	11.6%	13.4%	15.7%	21.7%

Notes: Median age, wealth index, and mean household income is the average of the original Woods & Poole values for the 7 counties in the EIA; income per capita calculated using personal income/total population for the EIA; persons per household calculated using total population/number of households for the EIA.

Source: Woods & Poole Economics, Inc., 2010.

Table 4-34

Demographic and Employment Baseline Projections for Economic Impact Area FL-2

	2005	2010	2011	2012	2013	2014	2015	2020	2025	2030	2040
Total Population (in thousands)	613.83	657.40	666.76	676.21	685.71	695.29	704.90	753.56	802.95	852.48	951.77
Age Under 19 years	25.8%	24.6%	24.3%	24.2%	24.0%	23.9%	24.0%	24.2%	24.0%	23.7%	22.9%
Age 20 to 34	24.5%	25.3%	25.6%	25.8%	25.9%	25.9%	25.5%	22.8%	20.4%	19.9%	20.2%
Age 35 to 49	20.7%	18.9%	18.5%	18.1%	17.8%	17.5%	17.4%	18.7%	20.7%	21.4%	17.3%
Age 50 to 64	17.1%	18.2%	18.4%	18.3%	18.3%	18.3%	18.3%	17.6%	16.4%	15.2%	18.4%
Age 65 and over	11.9%	12.9%	13.2%	13.6%	14.0%	14.4%	14.8%	16.7%	18.5%	19.8%	21.2%
Median Age of Population (in years)	37	38	38	38	39	39	39	40	41	42	43
White Population (in thousands)	66.6%	65.2%	65.0%	64.8%	64.6%	64.4%	64.2%	63.2%	62.2%	61.2%	59.5%
Black Population (in thousands)	27.1%	27.5%	27.6%	27.6%	27.7%	27.7%	27.8%	28.2%	28.5%	28.9%	29.5%
Native American Population (in thousands)	0.5%	0.5%	0.5%	0.5%	0.5%	0.5%	0.5%	0.5%	0.5%	0.4%	0.4%
Asian and Pacific Islander Population (in thousands)	1.3%	1.5%	1.5%	1.5%	1.6%	1.6%	1.6%	1.7%	1.9%	2.0%	2.2%
Hispanic or Latino Population (in thousands)	4.5%	5.3%	5.4%	5.5%	5.6%	5.8%	5.9%	6.4%	6.9%	7.5%	8.4%
Male Population (in thousands)	50.3%	50.8%	50.8%	50.9%	50.9%	51.0%	51.0%	51.2%	51.3%	51.4%	51.6%
Total Employment (in thousands of jobs)	322.62	330.09	338.56	342.74	346.98	351.28	355.62	378.16	402.13	427.62	483.55
Farm Employment	2.6%	3.0%	3.0%	3.0%	2.9%	2.9%	2.9%	2.7%	2.5%	2.4%	2.1%
Forestry, Fishing, Related Activities	1.3%	1.4%	1.4%	1.4%	1.4%	1.4%	1.4%	1.3%	1.3%	1.3%	1.3%
Mining	0.2%	0.2%	0.2%	0.2%	0.2%	0.2%	0.2%	0.2%	0.2%	0.2%	0.1%
Utilities	0.4%	0.4%	0.4%	0.4%	0.4%	0.4%	0.4%	0.4%	0.4%	0.4%	0.3%
Construction	6.5%	4.7%	4.7%	4.8%	4.8%	4.8%	4.8%	4.9%	5.0%	5.0%	5.1%
Manufacturing	4.6%	3.6%	3.6%	3.6%	3.5%	3.5%	3.5%	3.3%	3.2%	3.1%	2.8%
Wholesale Trade	2.1%	1.9%	1.9%	1.9%	1.9%	1.8%	1.8%	1.7%	1.7%	1.6%	1.4%
Retail Trade	11.0%	10.3%	10.2%	10.2%	10.2%	10.2%	10.2%	10.0%	9.9%	9.8%	9.5%
Transportation and Warehousing	1.6%	1.7%	1.7%	1.7%	1.7%	1.7%	1.7%	1.7%	1.7%	1.7%	1.6%
Information Employment	1.8%	1.7%	1.7%	1.7%	1.7%	1.7%	1.7%	1.6%	1.5%	1.5%	1.3%
Finance and Insurance	3.2%	3.5%	3.5%	3.5%	3.5%	3.5%	3.5%	3.5%	3.5%	3.5%	3.6%
Real Estate / Rental and Lease	3.1%	3.2%	3.2%	3.2%	3.2%	3.2%	3.2%	3.3%	3.3%	3.4%	3.4%
Professional and Technical Services	5.8%	6.2%	6.3%	6.4%	6.5%	6.6%	6.7%	7.1%	7.6%	8.1%	9.1%
Management	0.3%	0.3%	0.3%	0.3%	0.3%	0.3%	0.3%	0.3%	0.3%	0.3%	0.3%
Administrative and Waste Services	4.8%	4.8%	4.8%	4.9%	4.9%	4.9%	5.0%	5.1%	5.3%	5.4%	5.7%
Educational Services	1.1%	1.6%	1.6%	1.6%	1.7%	1.7%	1.7%	1.9%	2.0%	2.2%	2.6%
Health Care and Social Assistance	8.6%	10.3%	10.4%	10.5%	10.7%	10.8%	10.9%	11.4%	12.0%	12.5%	13.6%
Arts, Entertainment, and Recreation	1.2%	1.5%	1.5%	1.5%	1.5%	1.5%	1.5%	1.6%	1.6%	1.7%	1.7%
Accommodation and Food Services	6.7%	6.8%	6.8%	6.9%	6.9%	6.9%	6.9%	7.0%	7.2%	7.3%	7.5%
Other Services, Except Public Administration	6.2%	6.1%	6.1%	6.1%	6.2%	6.2%	6.2%	6.3%	6.3%	6.4%	6.5%
Federal Civilian Government	1.2%	1.3%	1.3%	1.3%	1.2%	1.2%	1.2%	1.1%	1.1%	1.0%	0.8%
Federal Military	0.4%	0.4%	0.4%	0.4%	0.4%	0.4%	0.4%	0.4%	0.3%	0.3%	0.3%
State and Local Government	25.3%	25.0%	24.8%	24.6%	24.4%	24.2%	24.0%	23.0%	22.0%	21.0%	19.2%

Table 4-34. Demographic and Employment Baseline Projections for Economic Impact Area FL-2 (continued).

	2005	2010	2011	2012	2013	2014	2015	2020	2025	2030	2040
Total Earnings (in millions of 2005 dollars)	11,927.62	11,506.58	11,863.49	12,113.72	12,369.19	12,629.96	12,896.15	14,312.49	15,882.28	17,622.00	21,685.31
Farm Employment	1.3%	1.2%	1.3%	1.2%	1.2%	1.2%	1.2%	1.1%	1.0%	0.9%	0.7%
Forestry, Fishing, Related Activities	1.3%	1.3%	1.3%	1.3%	1.3%	1.3%	1.2%	1.2%	1.1%	1.1%	1.0%
Mining	0.1%	0.2%	0.2%	0.2%	0.2%	0.2%	0.2%	0.2%	0.2%	0.2%	0.2%
Utilities	0.8%	0.8%	0.8%	0.8%	0.8%	0.8%	0.8%	0.9%	0.9%	0.9%	1.0%
Construction	6.4%	4.2%	4.5%	4.4%	4.4%	4.4%	4.4%	4.2%	4.1%	3.9%	3.6%
Manufacturing	5.9%	5.3%	5.5%	5.4%	5.4%	5.4%	5.4%	5.2%	5.1%	4.9%	4.6%
Wholesale Trade	2.7%	2.3%	2.4%	2.4%	2.4%	2.4%	2.3%	2.3%	2.2%	2.1%	1.9%
Retail Trade	7.2%	7.0%	7.0%	7.0%	6.9%	6.9%	6.9%	6.7%	6.6%	6.4%	6.1%
Transportation and Warehousing	1.5%	1.6%	1.7%	1.7%	1.7%	1.7%	1.6%	1.6%	1.6%	1.5%	1.5%
Information Employment	2.4%	2.3%	2.3%	2.3%	2.3%	2.3%	2.3%	2.2%	2.1%	2.0%	1.9%
Finance and Insurance	4.2%	4.5%	4.6%	4.6%	4.7%	4.7%	4.8%	5.0%	5.2%	5.4%	5.9%
Real Estate / Rental and Lease	1.1%	0.9%	0.9%	0.9%	0.9%	0.9%	0.9%	0.9%	0.9%	1.0%	1.0%
Professional and Technical Services	7.9%	8.1%	8.1%	8.2%	8.3%	8.4%	8.6%	9.2%	9.8%	10.4%	11.7%
Management	0.4%	0.5%	0.6%	0.6%	0.6%	0.6%	0.6%	0.6%	0.6%	0.7%	0.7%
Administrative and Waste Services	2.7%	2.7%	2.7%	2.7%	2.8%	2.8%	2.8%	2.9%	3.0%	3.1%	3.4%
Educational Services	0.5%	0.8%	0.8%	0.8%	0.8%	0.8%	0.9%	0.9%	1.0%	1.1%	1.4%
Health Care and Social Assistance	9.6%	11.6%	11.7%	11.8%	12.0%	12.1%	12.2%	12.9%	13.5%	14.1%	15.4%
Arts, Entertainment, and Recreation	0.4%	0.4%	0.5%	0.5%	0.5%	0.5%	0.5%	0.5%	0.5%	0.5%	0.5%
Accommodation and Food Services	2.7%	2.8%	2.7%	2.7%	2.7%	2.8%	2.8%	2.8%	2.8%	2.8%	2.9%
Other Services, Except Public Administration	5.2%	5.4%	5.3%	5.3%	5.3%	5.3%	5.4%	5.4%	5.5%	5.5%	5.6%
Federal Civilian Government	2.7%	3.2%	3.2%	3.2%	3.1%	3.1%	3.1%	3.0%	2.9%	2.8%	2.6%
Federal Military	0.5%	0.6%	0.5%	0.5%	0.5%	0.5%	0.5%	0.5%	0.5%	0.5%	0.5%
State and Local Government	32.3%	32.2%	31.6%	31.4%	31.2%	31.0%	30.8%	29.9%	28.9%	27.9%	26.0%
Total Personal Income Per Capita (in 2005 dollars)	27,200	26,656	26,811	27,063	27,321	27,585	27,856	29,328	31,005	32,905	37,298
Woods & Poole Economics Wealth Index (U.S. = 100)	67.0	66.8	66.7	66.6	66.5	66.4	66.3	65.9	65.6	65.4	64.9
Persons Per Household (in number of people)	2.6	2.6	2.6	2.6	2.6	2.5	2.5	2.5	2.5	2.5	2.5
Mean Household Total Personal Income (in 2005 dollars)	57,688	56,795	57,352	57,724	58,116	58,529	58,970	61,586	64,884	68,883	78,850
Total Number of Households (in thousands)	236.50	255.39	259.32	263.92	268.49	273.05	277.56	299.51	320.40	339.91	374.75
Income < $10,000 (thousands of households, 2000 dollars)	13.6%	12.8%	12.6%	12.4%	12.2%	12.1%	11.9%	11.0%	10.1%	8.9%	6.6%
Income $10,000 to $19,999	14.3%	13.6%	13.4%	13.2%	13.0%	12.8%	12.6%	11.7%	10.7%	9.4%	7.0%
Income $20,000 to $29,999	14.0%	13.3%	13.1%	12.9%	12.7%	12.5%	12.4%	11.5%	10.5%	9.3%	6.9%
Income $30,000 to $44,999	18.7%	18.8%	18.8%	18.8%	18.7%	18.6%	18.5%	17.9%	16.8%	14.9%	11.1%
Income $45,000 to $59,999	14.2%	14.9%	15.2%	15.4%	15.6%	15.8%	16.1%	17.2%	18.3%	19.3%	17.8%
Income $60,000 to $74,999	9.4%	9.9%	10.0%	10.2%	10.3%	10.5%	10.6%	11.5%	12.5%	14.3%	18.6%
Income $75,000 to $99,999	8.2%	8.6%	8.7%	8.8%	8.9%	9.1%	9.2%	9.9%	10.8%	12.4%	16.6%
Income $100,000 or more	7.8%	8.1%	8.3%	8.4%	8.5%	8.6%	8.7%	9.4%	10.2%	11.6%	15.4%

Notes: Median age, wealth index, and mean household income is the average of the original Woods & Poole values for the 15 counties in the EIA; income per capita calculated using personal income/total population for the EIA; persons per household calculated using total population/number of households for the EIA.

Source: Woods & Poole Economics, Inc., 2010.

Table 4-35

Demographic and Employment Baseline Projections for Economic Impact Area FL-3

	2005	2010	2011	2012	2013	2014	2015	2020	2025	2030	2040
Total Population (in thousands)	3,416.04	3,624.88	3,675.05	3,725.64	3,776.58	3,827.91	3,879.47	4,140.64	4,405.96	4,672.19	5,206.25
Age Under 19 years	24.0%	23.4%	23.3%	23.2%	23.2%	23.1%	23.1%	23.1%	23.2%	23.1%	23.0%
Age 20 to 34	18.9%	19.4%	19.7%	19.8%	19.9%	19.9%	19.8%	19.2%	18.6%	18.3%	18.6%
Age 35 to 49	21.2%	19.6%	19.2%	18.8%	18.5%	18.2%	18.1%	17.9%	18.4%	18.8%	17.8%
Age 50 to 64	18.1%	19.5%	19.8%	19.8%	19.8%	19.9%	19.9%	19.1%	17.5%	16.2%	16.5%
Age 65 and over	17.8%	18.0%	18.1%	18.4%	18.6%	18.9%	19.1%	20.6%	22.3%	23.7%	24.1%
Median Age of Population (in years)	41	41	42	42	42	42	42	43	43	44	44
White Population (in thousands)	74.5%	71.2%	70.7%	70.1%	69.6%	69.1%	68.5%	65.9%	63.3%	60.7%	55.4%
Black Population (in thousands)	11.3%	11.8%	11.9%	12.0%	12.0%	12.1%	12.1%	12.3%	12.5%	12.6%	12.7%
Native American Population (in thousands)	0.3%	0.3%	0.3%	0.3%	0.3%	0.3%	0.3%	0.3%	0.3%	0.3%	0.2%
Asian and Pacific Islander Population (in thousands)	2.5%	2.9%	3.0%	3.0%	3.1%	3.2%	3.3%	3.6%	4.0%	4.4%	5.3%
Hispanic or Latino Population (in thousands)	11.4%	13.7%	14.1%	14.5%	14.9%	15.3%	15.8%	17.8%	19.9%	22.0%	26.4%
Male Population (in thousands)	48.7%	48.9%	49.0%	49.0%	49.1%	49.2%	49.2%	49.4%	49.5%	49.6%	49.7%
Total Employment (in thousands of jobs)	1,944.16	1,868.77	1,922.79	1,951.29	1,980.12	2,009.31	2,038.85	2,192.00	2,354.46	2,526.62	2,901.49
Farm Employment	1.0%	1.2%	1.1%	1.1%	1.1%	1.1%	1.1%	1.0%	1.0%	0.9%	0.8%
Forestry, Fishing, Related Activities	0.5%	0.6%	0.6%	0.6%	0.6%	0.6%	0.6%	0.5%	0.5%	0.5%	0.5%
Mining	0.1%	0.1%	0.1%	0.1%	0.1%	0.1%	0.1%	0.1%	0.1%	0.1%	0.1%
Utilities	0.4%	0.4%	0.4%	0.4%	0.4%	0.4%	0.3%	0.3%	0.3%	0.3%	0.3%
Construction	7.3%	4.8%	4.8%	4.9%	4.9%	4.9%	4.9%	5.0%	5.0%	5.1%	5.2%
Manufacturing	5.0%	4.4%	4.3%	4.3%	4.2%	4.1%	4.0%	3.7%	3.4%	3.1%	2.6%
Wholesale Trade	3.4%	3.4%	3.3%	3.3%	3.3%	3.3%	3.3%	3.2%	3.1%	3.1%	2.9%
Retail Trade	11.4%	11.1%	11.1%	11.0%	11.0%	11.0%	11.0%	10.8%	10.6%	10.4%	10.0%
Transportation and Warehousing	2.3%	2.5%	2.4%	2.4%	2.4%	2.4%	2.4%	2.4%	2.4%	2.4%	2.4%
Information Employment	2.2%	2.0%	2.0%	2.0%	2.0%	2.0%	2.0%	1.9%	1.9%	1.8%	1.7%
Finance and Insurance	5.8%	5.9%	5.9%	5.9%	5.9%	5.8%	5.8%	5.7%	5.7%	5.6%	5.4%
Real Estate / Rental and Lease	4.5%	4.4%	4.5%	4.5%	4.5%	4.5%	4.5%	4.6%	4.6%	4.7%	4.8%
Professional and Technical Services	6.4%	7.3%	7.3%	7.3%	7.3%	7.3%	7.3%	7.3%	7.4%	7.4%	7.3%
Management	0.8%	1.2%	1.2%	1.2%	1.2%	1.3%	1.3%	1.3%	1.4%	1.4%	1.6%
Administrative and Waste Services	10.8%	7.8%	7.9%	8.0%	8.1%	8.2%	8.2%	8.7%	9.2%	9.6%	10.6%
Educational Services	1.3%	1.7%	1.7%	1.8%	1.8%	1.8%	1.8%	2.0%	2.1%	2.2%	2.5%
Health Care and Social Assistance	10.3%	13.0%	13.1%	13.2%	13.4%	13.5%	13.6%	14.2%	14.8%	15.4%	16.7%
Arts, Entertainment, and Recreation	2.0%	2.4%	2.4%	2.4%	2.4%	2.4%	2.3%	2.3%	2.3%	2.3%	2.2%
Accommodation and Food Services	6.8%	7.0%	7.0%	7.0%	6.9%	6.9%	6.8%	6.6%	6.4%	6.2%	5.8%
Other Services, Except Public Administration	5.9%	6.2%	6.2%	6.2%	6.2%	6.2%	6.2%	6.1%	6.1%	6.0%	5.9%
Federal Civilian Government	1.3%	1.5%	1.5%	1.5%	1.5%	1.5%	1.5%	1.5%	1.4%	1.4%	1.3%
Federal Military	0.7%	0.7%	0.7%	0.7%	0.7%	0.7%	0.7%	0.6%	0.6%	0.5%	0.5%
State and Local Government	9.9%	10.3%	10.3%	10.2%	10.2%	10.1%	10.1%	9.9%	9.6%	9.4%	8.9%

Table 4-35. Demographic and Employment Baseline Projections for Economic Impact Area FL-3 (continued).

	2005	2010	2011	2012	2013	2014	2015	2020	2025	2030	2040
Total Earnings (in millions of 2005 dollars)	79,115.35	72,699.32	75,523.98	77,335.32	79,187.57	81,081.56	83,018.17	93,371.74	104,929.66	117,819.11	148,161.00
Farm Employment	0.5%	0.3%	0.4%	0.4%	0.4%	0.4%	0.4%	0.3%	0.3%	0.3%	0.2%
Forestry, Fishing, Related Activities	0.3%	0.3%	0.3%	0.3%	0.3%	0.3%	0.3%	0.3%	0.3%	0.3%	0.3%
Mining	0.3%	0.3%	0.3%	0.3%	0.3%	0.3%	0.3%	0.4%	0.4%	0.4%	0.4%
Utilities	0.9%	0.8%	0.8%	0.8%	0.8%	0.8%	0.8%	0.8%	0.8%	0.8%	0.9%
Construction	7.5%	4.4%	4.8%	4.8%	4.7%	4.7%	4.7%	4.5%	4.3%	4.1%	3.8%
Manufacturing	6.8%	6.0%	6.1%	6.0%	5.9%	5.8%	5.8%	5.3%	4.9%	4.5%	3.8%
Wholesale Trade	4.9%	4.8%	4.9%	4.8%	4.8%	4.8%	4.8%	4.7%	4.6%	4.6%	4.4%
Retail Trade	8.3%	7.7%	7.7%	7.6%	7.6%	7.5%	7.5%	7.3%	7.0%	6.8%	6.3%
Transportation and Warehousing	2.3%	2.3%	2.3%	2.3%	2.3%	2.3%	2.3%	2.2%	2.2%	2.1%	2.1%
Information Employment	3.3%	3.1%	3.0%	3.0%	3.0%	3.0%	3.0%	2.9%	2.9%	2.8%	2.7%
Finance and Insurance	8.0%	7.2%	7.2%	7.2%	7.3%	7.3%	7.3%	7.4%	7.5%	7.6%	7.7%
Real Estate / Rental and Lease	2.3%	1.5%	1.5%	1.6%	1.6%	1.6%	1.6%	1.7%	1.7%	1.8%	1.9%
Professional and Technical Services	8.1%	9.2%	9.1%	9.1%	9.1%	9.1%	9.1%	9.1%	9.1%	9.1%	9.0%
Management	1.6%	2.4%	2.4%	2.5%	2.5%	2.6%	2.6%	2.8%	3.0%	3.3%	3.7%
Administrative and Waste Services	7.1%	4.8%	4.9%	4.9%	5.0%	5.1%	5.1%	5.4%	5.8%	6.1%	6.9%
Educational Services	0.8%	1.1%	1.1%	1.1%	1.2%	1.2%	1.2%	1.3%	1.4%	1.5%	1.7%
Health Care and Social Assistance	12.1%	15.5%	15.4%	15.6%	15.7%	15.9%	16.0%	16.7%	17.4%	18.1%	19.5%
Arts, Entertainment, and Recreation	1.5%	2.0%	2.0%	2.0%	1.9%	1.9%	1.9%	1.9%	1.8%	1.7%	1.6%
Accommodation and Food Services	3.9%	4.2%	4.1%	4.1%	4.0%	4.0%	4.0%	3.8%	3.6%	3.5%	3.2%
Other Services, Except Public Administration	4.0%	4.2%	4.1%	4.1%	4.1%	4.1%	4.1%	4.0%	4.0%	3.9%	3.8%
Federal Civilian Government	2.7%	3.5%	3.4%	3.4%	3.4%	3.4%	3.4%	3.5%	3.5%	3.5%	3.5%
Federal Military	1.2%	1.5%	1.5%	1.5%	1.5%	1.5%	1.5%	1.4%	1.4%	1.3%	1.2%
State and Local Government	11.8%	12.8%	12.6%	12.6%	12.5%	12.5%	12.5%	12.3%	12.2%	12.0%	11.6%
Total Personal Income Per Capita (in 2005 dollars)	33,224	31,323	31,639	32,001	32,373	32,754	33,144	35,240	37,593	40,226	46,260
Woods & Poole Economics Wealth Index (U.S. = 100)	79.5	77.2	77.2	77.2	77.1	77.1	77.1	77.0	77.0	77.0	77.0
Persons Per Household (in number of people)	2.4	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3
Mean Household Total Personal Income (in 2005 dollars)	64,512	62,252	63,029	63,502	63,992	64,509	65,058	68,279	72,269	77,062	88,938
Total Number of Households (in thousands)	1,449.40	1,546.55	1,568.95	1,595.36	1,621.62	1,647.70	1,673.53	1,798.54	1,917.25	2,027.90	2,223.65
Income < $10,000 (thousands of households, 2000 dollars)	9.1%	8.7%	8.6%	8.4%	8.3%	8.1%	8.0%	7.2%	6.3%	5.5%	4.1%
Income $10,000 to $19,999	13.8%	13.4%	13.1%	12.9%	12.6%	12.4%	12.1%	11.0%	9.7%	8.4%	6.2%
Income $20,000 to $29,999	14.7%	14.2%	13.9%	13.7%	13.5%	13.2%	12.9%	11.7%	10.3%	8.9%	6.6%
Income $30,000 to $44,999	19.6%	19.5%	19.3%	19.2%	19.0%	18.7%	18.5%	17.1%	15.3%	13.3%	9.9%
Income $45,000 to $59,999	15.1%	15.7%	16.0%	16.3%	16.6%	16.8%	17.1%	18.0%	18.6%	18.4%	15.2%
Income $60,000 to $74,999	9.7%	10.1%	10.3%	10.5%	10.7%	10.9%	11.1%	12.4%	14.2%	16.1%	18.7%
Income $75,000 to $99,999	8.4%	8.7%	8.9%	9.0%	9.2%	9.4%	9.6%	10.7%	12.2%	13.9%	18.7%
Income $100,000 or more	9.4%	9.7%	9.9%	10.1%	10.2%	10.4%	10.7%	11.9%	13.5%	15.4%	20.5%

Notes: Median age, wealth index, and mean household income is the average of the original Woods & Poole values for the 12 counties in the EIA; income per capita calculated using personal income/total population for the EIA; persons per household calculated using total population/number of households for the EIA.

Source: Woods & Poole Economics, Inc., 2010.

Table 4-36

Demographic and Employment Baseline Projections for Economic Impact Area FL-4

	2005	2010	2011	2012	2013	2014	2015	2020	2025	2030	2040
Total Population (in thousands)	5,960.39	6,210.44	6,294.73	6,379.76	6,465.42	6,551.79	6,638.56	7,078.51	7,525.98	7,975.38	8,877.71
Age Under 19 years	24.7%	24.0%	23.9%	23.7%	23.6%	23.6%	23.5%	23.5%	23.2%	23.0%	22.8%
Age 20 to 34	18.5%	18.6%	18.6%	18.7%	18.7%	18.8%	18.8%	18.2%	17.8%	17.5%	17.4%
Age 35 to 49	22.1%	20.8%	20.4%	20.1%	19.7%	19.3%	19.0%	18.3%	18.2%	18.3%	17.2%
Age 50 to 64	17.5%	18.9%	19.1%	19.3%	19.4%	19.6%	19.7%	19.3%	18.3%	16.7%	16.1%
Age 65 and over	17.2%	17.8%	18.0%	18.2%	18.5%	18.8%	19.1%	20.7%	22.5%	24.4%	26.5%
Median Age of Population (in years)	44	45	45	45	45	45	45	46	46	46	46
White Population (in thousands)	46.6%	43.3%	42.7%	42.1%	41.5%	40.9%	40.4%	37.7%	35.3%	32.9%	28.5%
Black Population (in thousands)	16.5%	16.5%	16.6%	16.6%	16.6%	16.7%	16.7%	16.8%	16.9%	17.0%	16.9%
Native American Population (in thousands)	0.2%	0.2%	0.2%	0.2%	0.2%	0.2%	0.2%	0.2%	0.2%	0.2%	0.1%
Asian and Pacific Islander Population (in thousands)	1.9%	2.1%	2.1%	2.2%	2.2%	2.2%	2.3%	2.5%	2.6%	2.8%	3.2%
Hispanic or Latino Population (in thousands)	34.8%	37.9%	38.5%	39.0%	39.5%	40.0%	40.5%	42.8%	45.0%	47.2%	51.2%
Male Population (in thousands)	48.8%	49.0%	49.1%	49.1%	49.1%	49.1%	49.1%	49.2%	49.2%	49.2%	49.0%
Total Employment (in thousands of jobs)	3,395.35	3,329.05	3,426.96	3,479.99	3,533.68	3,588.03	3,643.04	3,928.30	4,230.99	4,551.70	5,249.44
Farm Employment	0.6%	0.6%	0.6%	0.6%	0.6%	0.6%	0.6%	0.6%	0.5%	0.5%	0.4%
Forestry, Fishing, Related Activities	0.4%	0.5%	0.5%	0.5%	0.5%	0.4%	0.4%	0.4%	0.4%	0.4%	0.4%
Mining	0.1%	0.2%	0.2%	0.2%	0.2%	0.2%	0.2%	0.1%	0.1%	0.1%	0.1%
Utilities	0.2%	0.2%	0.2%	0.2%	0.2%	0.2%	0.2%	0.2%	0.2%	0.2%	0.2%
Construction	8.0%	5.0%	5.0%	5.0%	5.0%	5.1%	5.1%	5.3%	5.4%	5.6%	5.9%
Manufacturing	3.6%	2.9%	2.9%	2.9%	2.8%	2.8%	2.7%	2.5%	2.4%	2.2%	1.9%
Wholesale Trade	4.5%	4.3%	4.3%	4.2%	4.2%	4.2%	4.1%	3.9%	3.8%	3.6%	3.3%
Retail Trade	11.2%	11.1%	11.1%	11.0%	11.0%	10.9%	10.9%	10.7%	10.5%	10.3%	9.8%
Transportation and Warehousing	3.8%	3.9%	3.9%	3.9%	3.9%	3.8%	3.8%	3.7%	3.7%	3.6%	3.4%
Information Employment	2.0%	1.7%	1.7%	1.7%	1.7%	1.7%	1.7%	1.6%	1.6%	1.5%	1.4%
Finance and Insurance	5.0%	4.9%	4.9%	4.8%	4.8%	4.8%	4.8%	4.7%	4.5%	4.4%	4.1%
Real Estate / Rental and Lease	6.0%	6.1%	6.1%	6.1%	6.1%	6.1%	6.1%	6.1%	6.0%	6.0%	5.9%
Professional and Technical Services	6.5%	6.8%	6.8%	6.8%	6.8%	6.9%	6.9%	7.0%	7.1%	7.1%	7.3%
Management	0.7%	0.8%	0.8%	0.8%	0.8%	0.8%	0.8%	0.8%	0.9%	0.9%	1.0%
Administrative and Waste Services	9.0%	7.9%	8.0%	8.0%	8.1%	8.2%	8.2%	8.6%	9.0%	9.3%	10.1%
Educational Services	1.8%	2.5%	2.5%	2.5%	2.5%	2.5%	2.5%	2.6%	2.7%	2.8%	2.9%
Health Care and Social Assistance	9.1%	11.4%	11.5%	11.6%	11.7%	11.8%	11.8%	12.3%	12.8%	13.2%	14.2%
Arts, Entertainment, and Recreation	2.2%	2.5%	2.5%	2.5%	2.5%	2.5%	2.5%	2.5%	2.5%	2.4%	2.4%
Accommodation and Food Services	7.2%	7.4%	7.3%	7.3%	7.3%	7.3%	7.2%	7.1%	7.0%	6.8%	6.5%
Other Services, Except Public Administration	7.7%	8.4%	8.4%	8.4%	8.4%	8.4%	8.5%	8.6%	8.7%	8.7%	8.9%
Federal Civilian Government	1.0%	1.1%	1.1%	1.1%	1.0%	1.0%	1.0%	1.0%	1.0%	0.9%	0.8%
Federal Military	0.5%	0.5%	0.5%	0.5%	0.5%	0.4%	0.4%	0.4%	0.4%	0.3%	0.3%
State and Local Government	9.0%	9.6%	9.6%	9.5%	9.5%	9.5%	9.4%	9.3%	9.1%	9.0%	8.6%

Table 4-36. Demographic and Employment Baseline Projections for Economic Impact Area FL-4 (continued).

	2005	2010	2011	2012	2013	2014	2015	2020	2025	2030	2040
Total Earnings (in millions of 2005 dollars)	146,349.28	133,109.32	138,104.63	141,438.36	144,845.84	148,328.48	151,887.81	170,888.07	192,042.06	215,564.73	270,666.64
Farm Employment	0.5%	0.4%	0.4%	0.4%	0.4%	0.4%	0.4%	0.4%	0.3%	0.3%	0.3%
Forestry, Fishing, Related Activities	0.2%	0.2%	0.2%	0.2%	0.2%	0.2%	0.2%	0.2%	0.2%	0.2%	0.2%
Mining	0.1%	0.1%	0.1%	0.1%	0.1%	0.1%	0.1%	0.1%	0.1%	0.1%	0.1%
Utilities	0.4%	0.5%	0.5%	0.5%	0.5%	0.5%	0.5%	0.5%	0.5%	0.5%	0.5%
Construction	9.4%	5.2%	5.6%	5.6%	5.6%	5.5%	5.5%	5.4%	5.3%	5.2%	4.9%
Manufacturing	4.4%	3.6%	3.7%	3.7%	3.6%	3.6%	3.5%	3.3%	3.1%	2.9%	2.5%
Wholesale Trade	6.8%	6.7%	6.9%	6.8%	6.8%	6.7%	6.7%	6.4%	6.2%	5.9%	5.4%
Retail Trade	8.5%	8.4%	8.4%	8.3%	8.3%	8.2%	8.2%	7.9%	7.7%	7.4%	6.9%
Transportation and Warehousing	4.0%	4.0%	3.9%	3.9%	3.9%	3.9%	3.8%	3.7%	3.6%	3.5%	3.2%
Information Employment	3.6%	3.4%	3.4%	3.4%	3.4%	3.3%	3.3%	3.3%	3.2%	3.1%	3.0%
Finance and Insurance	6.9%	6.2%	6.1%	6.1%	6.1%	6.1%	6.1%	6.1%	6.1%	6.1%	6.0%
Real Estate / Rental and Lease	3.7%	2.4%	2.4%	2.4%	2.4%	2.4%	2.5%	2.5%	2.5%	2.6%	2.7%
Professional and Technical Services	8.3%	9.2%	9.1%	9.1%	9.1%	9.2%	9.2%	9.4%	9.5%	9.6%	9.9%
Management	1.3%	1.9%	1.9%	2.0%	2.0%	2.1%	2.1%	2.3%	2.5%	2.7%	3.2%
Administrative and Waste Services	6.2%	4.9%	4.9%	5.0%	5.0%	5.1%	5.1%	5.4%	5.6%	5.9%	6.5%
Educational Services	1.5%	2.2%	2.2%	2.2%	2.2%	2.2%	2.2%	2.3%	2.4%	2.5%	2.7%
Health Care and Social Assistance	9.5%	12.2%	12.1%	12.2%	12.3%	12.4%	12.5%	13.0%	13.5%	14.1%	15.1%
Arts, Entertainment, and Recreation	1.6%	1.9%	1.9%	1.9%	1.9%	1.9%	1.9%	1.8%	1.8%	1.8%	1.7%
Accommodation and Food Services	4.3%	4.6%	4.5%	4.5%	4.5%	4.5%	4.4%	4.3%	4.2%	4.1%	3.9%
Other Services, Except Public Administration	4.2%	4.6%	4.5%	4.5%	4.6%	4.6%	4.6%	4.6%	4.7%	4.7%	4.7%
Federal Civilian Government	2.2%	2.7%	2.6%	2.6%	2.6%	2.6%	2.6%	2.6%	2.6%	2.6%	2.6%
Federal Military	0.6%	0.7%	0.7%	0.7%	0.7%	0.7%	0.7%	0.7%	0.7%	0.6%	0.6%
State and Local Government	11.8%	14.0%	13.8%	13.8%	13.8%	13.8%	13.8%	13.8%	13.7%	13.6%	13.5%
Total Personal Income Per Capita (in 2005 dollars)	37,332	35,529	35,954	36,438	36,933	37,438	37,957	40,740	43,871	47,389	55,589
Woods & Poole Economics Wealth Index (U.S. = 100)	119.1	113.4	113.6	113.8	114.0	114.2	114.5	115.7	117.1	118.5	121.7
Persons Per Household (in number of people)	2.5	2.6	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5
Mean Household Total Personal Income (in 2005 dollars)	92,182	86,404	87,645	88,598	89,600	90,651	91,754	98,070	105,688	114,735	137,497
Total Number of Households (in thousands)	2,337.90	2,434.13	2,469.25	2,510.68	2,551.90	2,592.85	2,633.43	2,830.25	3,017.88	3,193.31	3,504.05
Income < $10,000 (thousands of households, 2000 dollars)	9.2%	8.8%	8.7%	8.5%	8.4%	8.2%	8.1%	7.2%	6.4%	5.6%	4.4%
Income $10,000 to $19,999	12.1%	11.7%	11.5%	11.4%	11.2%	11.0%	10.7%	9.6%	8.5%	7.5%	5.8%
Income $20,000 to $29,999	12.6%	12.3%	12.1%	11.9%	11.7%	11.5%	11.2%	10.0%	8.9%	7.9%	6.1%
Income $30,000 to $44,999	17.3%	17.0%	16.8%	16.5%	16.3%	16.0%	15.7%	14.0%	12.4%	11.0%	8.6%
Income $45,000 to $59,999	14.9%	15.3%	15.5%	15.6%	15.8%	15.9%	16.0%	16.2%	15.5%	14.1%	11.0%
Income $60,000 to $74,999	10.6%	11.0%	11.2%	11.4%	11.6%	11.8%	12.0%	13.5%	15.1%	16.3%	15.8%
Income $75,000 to $99,999	10.0%	10.3%	10.5%	10.7%	10.9%	11.1%	11.3%	12.8%	14.4%	16.4%	20.7%
Income $100,000 or more	13.1%	13.5%	13.8%	14.0%	14.3%	14.5%	14.8%	16.7%	18.8%	21.4%	27.6%

Notes: Median age, wealth index, and mean household income is the average of the original Woods & Poole values for the 9 counties in the EIA; income per capita calculated using personal income/total population for the EIA; persons per household calculated using total population/number of households for the EIA.

Source: Woods & Poole Economics, Inc., 2010.

Table 4-37

Baseline Population Projections (in thousands) by Economic Impact Area

Model Year	Calendar Year	AL-1	MS-1	LA-1	LA-2	LA-3	LA-4	TX-1	TX-2	TX-3	FL-1	FL-2	FL-3	FL-4
	2010	725.48	470.61	334.72	587.88	1,126.87	1,267.52	1,771.25	626.33	6,192.43	896.10	657.40	3,624.88	6,210.44
	2011	731.11	474.64	336.53	593.59	1,140.44	1,278.34	1,807.15	634.39	6,299.99	911.70	666.76	3,675.05	6,294.73
1	2012	736.83	478.72	338.39	599.38	1,154.15	1,289.31	1,843.24	642.51	6,408.25	927.40	676.21	3,725.64	6,379.76
2	2013	742.62	482.85	340.27	605.23	1,167.97	1,300.40	1,879.50	650.70	6,517.13	943.19	685.71	3,776.58	6,465.42
3	2014	748.49	487.02	342.20	611.14	1,181.91	1,311.64	1,915.95	658.94	6,626.68	959.08	695.29	3,827.91	6,551.79
4	2015	754.41	491.23	344.15	617.10	1,195.92	1,322.96	1,952.51	667.23	6,736.63	975.02	704.90	3,879.47	6,638.56
5	2016	760.38	495.47	346.12	623.10	1,210.00	1,334.37	1,989.19	675.55	6,847.01	991.02	714.55	3,931.27	6,725.77
6	2017	766.41	499.75	348.12	629.15	1,224.17	1,345.89	2,026.02	683.92	6,957.91	1,007.10	724.26	3,983.37	6,813.50
7	2018	772.47	504.05	350.13	635.22	1,238.39	1,357.45	2,062.92	692.31	7,069.08	1,023.22	734.00	4,035.62	6,901.51
8	2019	778.57	508.38	352.16	641.34	1,252.68	1,369.10	2,099.94	700.73	7,180.66	1,039.39	743.77	4,088.08	6,989.92
9	2020	784.68	512.71	354.20	647.47	1,266.99	1,380.77	2,137.01	709.17	7,292.42	1,055.59	753.56	4,140.64	7,078.51
10	2021	790.89	517.11	356.28	653.68	1,281.45	1,392.61	2,174.35	717.69	7,405.11	1,071.93	763.44	4,193.71	7,168.00
11	2022	797.15	521.54	358.38	659.95	1,296.07	1,404.55	2,212.34	726.31	7,519.54	1,088.51	773.44	4,247.45	7,258.63
12	2023	803.46	526.02	360.48	666.29	1,310.86	1,416.60	2,251.00	735.03	7,635.74	1,105.36	783.58	4,301.88	7,350.40
13	2024	809.82	530.53	362.60	672.68	1,325.83	1,428.75	2,290.33	743.85	7,753.73	1,122.46	793.85	4,357.01	7,443.33
14	2025	815.74	534.70	364.61	678.54	1,339.29	1,439.98	2,323.71	751.75	7,855.87	1,137.26	802.95	4,405.96	7,525.98
15	2026	821.98	539.11	366.70	684.79	1,353.80	1,451.87	2,361.17	760.29	7,968.97	1,153.65	812.85	4,459.20	7,615.86
16	2027	828.26	543.56	368.81	691.09	1,368.46	1,463.87	2,399.24	768.92	8,083.69	1,170.28	822.88	4,513.09	7,706.81
17	2028	834.60	548.05	370.92	697.46	1,383.29	1,475.96	2,437.91	777.65	8,200.07	1,187.15	833.03	4,567.63	7,798.85
18	2029	840.98	552.58	373.05	703.88	1,398.27	1,488.16	2,477.21	786.48	8,318.13	1,204.26	843.31	4,622.84	7,891.99
19	2030	846.94	556.77	375.07	709.79	1,411.83	1,499.47	2,511.01	794.43	8,421.37	1,219.22	852.48	4,672.19	7,975.38
20	2031	853.17	561.19	377.17	716.05	1,426.34	1,511.37	2,548.50	802.95	8,534.58	1,235.62	862.38	4,725.46	8,065.35
21	2032	859.46	565.63	379.27	722.36	1,440.99	1,523.36	2,586.55	811.57	8,649.31	1,252.25	872.41	4,779.34	8,156.35
22	2033	865.79	570.12	381.39	728.73	1,455.80	1,535.45	2,625.17	820.28	8,765.59	1,269.10	882.54	4,833.83	8,248.36
23	2034	872.17	574.64	383.51	735.16	1,470.76	1,547.64	2,664.37	829.09	8,883.43	1,286.17	892.80	4,888.94	8,341.42
24	2035	878.13	578.84	385.53	741.09	1,484.37	1,558.97	2,698.47	837.06	8,987.43	1,301.24	902.01	4,938.54	8,425.26
25	2036	884.41	583.28	387.64	747.40	1,498.95	1,570.96	2,736.13	845.63	9,101.21	1,317.72	911.96	4,992.08	8,515.75
26	2037	890.74	587.76	389.77	753.76	1,513.68	1,583.03	2,774.31	854.28	9,216.42	1,334.42	922.03	5,046.20	8,607.21
27	2038	897.11	592.27	391.90	760.17	1,528.55	1,595.20	2,813.03	863.02	9,333.09	1,351.32	932.20	5,100.91	8,699.66
28	2039	903.53	596.82	394.04	766.64	1,543.57	1,607.46	2,852.29	871.85	9,451.24	1,368.44	942.49	5,156.22	8,793.09
29	2040	909.54	601.05	396.08	772.62	1,557.29	1,618.89	2,886.77	879.89	9,556.30	1,383.66	951.77	5,206.25	8,877.71
30	2041	916.04	605.67	398.25	779.20	1,572.59	1,631.33	2,927.06	888.89	9,677.28	1,401.19	962.28	5,262.70	8,973.06
31	2042	922.60	610.31	400.43	785.83	1,588.03	1,643.87	2,967.91	897.99	9,799.78	1,418.94	972.89	5,319.75	9,069.43
32	2043	929.20	615.00	402.62	792.52	1,603.64	1,656.50	3,009.33	907.18	9,923.84	1,436.92	983.63	5,377.43	9,166.84
33	2044	935.84	619.72	404.83	799.26	1,619.39	1,669.23	3,051.33	916.46	10,049.47	1,455.12	994.48	5,435.73	9,265.29
34	2045	942.54	624.47	407.04	806.06	1,635.30	1,682.06	3,093.91	925.84	10,176.68	1,473.56	1,005.45	5,494.66	9,364.80
35	2046	949.28	629.27	409.27	812.92	1,651.37	1,694.99	3,137.09	935.31	10,305.51	1,492.22	1,016.55	5,554.23	9,465.38
36	2047	956.07	634.09	411.51	819.84	1,667.59	1,708.02	3,180.87	944.88	10,435.97	1,511.13	1,027.76	5,614.45	9,567.04
37	2048	962.91	638.96	413.76	826.82	1,683.97	1,721.15	3,225.27	954.55	10,568.08	1,530.27	1,039.10	5,675.32	9,669.80
38	2049	969.80	643.86	416.03	833.86	1,700.52	1,734.37	3,270.28	964.32	10,701.87	1,549.66	1,050.57	5,736.85	9,773.65
39	2050	976.73	648.81	418.30	840.95	1,717.22	1,747.70	3,315.92	974.19	10,837.34	1,569.29	1,062.16	5,799.05	9,878.62
40	2051	983.72	653.78	420.59	848.11	1,734.09	1,761.14	3,362.20	984.16	10,974.54	1,589.17	1,073.88	5,861.92	9,984.72

Notes: Actual Woods & Poole data for 2010 through 2020, 2025, 2030, 2035, and 2040. Missing estimates through 2040 calculated using average annual growth rate for the 5-year period; projections after 2040 calculated using the average annual growth rate from 2035 to 2040.

Source: Woods & Poole Economics, Inc., 2010.

Table 4-38

Baseline Employment Projections (in thousands) by Coastal Subarea

Model Year	Calendar Year	AL-1	MS-1	LA-1	LA-2	LA-3	LA-4	TX-1	TX-2	TX-3	FL-1	FL-2	FL-3	FL-4
	2010	353.63	243.91	177.73	321.93	663.02	728.32	840.00	309.97	3,596.00	489.82	330.09	1,868.77	3,329.05
	2011	362.59	249.36	182.05	330.21	680.63	745.53	864.86	317.96	3,700.61	504.24	338.56	1,922.79	3,426.96
1	2012	366.69	251.56	183.91	334.03	689.17	752.64	878.23	321.85	3,758.99	512.13	342.74	1,951.29	3,479.99
2	2013	370.81	253.76	185.81	337.89	697.80	759.77	891.81	325.78	3,818.15	520.13	346.98	1,980.12	3,533.68
3	2014	374.97	255.98	187.70	341.78	706.51	766.93	905.55	329.76	3,878.09	528.26	351.28	2,009.31	3,588.03
4	2015	379.15	258.22	189.62	345.70	715.33	774.11	919.48	333.78	3,938.83	536.52	355.62	2,038.85	3,643.04
5	2016	383.37	260.47	191.54	349.65	724.23	781.30	933.58	337.82	4,000.39	544.90	360.02	2,068.76	3,698.74
6	2017	387.62	262.73	193.50	353.63	733.24	788.52	947.87	341.92	4,062.77	553.43	364.46	2,099.03	3,755.10
7	2018	391.90	265.01	195.46	357.65	742.34	795.74	962.34	346.07	4,125.95	562.07	368.98	2,129.66	3,812.15
8	2019	396.21	267.30	197.44	361.69	751.53	802.98	977.00	350.24	4,189.99	570.86	373.54	2,160.65	3,869.88
9	2020	400.55	269.62	199.43	365.76	760.83	810.24	991.85	354.48	4,254.86	579.78	378.16	2,192.00	3,928.30
10	2021	404.99	271.97	201.47	369.93	770.43	817.53	1,007.28	358.83	4,322.32	589.12	382.95	2,224.49	3,988.84
11	2022	409.48	274.34	203.54	374.15	780.14	824.89	1,022.95	363.24	4,390.84	598.61	387.81	2,257.47	4,050.31
12	2023	414.02	276.74	205.62	378.41	789.98	832.32	1,038.87	367.71	4,460.45	608.25	392.73	2,290.93	4,112.73
13	2024	418.61	279.15	207.73	382.73	799.95	839.81	1,055.03	372.22	4,531.17	618.06	397.71	2,324.89	4,176.11
14	2025	422.75	281.38	209.65	386.61	808.81	846.71	1,069.01	376.26	4,592.14	626.48	402.13	2,354.46	4,230.99
15	2026	427.35	283.81	211.77	390.93	818.92	854.06	1,085.44	380.83	4,664.06	636.56	407.23	2,388.90	4,295.13
16	2027	431.99	286.26	213.92	395.30	829.16	861.46	1,102.12	385.46	4,737.10	646.80	412.39	2,423.83	4,360.25
17	2028	436.69	288.73	216.09	399.71	839.52	868.93	1,119.07	390.14	4,811.29	657.21	417.62	2,459.28	4,426.35
18	2029	441.43	291.22	218.28	404.18	850.02	876.47	1,136.27	394.88	4,886.64	667.78	422.92	2,495.24	4,493.45
19	2030	445.72	293.52	220.27	408.21	859.36	883.43	1,151.17	399.12	4,951.73	676.88	427.62	2,526.62	4,551.70
20	2031	450.47	296.02	222.48	412.68	870.01	890.79	1,168.65	403.92	5,028.34	687.75	433.04	2,563.07	4,619.55
21	2032	455.27	298.55	224.71	417.21	880.78	898.22	1,186.39	408.78	5,106.13	698.79	438.53	2,600.03	4,688.42
22	2033	460.12	301.09	226.97	421.78	891.69	905.70	1,204.41	413.70	5,185.13	710.01	444.09	2,637.53	4,758.32
23	2034	465.02	303.66	229.25	426.41	902.73	913.25	1,222.69	418.67	5,265.35	721.41	449.72	2,675.58	4,829.26
24	2035	469.47	306.03	231.32	430.59	912.57	920.25	1,238.56	423.13	5,334.78	731.22	454.72	2,708.83	4,890.99
25	2036	474.37	308.61	233.62	435.21	923.76	927.61	1,257.14	428.15	5,416.31	742.93	460.49	2,747.36	4,962.68
26	2037	479.32	311.21	235.94	439.89	935.09	935.02	1,275.99	433.24	5,499.10	754.83	466.32	2,786.44	5,035.42
27	2038	484.33	313.83	238.28	444.61	946.56	942.50	1,295.13	438.38	5,583.14	766.92	472.24	2,826.08	5,109.23
28	2039	489.39	316.47	240.64	449.38	958.16	950.04	1,314.56	443.59	5,668.48	779.21	478.22	2,866.28	5,184.12
29	2040	493.98	318.92	242.80	453.71	968.53	957.04	1,331.45	448.26	5,742.46	789.79	483.55	2,901.49	5,249.44
30	2041	499.14	321.61	245.21	458.58	980.40	964.70	1,351.41	453.58	5,830.23	802.44	489.67	2,942.76	5,326.39
31	2042	504.35	324.31	247.64	463.51	992.42	972.41	1,371.68	458.97	5,919.33	815.29	495.88	2,984.61	5,404.46
32	2043	509.62	327.05	250.10	468.48	1,004.59	980.19	1,392.26	464.42	6,009.81	828.36	502.17	3,027.07	5,483.67
33	2044	514.94	329.80	252.58	473.52	1,016.91	988.02	1,413.14	469.94	6,101.66	841.63	508.53	3,070.12	5,564.05
34	2045	520.32	332.58	255.09	478.60	1,029.38	995.93	1,434.33	475.52	6,194.92	855.11	514.98	3,113.79	5,645.61
35	2046	525.76	335.38	257.62	483.74	1,042.00	1,003.89	1,455.85	481.17	6,289.60	868.81	521.51	3,158.08	5,728.36
36	2047	531.25	338.20	260.17	488.94	1,054.78	1,011.92	1,477.68	486.88	6,385.73	882.72	528.12	3,203.00	5,812.32
37	2048	536.80	341.05	262.75	494.19	1,067.71	1,020.01	1,499.84	492.66	6,483.33	896.87	534.81	3,248.56	5,897.52
38	2049	542.40	343.92	265.36	499.49	1,080.81	1,028.17	1,522.34	498.52	6,582.42	911.23	541.59	3,294.77	5,983.96
39	2050	548.07	346.82	267.99	504.86	1,094.06	1,036.39	1,545.17	504.44	6,683.02	925.83	548.46	3,341.64	6,071.67
40	2051	553.79	349.74	270.65	510.28	1,107.48	1,044.68	1,568.35	510.43	6,785.16	940.66	555.41	3,389.17	6,160.67

Notes: Actual Woods & Poole data for 2010 through 2020, 2025, 2030, 2035, and 2040. Missing estimates through 2040 calculated using average annual growth rate for the 5 year period; projections after 2040 calculated using the average annual growth rate from 2035 to 2040.

Source: Woods & Poole Economics, Inc., 2010.

Table 4-39

Liquid Waste Collected from the *Deepwater Horizon* Event

Landfill Name	Percentage
Newpark Environmental Services—Fourchon Site Code 2913	29.67%
River Birch Industries Landfill	17.60%
Apex Environmental Services	17.44%
Liquid Environmental Solutions	13.07%
Tidewater Landfill LLC (Environmental Operations) Coast Guard Road Sanitary Landfill	11.08%
Newpark Environmental Mud Facility—Venice	11.08%
MBO LLC (Lacassine Oilfield Services)	3.20%
Newpark Environmental Services—Morgan City Site Code 5102	2.84%
Chemical Waste Management	1.04%
Aaron Oil	0.89%
Waste Water	0.83%
Intergulf	0.58%
Cliff Berry, Inc.—Tampa/ Miami	0.55%
Clearview Landfill	0.46%
Newpark Environmental Intercoastal City	0.27%
Vacco Marine	0.16%
Oil Recovery Company	0.08%
Vacco Marine/River Birch	0.03%
City of Tampa Treatment Plant	0.01%
Bealine	0.00%
SWS	0.00%
Gulf Coast Water Authority	0.00%
M.A. Norden Company	0.00%
WH Chastang Landfill	0.00%
Geocycle/Holcim	0.00%
Sunbelt Crushing	0.00%
Baldwin County Magnolia Landfill	0.00%
Tarpon Recycling	0.00%
Covanta-Huntsville	0.00%
WM Springhill Regional Landfill	0.00%
Fort Walton Transfer	0.00%
Gulf West Landfill (Texas)	0.00%
Allied Waste/BFI Colonial Landfill	0.00%
Jefferson Parish Waste Management	0.00%
Allied Waste Jefferson Davis Parish	0.00%
Allied Waste Recycling Center	0.00%
Newpark Environmental Services—Cameron Site Code 1205	0.00%
Advanced Disposal Services	0.00%
WM Pecan Grove	0.00%
Coastal Plains—Waste Management	0.00%

Sources: British Petroleum, 2011a and 2011b.

Table 4-40

Solid Waste Collected from the *Deepwater Horizon* Event

Landfill Name	Percentage
WM Springhill Regional Landfill	26.11%
Allied Waste/BFI Colonial Landfill	25.12%
Baldwin County Magnolia Landfill	11.31%
Clearview Landfill	8.66%
Newpark Environmental Services—Fourchon Site Code 2913	7.99%
River Birch Industries Landfill	7.70%
WH Chastang Landfill	6.81%
Jefferson Parish Waste Management	6.56%
Newpark Environmental Services—Cameron Site Code 1205	4.60%
WM Pecan Grove	3.82%
Covanta-Huntsville	0.78%
Tidewater Landfill LLC (Environmental Operations) Coast Guard Road Sanitary Landfill	0.50%
Sunbelt Crushing	0.34%
M.A. Norden Company	0.17%
Tarpon Recycling	0.07%
Coastal Plains—Waste Management	0.06%
Allied Waste Recycling Center	0.03%
Gulf West Landfill (Texas)	0.03%
Fort Walton Transfer	0.02%
Advanced Disposal Services	0.00%
Intergulf	0.00%
Aaron Oil	0.00%
Geocycle/Holcim	0.00%
Apex Environmental Services	0.00%
Liquid Environmental Solutions	0.00%
Chemical Waste Management	0.00%
Oil Recovery Company	0.00%
City of Tampa Treatment Plant	0.00%
Cliff Berry, Inc.—Tampa/ Miami	0.00%
Vacco Marine	0.00%
Vacco Marine/River Birch	0.00%
Gulf Coast Water Authority	0.00%
Waste Water	0.00%
Allied Waste Jefferson Davis Parish	0.00%
Newpark Environmental Mud Facility—Venice	0.00%
Newpark Environmental Services—Morgan City Site Code 5102	0.00%
Newpark Environmental Intercoastal City	0.00%
MBO LLC (Lacassine Oilfield Services)	0.00%
Bealine	0.00%
SWS	0.00%

Sources: British Petroleum, 2011a and 2011b.

Table 4-41

Deepwater Horizon Waste Destination Communities

Landfill Name and Location	Percent Minority Living within a 1-Mile Radius of the Site	Total Population Living within a 1-Mile Radius of the Site (2000 Census)	Percentage of Total DWH Liquid Waste Collected	Percentage of Total DWH Solid Waste Collected
Liquid Environmental Solutions, Mobile, AL	95.80%	4,257	13.17%	0.00%
Oil Recovery Company, Mobile, AL	93.90%	3,238	0.08%	0.00%
Cliff Berry, Inc., Miami, FL	92.80%	24,768	>0.58%	0.00%
River Birch Industries Landfill Avondale, LA	92.20%	167	16.99%	8.67%
Jefferson Parish Waste Management, Avondale, LA	91.40%	120	0.00%	0.02%
Sunbelt Crushing, Mobile, AL	76.80%	3,173	0.00%	0.29%
Chemical Waste Management, Emelle, AL	75.20%	33	1.02%	0.00%
WM Springhill Regional Landfill, Campbelton, FL	74.30%	109	0.00%	23.67%
Allied Waste/BFI Colonial Landfill, Sorrento, LA	74.10%	153	0.00%	21.98%
Allied Waste Recycling Center, Metairie, LA	63.50%	14,420	0.00%	0.06%
WH Chastang Landfill, Mount Vernon, AL	62.50%	123	0.00%	8.93%
Clearview Landfill Lake, MS	50.90%	55	0.44%	14.92%
Cliff Berry, Inc., Tampa, FL	50.50%	1,817	>0.58%	0.00%
Apex Environmental Services, Theodore, AL	50.40%	383	17.44%	0.00%
Newpark Environmental Services Site Code 5102, Morgan City, LA	35.90%	4,237	2.74%	0.00%
Landfill Name and Location	**Percent Below Poverty Living within a 1-Mile Radius of the Site**	**Total Population Living within a 1-Mile Radius of the Site (2000 Census)**	**Percentage of Total DWH Liquid Waste Collected**	**Percentage of Total DWH Solid Waste Collected**
Liquid Environmental Solutions, Mobile, AL	63.30%	4,257	13.17%	0.00%
Newpark Environmental Mud Facility, Venice, LA	50.00%	2	10.90%	0.00%
Oil Recovery Company, Mobile, AL	41.70%	3,238	0.08%	0.00%
Chemical Waste Management, Emelle, AL	36.40%	33	1.02%	0.00%
Newpark Environmental Services Site Code 2913, Fourchon, LA	33.30%	3	30.14%	0.00%
Vacco Marine, Houma, LA	29.20%	525	0.16%	0.00%
River Birch Industries Landfill, Avondale, LA	28.10%	167	16.99%	8.67%
Jefferson Parish Waste Management, Avondale, LA	26.70%	120	0.00%	0.02%
Apex Environmental Services, Theodore, AL	26.20%	383	17.44%	0.00%
Allied Waste/BFI Colonial Landfill, Sorrento, LA	25.00%	153	0.00%	21.98%
WM Pecan Grove, Pass Christian, MS	14.40%	290	0.00%	3.28%
Baldwin County Magnolia Landfill, AL	13.70%	446	0.00%	11.18%
MBO LLC (Lacassine Oilfield Services)	12.90%	85	3.82%	0.00%
Coast Guard Rd Sanitary Landfill	0.00%	0	0.00%	8.05%

Sources: British Petroleum, 2011 and 2011b.

Table 4-42

Gulf Coast Claims Facility — *Deepwater Horizon* Claimant Data by State
(status report as of April 27, 2011)

Alabama Claimant Status	No. of Claimants
Total GCCF Claimants to Date (claimants may have one or more claim type)	73,197
1. Paid Claimants	29,957

State	Claims for Emergency or Final Payment (includes individual and business)	Number of Claims Paid	Amount Paid
Alabama	1. Removal and Cleanup Costs	40	$414,560
	2. Real or Personal Property	75	$676,538
	3. Lost Earnings or Profits	49,629	$725,729,536
	4. Loss of Subsistence Use of Natural Resources	11	$84,240
	5. Physical Injury/Death	25	$68,000
Alabama Total	Total to Date	49,780	$726,972,874

Florida Claimant Status	No. of Claimants
Total GCCF Claimants to Date (claimants may have one or more claim type)	176,001
1. Paid Claimants	75,303

State	Claims for Emergency or Final Payment (includes individual and business)	Number of Claims Paid	Amount Paid
Florida	1. Removal and Cleanup Costs	39	$520,629
	2. Real or Personal Property	66	$393,393
	3. Lost Earnings or Profits	124,617	$1,551,648,940
	4. Loss of Subsistence Use of Natural Resources	8	$131,975
	5. Physical Injury/Death	13	$201,107
Florida Total	Total to Date	124,743	$1,552,896,044

Louisiana Claimant Status	No. of Claimants
Total GCCF Claimants to Date (claimants may have one or more claim type)	203,460
1. Claimants Paid and Approved for Payment	62,541

State	Claims for Emergency or Final Payment (includes individual and business)	Number of Claims Paid	Amount Paid
Louisiana	1. Removal and Cleanup Costs	9	$157,165
	2. Real or Personal Property	71	$929,045
	3. Lost Earnings or Profits	106,206	$1,321,768,784
	4. Loss of Subsistence Use of Natural Resources	16	$130,464
	5. Physical Injury/ Death	29	$85,423
Louisiana Total	Total to Date	106,331	$1,323,070,881

Table 4-42. Gulf Coast Claims Facility — *Deepwater Horizon* Claimant Data by State, (status report as of April 27, 2011) (continued).

Mississippi Claimant Status	No. of Claimants
Total GCCF Claimants to Date (claimants may have one or more claim type)	55,334
1. Paid Claimants	15,868

State	Claims for Emergency or Final Payment (includes individual and business)	Number of Claims Paid	Amount Paid
Mississippi	1. Removal and Cleanup Costs	0	$0
	2. Real or Personal Property	32	$298,983
	3. Lost Earnings or Profits	26,918	$336,742,048
	4. Loss of Subsistence Use of Natural Resources	5	$37,189
	5. Physical Injury/ Death	11	$41,763
Mississippi Total	Total to Date	26,966	$337,119,983

Texas Claimant Status	No. of Claimants
Total GCCF Claimants to Date (claimants may have one or more claim type)	11,735
1. Paid Claimants	3,141

State	Claims for Emergency or Final Payment (includes Individual and Business)	Number of Claims Paid	Amount Paid
Texas	1. Removal and Cleanup Costs	1	$169,100
	2. Real or Personal Property	5	$55,000
	3. Lost Earnings or Profits	4,222	$153,429,443
	4. Loss of Subsistence Use of Natural Resources	0	$0
	5. Physical Injury/ Death	4	$14,000
Texas Total	Total to Date	4,232	$153,667,543

Source: Gulf Coast Claims Facility, 2011b.

Table 5-1

Scoping Comments

Name and Affiliation	Concerns
Defenders of Wildlife Washington, DC	• Ensure the reanalysis of baseline conditions is woven into the Agency's decision-making process. • The Supplemental EIS should include impacts to threatened and endangered species, target and nontarget fish species, water quality, seafloor conditions, and any other natural resources affected by the *Deepwater Horizon* spill. • The BOEMRE must closely examine the types of basic information about the Gulf marine environment that were not analyzed prior to the spill. • The reassessment of risk for future oil spills has two primary components. First, BOEMRE must reexamine the risk of oil spills in general. Second, BOEMRE must reexamine the risk of oil spills in the particular locations and conditions at issue in a particular NEPA analysis. • As BOEMRE examines the risk of future oil spills occurring, BOEMRE also must look closely at the likely impact of such spills. • The BOEMRE must ensure that its use of categorical exclusions and environmental assessments that tier to the Multisale EIS are on solid footing by taking a precautionary approach that reexamines the environmental impacts of a range of oil and gas activities that have not been analyzed adequately, or in some cases analyzed at all. • In examining ways to maximize avoidance and minimize impacts to environmental resources, BOEMRE should begin with analyzing additional measures to address safety and well control issues for both deep and shallow-water operations. • The Supplemental EIS also should examine options for improving offshore inspections and safety procedures, enforcing stronger cementing and well control protocols, and requiring improvements in the reliability factor of blowout prevention technology in any water depth. • Defenders of Wildlife further recommends that BOEMRE enact a hiatus in future permits and approvals for floating offshore storage and processing vessels due to the spill threat posed by these facilities and the demonstrated lack of effective response capabilities for large oil releases evidenced during the *Deepwater Horizon* event, and we request that this limitation on future permitting be analyzed in the Supplemental EIS. • In addition to the regulatory suggestions listed above, the Supplemental EIS should also assess the impact of requiring the following measures to increase worker safety, protect sensitive ecosystems and marine and intertidal habitats, and ensure a more adequate, rapid response to future OCS disasters: (1) research, development, and implementation of a new type of fail-safe backup valve, shut-in device that would reliably preclude loss of well control in the event of the failure of the blowout preventer in any water depth; measures beyond a future requirement of a second blind shear ram will likely be necessary; (2) predeployment of a rig capable of drilling a relief well at the appropriate water depth in a location within a certain reasonable response time of every drilling site; (3) strict requirements that oil spill contingency plans be certified by the U.S. Government as capable of immediate response in the event of a "worst case" well blowout, riser break, damaged floating storage vessel, tankship spill, or other cause of a major hydrocarbon release into the marine environment; (4) research and development of new types of biodegradable dispersants, their comprehensive testing and certification by USEPA for use in mass quantities under predefined

Table 5-1. Scoping Comments (continued).

Name and Affiliation	Concerns
Defenders of Wildlife Washington, DC	appropriate conditions, their manufacture in commercial quantities, and their predeployment at locations of possible future need; (5) engineering and development of large ship-scaled oil skimmers for use in realistic wind, wave, and ocean current conditions, to be certified by the U.S. Coast Guard and built and operated by the petroleum industry; (6) immediate development and manufacture of more effective oil spill containment technologies and sorbent booms, and their predeployment in storage facilities in geographic areas of likely future need; (7) required testing of spill response technology in real world conditions and mandatory certification as to the measurable response impact of response equipment and plans; (8) a minimum requirement for response capacity onsite or within reasonable distance such that operators have capacity to recover a certain minimum percentage of oil spilled; and (9) bonding requirements sufficient to cover the cost of response and cleanup in the event of a blowout or other spill are necessary. • The No Action alternative of canceling the remaining lease sales should receive robust consideration in order to guarantee maximum protection for the resources that have been damaged by the *Deepwater Horizon* event. • The Defenders of Wildlife further reiterate that no activities in reliance on the previous inadequate Gulf Multisale EIS should move forward until the Supplemental EIS is complete, including all analyses that tier to the previous EIS to justify use of an environmental assessment or categorical exclusion. • The Supplemental EIS should also strongly consider exclusion of sensitive areas and possible recommendations for Gulf marine protected areas.
Center for Biological Diversity San Francisco, CA	• In determining the scope of the environmental impacts of OCS drilling in the GOM, BOEMRE should take into account the fact that many of the species move in and throughout the GOM. • It should also take into account all aspects of drilling including spills—both large and small, seismic activities—both noise impacts and vessel strikes, impacts to fisheries, tourism, and other industries that rely on the health of the GOM. • It is unclear at this time, and may be for some time, the entire impact of the spill on the flora and fauna of the GOM; therefore, BOEMRE should employ precautionary principles in its estimates of the harm as well as its assumptions about future spills. • The BOEMRE must also take into account the already degraded status of the Gulf of Mexico in its assessment of the environmental baseline, as well as the effect of these persistent stressors. • The BOEMRE should include detailed assessments of (1) areas of high seismic risk or seismicity, relatively untested deep water, or remote areas; or (2) activities within the boundary of a proposed or established marine sanctuary, and/or within or near the boundary of a proposed or established wildlife refuge or areas of high biological sensitivity; or (3) activities in areas of hazardous natural bottom conditions; or (4) utilizing new or unusual technology. • The BOEMRE should analyze and review areas and activities in the GOM OCS program that (a) have significant impacts on public health or safety; (b) have significant impacts on such natural resources and unique geographic characteristics as historic or cultural resources; park, recreation, or refuge lands; wilderness areas; wetlands (Executive Order 11990); floodplains (Executive Order 11988); national monuments; migratory birds; and other ecologically significant or critical areas;

Table 5-1. Scoping Comments (continued).

Name and Affiliation	Concerns
Center for Biological Diversity San Francisco, CA	(c) have highly controversial environmental effects or involve unresolved conflicts concerning alternative uses of available resources [NEPA Section 102(2)(E)]; (d) have highly uncertain and potentially significant environmental effects or involve unique or unknown environmental risks; . . . . (h) have significant impacts on species listed, or proposed to be listed, on the List of Endangered or Threatened Species or have significant impacts on designated Critical Habitat for these species; (i) violate a Federal law, or a State, local, or tribal law or requirement imposed for the protection of the environment. • The BOEMRE should also address the following significant issues in its Supplemental EIS: (1) environmental impacts or worst-case scenario oil spills and cumulative oil spills, including response activities and the use of dispersants; (2) the direct, indirect, and cumulative climate change impacts of the action, including the greenhouse gas emissions from the produced oil and gas, and the influence of those climate change impacts on the affected environment; (3) the impacts of the action on special status species such as those protected under the Endangered Species Act and Marine Mammal Protection Act and sensitive habitat areas, including but not limited to critical habitat, essential fish habitat, marine protected areas; (4) a reasonable range of alternatives that would avoid or minimize environmental impacts; (5) broader cumulative impacts analysis which take into consideration the incremental impacts of the action when considered in conjunction with past, present, and reasonably foreseeable future actions in the Gulf; (6) at lease sale and exploration stages, each EIS should contain site-specific analyses, smaller in scale than a typical multisale EIS, though not so narrowly focused as to result in impermissible segmentation of the project; (7) at exploration and drilling stages, specific focus on time and place of activity, keeping in mind seasonal shifts in migratory patterns and habitat composition.
Chevron North America Exploration and Production Company Houston, TX	• The Supplemental EIS should be confined to truly new information and focus on impacts of accidental events and to a lesser extent, cumulative impacts. • The BOEMRE must heed its own finding that a catastrophic spill remains a very low probability. • The planned Supplemental EIS must proceed with the supplemental analyses based upon information available at a certain date and cannot rely on speculative information and not await a series of new GOM studies. • When there are gaps in data and knowledge, BOEMRE must identify the information that is not known in the Supplemental EIS. • The BOEMRE must carefully review all new information and ensure its reliability before inclusion in the Supplemental EIS. • The BOEMRE must consider recent, significant improvements in safety and response capacity in the Supplemental EIS. • Chevron encourages BOEMRE to consider a reasonable range of clearly defined proposed alternatives and each alternative should be concise with no ambiguity. • Future NEPA analysis should tier to this Supplemental EIS. • The BOEMRE must review any suggestions for new and additional mitigation measures very carefully and have sufficient information to support their adoption. • There is no evidence that certain activities at a particular water depth are inherently more dangerous than others.

Table 5-1. Scoping Comments (continued).

Name and Affiliation	Concerns
Dean Peeler Alabama Petroleum Council (APC) Mobile, AL	• It is prudent to update the baseline conditions and potential environmental effects of oil and natural gas leasing. • The BOEMRE should use any currently new information that helps evaluate the defined impacts of the lease sales. • Proposed Lease Sales 216, 218, and 222 should be held with no reduction in the acreage traditionally offered in areawide lease sales. • The Supplemental EIS development should complement other environmental analyses by BOEMRE on the 2012-2017 5-Year Program.
Andy Radford American Petroleum Institute (API)	• Lease Sales 216, 218, and 222 should be held with no reduction in the acreage traditionally offered in areawide lease sales. • The scope of the Supplemental EIS should be focused specifically on new information that is readily available during the drafting of the Supplemental EIS and should limit the Supplemental EIS to an analysis of this new information as it exists at this time. • The BOEMRE must consider the extensive safety improvements implemented since the *Deepwater Horizon* event and consider the possibility of a catastrophic oil spill remains a very low probability. • The implementation of new drilling and environmental safeguards by industry since the *Deepwater Horizon* event should be considered and analyzed in the Supplemental EIS. • The possibility of another catastrophic spill will be reduced even further since implementation of the extensive safety improvements. • The Supplemental EIS should be designed specifically to be used as a reference for tiering in the future.
Marine Mammal Commission Bethesda, MD	• The BOEMRE should develop a set of standards for baseline information needed to assess the effects of oil and gas operations on marine mammals and their environment, initiate research on these topics prior to the resumption of lease sales in the Gulf of Mexico, and consider ways to improve oil-spill prevention and response capabilities.
U.S. Fish and Wildlife Service Lafayette, LA	• The Supplemental EIS should evaluate direct, indirect, and cumulative oil spill impacts from MC 252 to wetlands, migratory birds, endangered and threatened species, and designated critical habitat, as well as any impacts to those FWS trust resources from potential future spills. • Any possible correlations of the MC 252 spill and potential future spills to climate change should also be discussed. • The Supplemental EIS should include an assessment of potential direct, indirect, and cumulative impacts (including global climate change) to FWS trust resources from oil and gas industry exploration, development and response activities. • The FWS requests that BOEMRE discuss the relative risk of exploration and production wells leaking oil on the continental shelf versus those located on the continental slope and deepwater Gulf of Mexico. The BOEMRE should revise spill probabilities and model different sized spills, including catastrophic or multiday spills for the Gulf of Mexico for sources of spills in offshore and nearshore environments. • Any new safety regulations or revised permit review processes should be evaluated in the proposed Supplemental EIS for their impact to FWS trust resources. Changes to spill contingency planning, spill response, and restoration actions should also be described and their effects on FWS trust resources assessed.

Table 5-1. Scoping Comments (continued).

Name and Affiliation	Concerns
International Association of Geophysical Contractors (IAGC) Houston, TX	• Any analysis of alternatives should recognize and take into account the improved regulatory management, oversight, and enforcement enacted since the blowout of the Macondo well and the resulting oil spill. • The BOEMRE should analyze an alternative that includes the holding of all remaining scheduled lease sales for the entire Western and Central Planning Areas. • The IAGC believes that there should be no discrimination between areas within the Western and Central Planning Areas in regard to geophysical, leasing, drilling, and production activities based upon popular political goals or environmental opinions that cannot be substantiated. • The IAGC strongly recommends that the final Supplemental EIS clearly provide for and facilitate new geophysical data acquisition and subsequent analysis of the hydrocarbon production of the Western and Central Planning Areas. • In developing the Supplemental EIS, BOEMRE should only rely on the best available scientific information and knowledge. • The IAGC also encourages BOEMRE to consider the environmental and socioeconomic information gathered and analyzed, and the conclusions made as part of this process to be utilized in the Supplemental EIS to be developed for the next 5-Year OCS Program.
Stone Energy Lafayette, LA	• Stone Energy recommends that BOEMRE incorporate consideration of all new regulations and requirements put in place post-Macondo.
Consumer Energy Alliance Houston, TX	• The BOEMRE should proceed with the Supplemental EIS in an expedited and efficient manner, and consider thoroughly the socioeconomic impacts of oil and gas development on coastal communities.
National Oceanic and Atmospheric Administration, National Marine Fisheries Service St. Petersburg, FL	• The BOEMRE should consider the understatement of frequency and magnitude of oil spills, understatement of potential environmental impacts of oil spills, the need to better evaluate the potential adverse impacts that a spill could have on the seafood industry and markets, the need to better evaluate modeling of spills, and the need to address cumulative impacts on wetlands. • The Supplemental EIS should provide an analysis of the potential social, economic, and environmental impacts of a major oil event to fish stocks and to commercial and recreational fisheries in the Gulf of Mexico. Additionally, the Supplemental EIS should include an analysis of the potential effects of a major spill event to seafood, including wild-caught finfish and shellfish and aquaculture products that are important components of the Nation's food supply. These analyses should consider fishery closures, impacts to food safety, and contamination by hydrocarbon compounds and dispersants. • The Environmental Sensitivity Index used in past programs does not consider the sensitivity of marine habitats in the OCS to oil spills or other activities associated with oil and gas exploration, development, or production. The NOAA suggests that BOEMRE broaden the scope of its analysis to consider the impacts of all activities, including potential oil-spills and the use of chemical dispersants in any oil spill response efforts, to EFH and other vulnerable deepwater habitats such as deep-sea corals. The NOAA also suggests that BOEMRE evaluate the potential impacts to EFH for each life stage of each managed species, as well as impacts to other vulnerable habitats, from a worst-case scenario spill, including impacts to benthic and pelagic coastal and offshore habitats and prepare proposed mitigation requirements for such a spill. • The NOAA provided a list of 14 habitat areas of particular concern, which are designated within the Western and Central Planning Areas.

Table 5-1. Scoping Comments (continued).

Name and Affiliation	Concerns
National Oceanic and Atmospheric Administration, National Marine Fisheries Service St. Petersburg, FL	• The EFH section of the Supplemental EIS should reflect the current EFH identifications and descriptions by the Gulf of Mexico Fishery Management Council in 2005 for Council-managed species and by NMFS for highly migratory species in 2009. • The NOAA recommends a recalculation of the likelihood of a major oil-spill event and an analysis of the effects from oil spills that utilize the flow rates and quantities identified in the "Oil Budget Calculator Deepwater Horizon Technical Documentation." Additionally, the Supplemental EIS should reanalyze the effects of dispersant application and in-situ burning. • If the proposed activity may affect a listed species or designated critical habitat, BOEMRE must initiate consultation with NMFS pursuant to Section 7 of the ESA. • The NMFS would like to work with BOEMRE to enhance, refine, or develop new oil-spill analyses to improve the understanding of the effects of oil spills on listed species and to improve the Section 7 consultation. The NMFS recommends that spill probabilities and modeling of different sized spills, including catastrophic spills, be provided for sources of spills in offshore and nearshore environment and for surface and deepwater sources. The NMFS also asks BOEMRE to provide additional information regarding the relative risk of exploration and production wells leaking oil on the continental shelf versus those located on the continental slope and deepwater Gulf of Mexico. • The NOAA recommends that revised spill probabilities and modeling of different sized spills, including catastrophic spills for the Gulf of Mexico for sources of spills in offshore and nearshore environments be conducted. These models must include both surface and deepwater sources, as well as the effects of oil-spill response plans (e.g., dispersants) on the fate of the oil in the models. The Supplemental EIS should consider the variety and magnitude of effects associated with the chance of an oil spill taking listed species and adversely modifying or destroying critical habitat. • Please describe any changes to the proposed action resulting from the Deepwater Horizon event, including safety, spill contingency planning, spill response, and restoration actions. Also include any new programs and safeguards to reduce the likelihood of spills occurring in the future and provide an analysis of any new information and the potential for impacts to occur on listed species and critical habitat. • The Supplemental EIS should define the proposed lease sale areas, air permit requirements, and types of operations that fall under the jurisdictions of both BOEMRE and USEPA. The USEPA may be included as a co-agency in the biological opinion for air emissions for lease areas under their jurisdiction and should be included in any such request for ESA consultation. • The NMFS recommends that BOEMRE conduct a study to better understand the cumulative effects of noise from oil and gas construction and development activities on the OCS. This recommendation includes characterizing all aspects of noise-producing construction and operation activities such as pile driving during well construction and platform installation, and other common OCS activities. Major noise-producing activities (>120 dB re 1 μPa_{rms}) should be identified, and measurements of noise from these activities should be reported in appropriate units of measurement to estimate the acoustic footprint on the environment, duration, frequency, and relative contribution to ambient noise levels in the Gulf of Mexico. • The BOEMRE should consider a data collection program for the protected species observer program in coordination with NMFS, and include the program in the Supplemental EIS as appropriate.

Table 5-1. Scoping Comments (continued).

Name and Affiliation	Concerns
National Oceanic and Atmospheric Administration, National Marine Fisheries Service St. Petersburg, FL	• Pipeline construction may affect habitats important to listed species and should be considered in the Supplemental EIS. • The BOEMRE should continue to work with NMFS and the Offshore Operators Committee to provide informational materials to the offshore oil and gas workers, require annual training, and continue to develop best management practices to reduce the release of debris into the marine environment. The BOEMRE should work with NMFS to update the Marine Debris Notice to Lessees (NTL) 2003-G11 and apply this to other geographic areas/regions as appropriate. • The NOAA recommends that the Vessel Strike Avoidance Measures and Reporting for Mariners be applied throughout approved lease areas. • The Supplemental EIS should characterize all noise sources with source levels above 120 dB re 1 μPa_{rms} as the potential to affect marine mammals and other listed species. • Many general impacts associated with the construction and operation of oil and gas structures should be considered in the Supplemental EIS. Habitat alterations to water quality may result from accidental spills, turbidity during terminal an pipeline construction, wastewater discharges, and warming water outflow. Habitat effects may also occur from propeller wash, benthic impacts from pipeline and terminal construction, and discharges of marine debris. • In the event that any aspect of a proposed oil and gas operation will result in a "take," the oil and gas applicant, or the lead agency acting on behalf of the applicant, would be required to obtain an incidental take authorization from NOAA. • The NOAA had two primary comments on the Supplemental EIS related to national marine sanctuaries: (1) NOAA requests that BOEMRE review the designation of all No-Activity Zones associated with all of the topographic features in the Central and Western Planning Area, and re-establish these areas based on current bathymetric and biological data; and (2) NOAA requests that BOEMRE require the shunting of material from all wells drilled within the specified buffer zones around the No-Activity Zones. • As BOEMRE considers scoping for the Supplemental EIS, BOEMRE should consider the following issues: (1) potential and cumulative impacts on the mesophotic and deep-sea communities during the development of oil and gas resources; (2) potential and cumulative impacts on mesophotic and deep-sea coral communities in the siting of undersea pipelines; (3) potential and cumulative impacts on mesophotic and deep-sea coral communities in the event of a major spill; recent findings from research conducted to assess impacts from the *Deepwater Horizon* spill on deep-sea coral communities should be helpful in considering these impacts; (4) potential and cumulative impacts on shallow coral reef, mesophotic and deep-sea coral communities connected by prevailing ocean currents to the lease sites; and (5) potential and cumulative socioeconomic impacts to communities dependent on recreational and commercial fishing in the lease areas, as well as communities dependent on coastal and ocean tourism and fishing in places connected by prevailing ocean currents.

References Cited

Alonso-Alvarez, C., I. Munilla, M. Lòpez-Alonso, and A. Velando. 2007. Sublethal toxicity of the Prestige oil spill on yellow-legged gulls. Environment International 33:773-781.

Anderson, C.M. and R.P. LaBelle. 2000. Update of comparative occurrence rates for offshore oil spills. Spill Science and Technology Bulletin 6(5/6):302-321.

Atkins, M., T. Edward, D. Johnson, and M. Dance. 2007. Pipeline damage assessment from Hurricanes Katrina and Rita in the Gulf of Mexico. U.S. Dept. of the Interior, Minerals Management Service, Herndon, VA. TA&R 581.

Banks, A.N., W.G. Sanderson, B. Hughes, P.A. Cranswick, L.E. Smith, S. Whitehead, A.J. Musgrove, B. Haycock, and N.P. Fairney. 2008. The *Sea Empress* oil spill (Wales, UK): Effects on common scoter *Melanitta nigra* in Carmarthen Bay and status ten years later. Marine Pollution Bulletin 56:895-902.

British Petroleum. 2011a. Waste disposal and recoverable facilities (current and potential locations). Internet website: http://usresponse.bp.com/external/content/document/2911/995083/1/Waste_Disposal_Locations%20%2012511.pdf. Accessed March 20, 2011.

British Petroleum. 2011b. MC 252 weekly waste tracking cumulative report by disposal facility: Report for the weeks of 04/04/2011 to 04/10/11; consolidated report. 22 pp. Internet website: http://usresponse.bp.com/external/content/document/2911/1066495/1/Consolidated_Weekly_Report_04102011_Disposal_Facility.pdf. Accessed March 20, 2011.

Brooks, J.M. and C.P. Giammona. 1990. Mississippi-Alabama marine ecosystem study: Annual report; Year 2. Volume I: Technical narrative. U.S. Dept. of the Interior, Minerals Management Service, Gulf of Mexico OCS Region, New Orleans, LA. OCS Study MMS 89-0095. 348 pp.

Burger, A.E. 1993. Estimating the mortality of seabirds following oil spills: Effects of spill volume. Marine Pollution Bulletin 26:140-143.

Byrd, G.V., J.H. Reynolds, and P.L. Flint. 2009. Persistence rates and detection probabilities of bird carcasses on beaches of Unalaska Island, Alaska, following the wreck of the M/V *Selendang Ayu*. Marine Ornithology 37:197-204.

Cadiou, B., L. Riffaut, K.D. McCoy, J. Cabelguen, M. Fortin, G. Gélinaud, A. Le Roch, C. Tirard, and T. Boulinier. 2004. Ecological impact of the "*Erika*" oil spill: Determination of the geographic origin of the affected common guillemots. Aquatic Living Resources 17:369-377.

Camphuysen, K., M. Heubeck, S.L. Cox, R. Bao, D. Humple, C. Abraham, and A. Sandoval. 2002. The *Prestige* oil spill in Spain. Atlantic Birds 4:131-140.

Canadian Center for Energy Information. 2010. What are oil sands and heavy oil? Internet website: http://www.centreforenergy.com/AboutEnergy/ONG/OilsandsHeavyOil/Overview.asp?page=1. Accessed September 27, 2010.

Castège, I., G. Hèmery, N. Roux, J. D'Elbèe, Y. Lalanne, F. D'Amico, and C. Mouchès. 2004. Changes in abundance and at-sea distribution of seabirds in the Bay of Biscay prior to, and following the "Erika" oil spill. Aquatic Living Resources 17:369-377.

Castège, I., Y. Lalanne, V. Gouriou, G. Hèmery, M. Girin, F. D'Amico, C. Mouchès, J. D'Elbèe, L. Soulier, J. Pensu, D. Lafitte, and F. Pautrizel. 2007. Estimating the actual seabirds mortality at sea and relationship with oil spills: Lesson from the "Prestige" oil spill in Aquitaine (France). Ardeola 54:289-307.

Chapman, B.R. 1981. Effects of *Ixtoc I* oil spill on Texas shorebird populations. In: Proceedings of the 7th International Oil Spill Conference, Atlanta, GA. Washington, DC: American Petroleum Institute. Pp. 461-465.

Chapman, B.R. 1984. Seasonal abundance and habitat-use patterns of coastal bird populations on Padre and Mustang Island barrier beaches (following the *Ixtoc I* oil spill). U.S. Dept. of the Interior, Fish and Wildlife Service, Washington, DC. FWS/OBS-83/31. 73 pp. Internet website: http://www.gomr.boemre.gov/PI/PDFImages/ESPIS/3/3850.pdf.

Devers, W. 2010. Official communication. Long Beach fish kills report. Marine fisheries scientist, Mississippi Dept. of Marine Sciences. September 27, 2010.

Dickey, D. 2006. Official communication. U.S. Dept. of Transportation, Coast Guard. Headquarters Office of Compliance and Analysis, Washington DC. June 28, 2006.

Dickey, D. 2010. Official communication. Oil-spill events (2008). U.S. Dept. of Transportation, Coast Guard, Headquarters Office of Compliance and Analysis, Washington DC. April 26, 2010.

Dismukes, D.E. In preparation. OCS-related infrastructure fact book. Volume I: Post-hurricane impact assessment. U.S. Dept. of the Interior, Bureau of Ocean Energy Management, Regulation and Enforcement, Gulf of Mexico OCS Region, New Orleans, LA. OCS Study BOEMRE 2011-043.

Energo Engineering. 2010. Assessment of damage and failure mechanisms for offshore structures and pipelines in Hurricanes Gustav and Ike. U.S. Dept. of the Interior, Minerals Management Service, Herndon, VA. TA&R 642.

Federal Register. 2010. Increased safety measures for energy development on the outer continental shelf. 75 FR 198, 63346-63377. Internet website: http://www.gpo.gov/fdsys/pkg/FR-2010-10-14/pdf/2010-25256.pdf.

Federal Register. 2011. Reorganization of Title 30: Bureaus of Safety and Environmental Enforcement and Ocean Energy Management. 30 CFR Chapters II and V. Direct Final Rule. Tuesday, October 18, 2011. 76 FR 201, pp. 64432-64780. Internet website: http://www.gpo.gov/fdsys/pkg/FR-2011-10-18/pdf/2011-22675.pdf.

Flint, P.L. and A.C. Fowler. 1998. A drift experiment to assess the influence of wind on recovery of oiled seabird on St. Paul Island, Alaska. Marine Pollution Bulletin 36:165-166.

Flint, P.L., A.C. Fowler, and R.F. Rockwell. 1999. Modeling bird mortality associated with the M/V *Citrus* oil spill off St. Paul Island, Alaska. Ecological Modelling 117:261-267.

Flint, P.L., E.W. Lance, K.M. Sowl, and T.F. Donnelly. 2010. Estimating carcass persistence and scavenging bias in a human-influenced landscape in western Alaska. Journal of Field Ornithology 81:206-214.

Ford, R.G., M.L. Bonnell, D.H. Varoujean, G.W. Page, H.R. Carter, B.E. Sharp, D. Heinemann, and J.L. Casey. 1996. Total direct mortality of seabirds from the *Exxon Valdez* oil spill. American Fisheries Society Symposium 18:684-711.

Fowler, A.C. and P.L. Flint. 1997. Persistence rates and detection probabilities of oiled king eider carcasses on St. Paul Island, Alaska. Marine Pollution Bulletin 34:522-526.

Gardner, J.V., P. Dartnell, and K.J. Sulak. 2002. Multibeam mapping of the pinnacles region, Gulf of Mexico. U.S. Dept. of the Interior, Geological Survey. Open File Report OF02-006. Internet website: http://geopubs.wr.usgs.gov/open-file/of02-006/. Accessed September 9, 2010.

Gulf Coast Claims Facility. 2010. Frequently asked questions. Internet website: http://gulfcoastclaimsfacility.com/faq#Q11. Accessed January 23, 2011.

Gulf Coast Claims Facility. 2011. Statistics and overall summary, and state status reports (April 27, 2011). Internet website: http://www.gulfcoastclaimsfacility.com/reports. Accessed April 28, 2011.

Helm, R.C., R.G. Ford, and H.R. Carter. 2006. The Oil Pollution Act of 1990 and Natural Resources Damage Assessment. Marine Ornithology 34:99-108.

Helm, R.C., R.G. Ford, and H.R. Carter. 2008. Oil spills, seabirds, and NRDA: Differences between U.S. West, East, and Gulf Coasts. In: Proceedings of the 20th International Oil Spill Conference, Savannah, GA, USA. Washington, DC: American Petroleum Institute. Pp. 1131-1139. Internet website: http://www.iosc.org/papers/2008%20193.pdf.

Jernelöv, A. 2010. The threats from oil spills: Now, then, and in the future. Ambio 39:353-366. Internet website: http://www.springerlink.com/content/303223683645l54u/fulltext.pdf.

Kaplan, M.F. and C. Whitman. Unpublished. Measuring the economic impact of tourism and recreation industries on Gulf Coast communities—Relationship between OCS development and coastal resources (2008). U.S. Dept. of the Interior, Minerals Management Service, Gulf of Mexico OCS Region, New Orleans, LA. Contract No. 1435-01-99-CA-30951-18261. x + 164 pp.

King, J.G. and G.A. Sanger. 1979. Oil vulnerability index for marine oriented birds. In: Bartonek, J.C. and D.N. Nettleship, eds. Conservation of marine birds in North America. U.S. Dept. of the Interior, Fish and Wildlife Service, Washington, DC. Wildlife Research Report Number 11. Pp. 227-239. Internet website: http://www.archive.org/stream/conservationofma00naturich#page/n3/mode/2up. Accessed March 25, 2011.

Law, R.J. and C. Kelley. 2004. The impact of the "Sea Impress" oil spill. Aquatic Living Resources 17:389-394.

Louisiana Dept. of Natural Resources. 2010. Production information. SONRIS lite: Internet database. Internet website: http://sonris-www.dnr.state.la.us/www_root/sonris_portal_1.htm. Accessed October 6, 2010.

Michel, J. 1992. Chapter 2. Oil behavior and toxicity. In: Introduction to coastal habitats and biological resources for spill response. U.S. Dept. of Commerce, National Oceanic and Atmospheric Administration, Office of Response and Restoration. NOAA Report No. HMRAD 92-4. Internet website: http://response.restoration.noaa.gov/type_subtopic_entry.php?RECORD_KEY%28entry_subtopic_type%29=entry_id,subtopic_id,type_id&entry_id(entry_subtopic_type)=275&subtopic_id(entry_subtopic_type)=8&type_id(entry_subtopic_type)=2. Accessed March 22, 2011.

Munilla, I. and A. Velando. 2010. Oiling of live gulls as a tool to monitor acute oil spill effects on seabirds. Ibis 152:405-409.

National Academy of Engineering (NAE) and National Research Council (NRC). 2011. Blowout prevention: Analysis of the *Deepwater Horizon* explosion, fire, and oil spill. Internet website: http://sites.nationalacademies.org/BlowoutPrevention/index.htm. Accessed March 15, 2011.

National Archives and Records Administration. 2010. Electronic Code of Federal Regulations. Internet website: http://www.archives.gov/. Accessed January 27, 2011.

National Ocean Economics Program. 2006. Oil & gas production. Internet website: http://noep.csumb.edu/Minerals/oil_gas.asp. Accessed September 11, 2006.

Oil Spill Commission. 2010. The amount and fate of the oil. Staff Working Paper No. 3. National Commission on the BP Deepwater Horizon Oil Spill and Offshore Drilling. 29 pp. Internet website: http://www.oilspillcommission.gov/sites/default/files/documents/Working%20Paper.Amount%20and%20Fate.For%20Release.pdf.

Oil Spill Commission. 2011. Deep water: The Gulf oil disaster and the future of offshore drilling. Report to the President, National Commission on the BP Deepwater Horizon Oil Spill and Offshore Drilling. 398 pp. Internet website: http://www.oilspillcommission.gov/final-report. Accessed March 15, 2011.

Piatt, J.F. and R.G. Ford. 1996. How many seabirds were killed by the *Exxon Valdez* oil spill? American Fisheries Society Symposium 18:712-719.

Piatt, J.F., C.J. Lensink, W. Butler, M. Kendziorek, and D.R. Nysewander. 1990a. Immediate impact of the *Exxon Valdez* oil spill on seabirds. Auk 107:387-397.

Piatt, J.F., H.R. Carter, and D.N. Nettleship. 1990b. Effects of oil pollution in marine bird populations. In: White, J., ed. The effects of oil on wildlife: Research, rehabilitation and general concerns. Proceedings of the Oil Symposium, Herndon, VA, October 16-18, 1990. Hanover, PA: Sheridan Press. Pp. 125-141.

RestoreTheGulf.gov. 2011. Transcripts and docs. Internet website: http://www.restorethegulf.gov/news/transcripts-docs. Accessed March 11, 2011.

Schroeder, W.W., A.W. Shultz, and J.J. Dindo. 1988. Inner-shelf hardbottom areas, northeastern Gulf of Mexico. Trans. Gulf Coast Assoc. Geol. Soc. 38:535-541.

Shipp, R.L. and T.L. Hopkins. 1978. Physical and biological observations of the northern rim of the DeSoto Canyon made from a research submersible. N.E. Gulf Sci. 2(2):113-121.

Tan, L., M. Belanger, and C. Wittnich. 2010. Revisiting the correlation between estimated seabird mortality and oil spill size. Journal of Marine Animals and Their Ecology 3:20-26.

U.S. Dept of Agriculture. Forest Service. 2010. National survey on recreation and the environment, 2005-2009. U.S. Dept. of Agriculture, Forest Service, Southern Research Station.

U.S. Dept. of Commerce. Census Bureau. 2010. State and county quick facts. Internet website: http://quickfacts.census.gov/qfd/states/22000.html. Last revised November 4, 2010. Accessed April 2011.

U.S. Dept. of Commerce. National Oceanic and Atmospheric Administration. 2010a. *Deepwater Horizon* oil: Characteristics and concerns. National Ocean Service. 2 pp. Internet website: http://sero.nmfs.noaa.gov/sf/deepwater_horizon/OilCharacteristics.pdf. Last revised May 15, 2010. Accessed August 27, 2010.

U.S. Dept. of Commerce. National Oceanic and Atmospheric Administration. 2010b. National Hurricane Center, Miami, FL. Internet website: http://www.nhc.noaa.gov. Accessed November 16, 2010.

U.S. Dept. of Commerce. National Oceanic and Atmospheric Administration. 2010c. 2008—Fisheries economics of the U.S. Internet website: http://www.st.nmfs.noaa.gov/st5/publication/fisheries_economics_2008.html#. Accessed December 1, 2010.

U.S. Dept. of Commerce. National Oceanic and Atmospheric Administration. 2010d. Recreational fisheries statistics queries. Internet website: http://www.st.nmfs.noaa.gov/st1/recreational/queries/index.html. Accessed December 1, 2010.

U.S. Dept. of Commerce. National Oceanic and Atmospheric Administration. 2011. *Deepwater Horizon* MC 252 waste management sites. Internet website: http://www.bp.com/liveassets/bp_internet/globalbp/globalbp_uk_english/incident_response/STAGING/local_assets/downloads_pdfs/wastemgnt_7282010.pdf . Accessed May 16, 2011.

U.S. Dept. of Energy. Energy Information Administration. 2006. Petroleum and other liquids. Internet website: http://www.eia.doe.gov/oil_gas/petroleum/info_glance/petroleum.html. Accessed September 11, 2006.

U.S. Dept. of Labor. Bureau of Labor Statistics. 2010. Quarterly census of employment and wages. Internet website: http://www.bls.gov/cew/home.htm. Accessed December 1, 2010.

U.S. Dept. of Labor. Bureau of Labor Statistics. 2011. Quarterly census of employment and wages for 2010. Internet website: http://.bls.gov//. Accessed April 1, 2011.

U.S. Dept. of the Army. Corps of Engineers. 2011. Amount of dredged material ocean disposed by year in cubic yards by single district. Internet website: http://el.erdc.usace.army.mil/odd/. Stated as current through 2008. Accessed January 27, 2011.

U.S. Dept. of the Interior. 2010a. Increased safety measures for energy development on the outer continental shelf, May 27, 2010. U.S. Dept. of the Interior, Washington, DC. 44 pp. Internet website: http://www.doi.gov/deepwaterhorizon/loader.cfm?csModule=security/getfile&PageID=33598. Accessed March 13, 2011.

U.S. Dept. of the Interior. 2010b. Outer Continental Shelf Safety Oversight Board, report to Secretary of the Interior Ken Salazar. U.S. Dept. of the Interior, Washington, DC. September 1, 2010. 37 pp. Internet website: http://www.doi.gov/news/pressreleases/loader.cfm?csModule=security/getfile&PageID=43677. Accessed March 13, 2011.

U.S. Dept. of the Interior. Bureau of Ocean Energy Management, Regulation and Enforcement. 2011. Draft report: Update of oil spill occurrence rates for offshore oil spills. Email received from Melinda Mayes on July 5, 2011.

U.S. Dept. of the Interior. Fish and Wildlife Service. 2010. Bird impact data from DOI-ERDC database download 30 Nov. 2010: Weekly bird impact data and consolidated wildlife reports. 3 pp. Internet website: http://www.fws.gov/home/dhoilspill/pdfs/Bird%20Data%20Species%20Spreadsheet%2011302010.pdf.

U.S. Dept. of the Interior, Fish and Wildlife Service, and U.S. Dept. of Commerce, Census Bureau. 2006. 2006 national survey of fishing, hunting, and wildlife-associated recreation. FHW/06-NAT. 168 pp. Internet website: http://www.census.gov/prod/2008pubs/fhw06-nat.pdf.

U.S. Dept. of the Interior. Office of the Inspector General. 2010. A new horizon: Looking to the future of the Bureau of Ocean Energy Management, Regulation and Enforcement. No. CR-EV-MMS-0015-2010. Washington, DC. 82 pp. Internet website: http://www.doioig.gov/images/stories/reports/pdf/A%20New%20Horizon%20Public.pdf.

U.S. Dept. of Transportation. Coast Guard. 2001. Polluting incident compendium: Cumulative data and graphics for oil spills, 1973-2000. Internet website: http://www.uscg.mil/hq/g-m/nmc/response/stats/summary.htm.

U.S. Dept. of Transportation. Maritime Administration (MARAD). 2009. Vessel calls snapshot, 2009. 10 pp. Internet website: http://www.marad.dot.gov/documents/Vessel_Calls_at_US_Ports_Snapshot.pdf.

U.S. Environmental Protection Agency. 2008. National list of beaches. U.S. Environmental Protection Agency, Office of Water. EPA-823-R-08-004. 160 pp.

U.S. Environmental Protection Agency. 2011. 8-hour ozone nonattainment area/state/county report. Internet website: http://www.epa.gov/oaqps001/greenbk/gnca.html. Accessed April 28, 2011.

U.S. Environmental Protection Agency and British Petroleum. 2010. Unified Area Command Plan—Deepwater Horizon MC252: Waste and material tracking system and reporting plan. Internet website: http://www.epa.gov/bpspill/waste/bp_waste_tracking_plan.pdf. Issued August 20, 2010. Accessed October 8, 2010.

U.S. Travel Association. 2010. Economic impact of travel and tourism. The Power of Travel Data Center. Internet website: http://poweroftravel.org/statistics. Accessed December 14, 2010.

Velando, A., D. Álvarez, J. Mouriño, F. Arcos, and Á. Barros. 2005a. Population trends and reproductive success of the European shag *Phalocrocorax aristotelis* on the Iberian Peninsula following the *Prestige* oil spill. Journal of Ornithology 146:116-120.

Velando, A., I. Munilla, and P.M. Leyenda. 2005b. Short-term indirect effects of the *Prestige* oil spill on European shags: Changes in availability of prey. Marine Ecology Progress Series 302:263-274.

Waring, G.T., E. Josephson, K. Maze-Foley, and P.E. Rosel, eds. 2009. U.S. Atlantic and Gulf of Mexico marine mammal stock assessments -- 2011. U.S. Dept. of Commerce, National Oceanic and Atmospheric Administration. NOAA Technical Memorandum NMFS NE 219. 598 pp.

Weaver, D.C., G.D. Dennis, and K.J. Sulak. 2002. Northeastern Gulf of Mexico coastal marine ecosystem program: Community structure and trophic ecology of demersal fishes on the pinnacle reef tract: Final synthesis report. U.S. Dept. of the Interior, Geological Survey, USGS BSR-2001-008 and Minerals Management Service, Gulf of Mexico OCS Region, New Orleans, LA. OCS Study MMS 2002-034. 143 pp.

Wiens, J.A., R.G. Ford, and D. Heinemann. 1984. Information needs and priorities for assessing the sensitivity of marine birds to oil spills. Biological Conservation 28:21-49.

Wiese, F.K. and I.L. Jones. 2001. Experimental support for a new drift block design to assess seabird mortality from oil pollution. Auk 118:1062-1068.

Wilhelm, S.I., G.J. Robertson, P.C. Ryan, and D.C. Schneider. 2007. Comparing an estimate of seabirds at risk to a mortality estimate from the November 2004 *Terra Nova* FPSO oil spill. Marine Pollution Bulletin 54:537-544.

Williams, J.M., M.L. Tasker, I.C. Carter, and A. Webb. 1995. A method of assessing seabird vulnerability to surface pollutants. Ibis 137:S147-S152.

Woods & Poole Economics, Inc. 2010. The 2011 complete economic and demographic data source (CEDDS) on CD-ROM.

APPENDIX B

CATASTROPHIC SPILL EVENT ANALYSIS

CATASTROPHIC SPILL EVENT ANALYSIS: HIGH-VOLUME, EXTENDED-DURATION OIL SPILL RESULTING FROM LOSS OF WELL CONTROL ON THE GULF OF MEXICO OUTER CONTINENTAL SHELF

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1. INTRODUCTION

In 1986, the Council on Environmental Quality (CEQ) regulations were amended to rescind the requirement to prepare a "worst-case analysis" for an environmental impact statement (EIS) (see 40 CFR 1502.22(b)(4)). The regulation, as amended, states that catastrophic, low-probability impacts must be analyzed if the analysis is "supported by credible scientific evidence, is not based on pure conjecture, and is within the rule of reason."

The August 16, 2010, CEQ report, prepared following the *Deepwater Horizon* (DWH) event and spill in the Gulf of Mexico (CEQ, 2010), recommended that the Bureau of Ocean Energy Management (BOEM), formerly the Minerals Management Service (MMS), should "ensure that NEPA documents provide decisionmakers with a robust analysis of reasonably foreseeable impacts, including an analysis of reasonably foreseeable impacts associated with low probability catastrophic spills for oil and gas activities on the Outer Continental Shelf" (CEQ, 2010). This analysis provides that robust analysis of the impacts from low-probability catastrophic spills for all applicable decisionmakers including, but not limited to, the Secretary of the Department of the Interior (USDOI) for the National 5-Year Program, the Assistant Secretary of Land and Minerals Management for an oil and gas lease sale, and the Gulf of Mexico Regional Supervisors, Office of Environment and Office of Leasing and Plans, for an exploration or development plan.

It should be noted that the analysis presented here is intended to be a general overview of potential effects of a catastrophic spill in the Gulf of Mexico. The analysis does not include detailed sale-specific or site-specific analyses nor is it intended to replace such analyses for individual resources in the Supplemental EIS. As such, the *Catastrophic Spill Event Analysis* should be read with the understanding that further detail about accidental oil impacts on a particular resource may be found in the Supplemental EIS analysis or previous relevant National Environmental Policy Act (NEPA) analyses (e.g., Multisale EIS).

1.1. WHAT IS A CATASTROPHIC EVENT?

As applicable to NEPA, Eccleston (2008) defines a catastrophic event as "large-scale damage involving destruction of species, ecosystems, infrastructure, or property with long-term effects, and/or major loss of human life." For oil and gas activities on the Outer Continental Shelf (OCS), a catastrophic event is a high-volume, long-duration oil spill regardless of the cause, whether natural disaster (i.e., hurricane) or manmade (i.e., human error and terrorism). This high-volume, long-duration oil spill, or catastrophic spill, has been further defined by the National Oil and Hazardous Substances Pollution Contingency Plan as a "spill of national significance" or "a spill which, because of its severity, size, location, actual or potential impact on the public health and welfare or the environment, or the necessary response effort, is so complex that it requires extraordinary coordination of federal, state, local, and responsible party resources to contain and cleanup the discharge" (40 CFR 300, Appendix E).

Each oil-spill event is unique; its outcome depends on several factors, including time of year and location of release relative to winds, currents, land, and sensitive resources, specifics of the well (i.e., flow rates, hydrocarbon characteristics, and infrastructure damage), and response (i.e., speed and effectiveness). For this reason, the severity of impacts from of an oil spill cannot be predicted based on volume alone, although a minimum volume of oil must be spilled to reach catastrophic impacts.

Though large spills may result from a pipeline rupture, such events will not result in a catastrophic spill because the ability to detect leaks and shut off pipelines limits the amount of the spill to the contents of the pipeline. The largest, non-blowout-related spill on the Gulf of Mexico OCS occurred in 1967, a result of internal pipeline corrosion following initial damage by an anchor. In 13 days, 160,638 barrels of oil leaked (USDOI, BOEMRE, 2010a); however, no significant environmental impacts were recorded as a result of this spill.

Although loss of well control is defined as the uncontrolled flow of reservoir fluid that may result in the release of gas, condensate, oil, drilling fluids, sand, or water, it is a broad term that includes very minor well control incidents as well as the most severe well control incidents. Historically, loss of well control incidents occurred during development drilling operations, but loss of well control incidents can occur during exploratory drilling, production, well completions, or workover operations. These losses of well control incidents may occur between formations penetrated in the wellbore or at the seafloor.

Blowouts are a more severe loss of well control incident that creates a great risk of a large oil spill and serious human injury. Two blowouts that resulted in catastrophic spills have occurred in U.S. and Mexican waters of the Gulf of Mexico. In 1979, the *Ixtoc* blowout in shallow water (water depth of 164 feet [ft]; 50 meters [m]; and 50 miles [mi]; 80 kilometers [km] offshore in the Bay of Campeche, Mexico) spilled 3.5 million barrels of oil in 10 months (USDOC, NOAA, Office of Response and Restoration, 2010a; USDOC, NOAA, Hazardous Materials Response and Assessment Division, 1992; ERCO, 1982). On April 20, 2010, the DWH event, in deep water (4,992 ft; 1,522 m) 48 mi (77 km) offshore in Mississippi Canyon Block 252, spilled an estimated 4.9 million barrels of oil until it was capped almost 3 months later.

Prior to the DWH event, the two largest spills resulting from a loss of well control in U.S. waters of the Gulf of Mexico occurred in 1970 and released 30,000 and 53,000 barrels of oil, respectively (USDOI, BOEMRE, 2010a). These incidents resulted in four human fatalities. Although these incidents occurred only 8-14 mi (13-26 km) from shore, there was minor shoreline contact with oil (USDOC, NOAA, Office of Response and Restoration, 2010b and 2010c). In 1987, a blowout of the Mexican exploratory oil well, YUM II, resulted in a spill of 58,640 barrels and 75 mi of impacted shoreline (USDOC, NOAA, Hazardous Materials Response and Assessment Division, 1992). None of these spills met the definition of a catastrophic event or spill. For this reason, only the *Ixtoc* and DWH blowouts and spills are analyzed below.

1.2. METHODOLOGY

Two general approaches are utilized to analyze a catastrophic event under NEPA. The first approach is a bounding analysis for each individual resource category (e.g., marine mammals, sea turtles, etc.). A bounding analysis involves selecting and evaluating a different set of factors and scenarios for each resource in the context of a worst-case analysis. The second approach involves the selection of a single set of key circumstances that, when combined, result in catastrophic consequences. The second approach is used for a site-specific analysis and, consequently, its possible application is more limited. Accordingly, this analysis combines the two approaches, relying on a generalized scenario while identifying site-specific severity factors for individual resources. This combined approach allows for the scientific investigation of a range of possible, although not necessarily probable, consequences of a catastrophic blowout and oil spill in the Gulf of Mexico.

1.2.1. Geographic Scope

The Gulf of Mexico is a semi-enclosed basin with an extensive history of oil and gas activities and with unique environmental conditions and hydrocarbon reservoir properties; consequently, this analysis is only applicable to the Gulf of Mexico OCS and is not intended for other OCS regions.

When possible, this analysis distinguishes between shallow water (<1,000 ft; 305 m) and deep water (≥1,000 ft; 305 m).

1.2.2. Impact-Producing Factors and Scenario

A hypothetical, yet feasible, scenario was developed to provide a framework for identifying the impacts of an extended oil spill from an uncontrolled blowout in both shallow and deep water. Unless noted, this scenario is based on the larger magnitude, blowout-related oil spills that have occurred in the Gulf of Mexico (discussed in Section 1.1). As noted above, because each spill event is unique, its outcome depends on many factors. Therefore, the impacts from present or future spills cannot be predicted based on this scenario.

1.2.3. Environmental and Socioeconomic Impacts

This analysis evaluates the impacts to the Gulf of Mexico's coastal, marine, environmental, and socioeconomic resources from a catastrophic blowout, oil spill, and associated cleanup activities.

Although the most recent EIS's prepared by this Agency for oil and gas lease sales in the Gulf of Mexico analyze the potential impacts from smaller oil spills that are more reasonably foreseeable (USDOI, MMS, 2007 and 2008), the analysis below focuses on the most likely and most significant impacts created by a high-volume, extended-duration spill. Because catastrophic consequences may not occur for all resources, factors affecting the severity of impacts are identified by individual resource.

1.3. How to Use This Analysis

The purpose of this technical analysis is to assist BOEM in meeting CEQ requirements. The CEQ regulations address impacts with catastrophic consequences in the context of evaluating reasonably foreseeable significant adverse effects in an EIS when they address the issue of incomplete or unavailable information (40 CFR 1502.22). "'Reasonably foreseeable' impacts include impacts which have catastrophic consequences even if their probability of occurrence is low, provided that the analysis of the impacts is supported by credible scientific evidence, is not based on pure conjecture, and is within the rule of reason" (40 CFR 1502.22(b)(4)). Therefore, this analysis, based on credible scientific evidence, identifies the most likely and most significant impacts from a high-volume blowout and oil spill that continues for an extended period of time. The scenario and impacts discussed in this analysis should not be confused with the scenario and impacts anticipated to result from routine activities or more reasonably foreseeable accidental events of a proposed action.

This technical analysis is designed to be incorporated by reference in future NEPA documents and consultations. Therefore, factors that affect the severity of impacts of a high-volume, extended-duration spill are highlighted throughout the analysis for use in subsequent site-specific analyses.

To analyze a hypothetical catastrophic event in an area such as the Gulf of Mexico, several assumptions and generalizations were made. However, future project-specific analyses should also consider specific details such as potential flow rates for the specific proposed activity, the properties of the targeted reservoir, and distance to shore of the proposed activities.

The life cycle of a catastrophic blowout and spill is divided into four geographic areas and/or time periods, some of which may overlap:

- Phase 1: Initial event (Section 2)
- Phase 2: Offshore spill (Section 3)
- Phase 3: Onshore contact (Section 4)
- Phase 4: Post-spill, long-term recovery (Section 5)

Each phase of a catastrophic oil spill is addressed in this analysis. For each phase, the scenario is described, factors that could produce environmental impacts are listed, and the most likely and most significant impacts are discussed.

2. INITIAL EVENT (PHASE 1)

While most of the environmental and socioeconomic impacts of a catastrophic blowout would occur during the ensuing high-volume, extended-duration spill (see Sections 3, 4, and 5), it is important to acknowledge the deadly events that could occur in the initial phase of a catastrophic blowout. The following scenario was developed to provide a framework for identifying the most likely and most significant impacts during the initial phase.

2.1. Impact-Producing Factors and Scenario

Phase 1 of the scenario is the initiation of a catastrophic blowout incident. Impacts, response, and intervention depend on the spatial location of the blowout and leak. While there are several points where a blowout could occur, four major distinctions that are important to the analysis of impacts are described in Table 1 below.

For this analysis, an explosion and subsequent fire are assumed to occur. If a blowout associated with the drilling of a single exploratory well occurs, this could result in a fire that would burn for 1 or 2 days. If a blowout occurs on a production platform, other wells could feed the fire, allowing it to burn for over a month (USDOC, NOAA, Office of Response and Restoration, 2010c). The drilling rig or platform may sink. If the blowout occurs in shallow water, the sinking rig or platform may land in the immediate vicinity; if the blowout occurs in deep water, the rig or platform could land a great distance away, beyond avoidance zones. For example, the DWH drilling rig sank, landing 1,500 ft (457 m) away on the seafloor. Regardless of water depth, the immediate response would be from search and rescue vessels and aircraft, such as United States Coast Guard (USCG) cutters, helicopters, and rescue planes, and firefighting vessels.

Table 1

Blowout Scenarios and Key Differences in Impacts, Response, and/or Intervention

Location of Blowout and Leak	Key Differences in Impacts, Response, and/or Intervention
Blowout occurs at the sea surface (i.e., at the rig)	Offers the least chance for oil recovery because of the restricted access to the release point; therefore, greater impacts to coastal ecosystems. In addition to relief wells, there is potential for other intervention measures such as capping and possible manual activation of blowout-preventer (BOP) rams.
Blowout occurs along the riser anywhere from the seafloor to the sea surface. However, a severed riser would likely collapse, resulting in a leak at the seafloor.	In deep water, the use of subsea dispersants may reduce impacts to coastal ecosystems; however, their use may increase exposure of marine resources to oil. There is a possibility for limited recovery of oil at the source. In addition to relief wells, there is potential for other intervention measures, such as capping and possible manual activation of BOP rams.
At the seafloor, through leak paths on the BOP/wellhead	In deep water, the use of subsea dispersants may reduce impacts to coastal ecosystems; however, their use may increase exposure of deepwater marine resources to dispersed oil. With an intact subsea BOP, intervention may involve the use of drilling mud to kill the well. If the BOP and well stack are heavily compromised, the only intervention method may be relief wells. Greatest possibility for recovery of oil at the source, until the well is capped or killed.
Below the seafloor, outside the wellbore (i.e., broached)	Disturbance of a large amount of sediments resulting in the burial of benthic resources in the immediate vicinity of the blowout. The use of subsea dispersants would likely be more difficult (PCCI, 1999). Stopping this kind of blowout would probably involve relief wells. Any recovery of oil at the seabed would be very difficult.

2.2. MOST LIKELY AND MOST SIGNIFICANT IMPACTS

Impacts during Phase 1 would be limited to environmental resources in the immediate vicinity of the blowout. The most recent EIS's prepared by this Agency for oil and gas lease sales in the Gulf of Mexico detail the potential impacts from reasonably foreseeable blowouts (USDOI, MMS, 2007 and 2008). In addition to the impacts described in those documents, the most likely and most significant impacts resulting from a catastrophic blowout outside the wellbore are described below.

2.2.1. Physical Resources

2.2.1.1. Air Quality

A catastrophic blowout close to the water surface would initially emit large amounts of methane and other gases into the atmosphere. If high concentrations of sulfur are present in the produced gas, hydrogen sulfide (H_2S) could present a hazard to personnel. The natural gas H_2S concentrations in the

Gulf of Mexico OCS are generally low; however, there are areas such as the Norphlet formation in the northeastern Gulf of Mexico, for example, that contain levels of H_2S up to 9 percent. Ignition of the blowout gas and subsequent fire would result in emissions of nitrogen oxides (NO_x), sulfur oxides (SO_x), carbon monoxide (CO), volatile organic compounds (VOC's), particulate matter (PM_{10}), and fine particulate matter ($PM_{2.5}$). The fire could also produce polycyclic aromatic hydrocarbons (PAH's), which are known to be hazardous to human health. The pollutant concentrations would decrease with downwind distance. A large plume of black smoke would be visible at the source and may extend a considerable distance downwind. However, with increasing distance from the fire, the gaseous pollutants would undergo chemical reactions, resulting in the formation of fine particulate matter ($PM_{2.5}$) that includes nitrates, sulfates, and organic matter. The $PM_{2.5}$ concentrations in the plume would have the potential to temporarily degrade visibility in any affected Prevention of Significant Deterioration (PSD) Class I areas (i.e., National Wilderness Areas and National Parks) and other areas where visibility is of significant value. Organic aerosols formed downwind from the DWH oil spill (de Gouw et al., 2010), during which the lightest compounds in the oil from the DWH blowout evaporated within hours and during which the heavier compounds took longer to evaporate, contributing to the formation of air pollution particles downwind.

2.2.1.2. Offshore Water Quality

During the initial phase of a catastrophic blowout, water quality impacts include disturbance of sediments and release and suspension of oil and natural gas (methane) into the water column. These potential impacts are discussed below. As this section deals with the immediate effects of a blowout that would be located at least 3 nautical miles from shore, it is assumed that there would be no impacts on coastal water quality during this initial stage.

Disturbance of Sediments

A catastrophic blowout below the seafloor, outside the wellbore (Table 1) has the potential to resuspend sediments and disperse potentially large quantities of bottom sediments. Some sediment could travel several kilometers, depending on particle size and subsea current patterns. In the deep Gulf of Mexico, surficial sediments are mostly composed of silt and clay, and, if resuspended, could stay in the water column for several hours to even days. Bottom currents in the deep Gulf of Mexico have been measured to reach 30 centimeters/second (cm/sec) (12 inches/second [in/sec]) with mean flows of 1.5-2.5 cm/sec (0.6-0.9 in/sec) (Hamilton, 1990). At these mean flow rates, resuspended sediment could be transported 1.3-2.1 kilometers/day (0.8-1.3 miles/day). Sediment resuspension can lead to a temporary change in the oxidation-reduction chemistry in the water column, including a localized and temporal release of any formally sorbed metals, as well as nutrient recycling (Caetano et al., 2003; Fanning et al., 1982). Sediments also have the potential to become contaminated with oil components.

A subsea release also has the potential to destabilize the sediments and create slumping or larger scale sediment movements along depth gradients. These types of events would have the potential to move and/or damage any infrastructure in the affected area.

Release and Suspension of Oil into the Water Column

As the DWH event showed, a subsea release of hydrocarbons at a high flow rate has the potential to disperse and suspend plumes of oil droplets (chemically dispersed or otherwise) within the water column and to induce large patches of sheen and oil on the surface. These dispersed hydrocarbons may adsorb onto marine detritus (marine snow) or may be mixed with drilling mud and deposited near the source. Mitigation efforts such as burning may introduce hydrocarbon byproducts into the marine environment, which would be distributed by surface currents. The acute and chronic sublethal effects of these dilute suspended "plumes" are not well understood and require future research efforts.

Large quantities of oil put into offshore water may alter the chemistry of the sea with unforeseeable results. The VOC's, including benzene, can have acutely toxic effects. The components of crude oil that are water soluble are more available than some of the heavier components to exert a toxic effect on marine life. The PAH's are present in crude oil and include carcinogenic compounds and compounds that pose various risks to marine organisms and possibly to the higher trophic level species, including humans that feed on these organisms. The PAH's are also persistent in the environment. Impacts from the subsequent extended oil spill on offshore water quality are discussed further in Section 3.2.1.2.

Release of Natural Gas (Methane) into the Water Column

A catastrophic blowout could release natural gas into the water column; the amount of gas released is dependent upon the water depth, the natural gas content of the formation being drilled, and its pressure. Methane is the primary component of natural gas (NaturalGas.org, 2010). Methane may stay in the marine environment for long periods of time (Patin, 1999; p. 237), as methane is highly soluble in seawater at the high pressures and cold temperatures found in deepwater environments (NRC, 2003; p. 108). However, methane diffusing through the water column would likely be oxidized in the aerobic zone and would rarely reach the air-water interface (Mechalas, 1974; p. 23). In addition to methane, natural gas contains smaller percentages of other gases such as ethane and propane. It may also contain VOC's (including benzene, toluene, ethylbenzene, and xylene) and H_2S, which have individual toxic characteristics. Methane and other natural gas constituents are carbon sources, and their introduction into the marine environment could result in reducing the dissolved oxygen levels because of microbial degradation of the methane potentially creating hypoxic or "dead" zones. Depletion of dissolved oxygen in the Gulf of Mexico because of the release of natural gas from the Macondo well (DWH event) is currently being examined as a result of the DWH event (Schenkman, 2010). Unfortunately, little is known about methane toxicity in the marine environment, but there is concern as to how methane in the water column might affect fish (see Section 3.2.2.2).

2.2.2. Biological Resources

Impacts during the initial event would be limited to environmental resources in the immediate vicinity of the blowout as described below.

2.2.2.1. Marine and Migratory Birds

Many migratory birds use offshore platforms or rigs as rest sites during migration (Russell, 2005). In addition, seabirds are attracted to offshore platforms and rigs (Tasker et al., 1986; Weise et al., 2001). The numbers of birds present at a platform or rig are greater when platforms or rigs are closer to shore during drilling operations (Baird, 1990). Birds resting on the drilling rig or platform during a catastrophic blowout are likely to be killed by an explosion. While it is assumed that most birds in trans-Gulf migration would likely avoid the fire and smoke plume during the day, it is conceivable that the light from the fire could interfere with nocturnal migration, especially during poor visibility conditions. It has been documented that seabirds are attracted to natural gas flares at rigs and platforms (Russell, 2005; Wiese et al., 2001); therefore, additional bird fatalities could result from the fire following the blowout. Though different species migrate throughout the year, the largest number of species migrate from March through November. A blowout during this time would cause a greater number of bird fatalities. While the number and species of birds killed depends on the blowout location and time of year, these initial fatalities would likely not result in population-level impacts for species present at the time of the blowout and resulting fire (Russell, 2005, Table 6.12).

2.2.2.2. Fish, Fisheries, and Essential Fish Habitat

Depending on the type of blowout and the proximity of marine life to it (Table 1), an eruption of gases and fluids may generate not only a toxic effect but also pressure waves and noise significant enough to injure or kill local biota. Within a few thousand meters of the blowout, resuspended sediments may clog fish gills and interfere with respiration. Settlement of resuspended sediments may, in turn, smother invertebrates or interfere with their respiration. Offshore benthic habitats that support fisheries could also be impacted, as discussed below.

2.2.2.3. Marine Mammals

Depending on the type of blowout, the pressure waves and noise generated by the eruption of gases and fluids would likely be significant enough to harass, injure, or kill marine mammals, depending on the proximity of the animal to the blowout. A high concentration of response vessels could result in harassment or displacement of individuals and could place marine mammals at a greater risk of vessel collisions, which would likely cause fatal injuries.

2.2.2.4. Sea Turtles

Five species of sea turtles are found in the waters of the Gulf of Mexico: green, leatherback, hawksbill, Kemp's ridley, and loggerhead. All species are protected under the Endangered Species Act (ESA), and all are listed as endangered except the loggerhead turtle, which is listed as threatened. Depending on the type of blowout (Table 1), an eruption of gases and fluids may generate significant pressure waves and noise that may harass, injure, or kill sea turtles, depending on their proximity to the accident. A high concentration of response vessels could place sea turtles at a greater risk of fatal injuries from vessel collisions.

Further, mitigation by burning puts turtles at risk because they tend to be gathered up in the corralling process necessary to concentrate the oil in preparation for the burning. Trained observers should be required during any mitigation efforts that include burning.

2.2.2.5. Offshore Benthic Habitats

Gulf of Mexico benthic resources are divided into shelf habitats and deepwater habitats. Shelf habitats of the Gulf of Mexico include soft-bottom habitats (sandy and muddy substrate) and hard-bottom habitats (rock or salt outcroppings that provide habitat for encrusting organisms). Deepwater benthic communities of the Gulf of Mexico include soft-bottom, coral, and chemosynthetic habitats. The impacts to these benthic communities depend on the location and the type of catastrophic blowout that occurs.

Introduction

Sediment disturbance as a result of the blowout above the seafloor would not occur. A catastrophic blowout that occurs above the seabed (at the rig, along the riser between the seafloor and sea surface, or through leak paths on the BOP/wellhead) would result in released oil rising to the sea surface. However, if the leak is deep in the water column and the oil is ejected under pressure, oil droplets may become entrained deep in the water column. The upward movement of the oil may be reduced if methane in the oil is dissolved at the high underwater pressures, reducing the oil's buoyancy (Adcroft et al., 2010). The large oil droplets will rise to the sea surface, but the smaller droplets, formed by vigorous turbulence in the plume or the injection of dispersants, may remain neutrally buoyant in the water column, creating a subsurface plume (Adcroft et al., 2010). Oil droplets less than 100 micrometers in diameter may remain in the water column for several months (Joint Analysis Group, 2010), where they will not be in contact with benthic habitats; similarly, large oil drops on the sea surface will not be in contact with benthos. However, oil in the water column or at the sea surface may sometimes sink, contact benthos, and have impacts, as discussed below.

As discussed below, a catastrophic blowout outside the well casing and below the seafloor or at the seafloor water interface could resuspend large quantities of bottom sediments and create a large crater, destroying many organisms within a few hundred meters of the wellhead. Some of the sediment could travel up to a few thousand meters before redeposition, negatively impacting a localized area of benthic communities.

The use of subsea dispersants would increase the exposure of offshore benthic habitats to dispersed oil droplets in the water column, as well as the chemicals used in the dispersants. The use of subsea dispersants is not likely to occur for seafloor blowouts outside the well casing.

Soft-Bottom Shelf Habitats

The vast majority of the Gulf of Mexico seabed is comprised of soft sediments. Microbes to metazoans (e.g., polychaete worms and crabs) inhabit the soft-bottom benthos, many forming the base of the food chain for several species. When soft-bottom infaunal communities are physically impacted by a blowout (either lost to the crater formation or smothered by sediment), recolonization by populations from neighboring soft-bottom substrate is expected within a relatively short period of time. Many of the organisms on soft bottoms live within the sediment and have the ability to migrate upward in response to burial by sedimentation. A blowout that occurs outside the well casing can rapidly deposit 30 cm (12 in) or more of sediment within a few hundred meters and may smother much of the soft-bottom community in a localized area. In situations where soft-bottom infaunal communities are negatively impacted, recolonization by populations from neighboring soft-bottom substrate would be expected over a relatively short period of time for all size ranges of organisms, in a matter of days for bacteria, and probably less than 1 year for most macrofauna and megafauna species. Recolonization could take longer for areas affected by direct contact of concentrated oil. Initial repopulation from nearby stocks of pioneering species, such as tube-dwelling polychaetes or oligochaetes, may begin with the next recruitment event (Rhodes and Germano, 1982). Full recovery would follow as later stages of successional communities overtake the pioneering species (Rhodes and Germano, 1982). The time it takes to reach a climax community may vary depending on the species and degree of impact. Full benthic community recovery may take years to decades if the benthic habitat is heavily oiled (Gesteira and Dauvin, 2000; Sanders et al., 1980; Conan, 1982). A slow recovery rate will result in a community with reduced biological diversity and possibly a lesser food value for predatory species.

Hard-Bottom Shelf Habitats

The Gulf of Mexico has several hard-bottom features on the continental shelf in water depths less than 300 m (984 ft), features upon which encrusting and epibenthic organisms attach. Though there are varying degrees of relief on the hard bottom, the impacts from a catastrophic blowout are similar for the banks of varying relief because similar organisms occur on these features. Thus, they are discussed as a single grouping under “hard-bottom communities,” with references to specific communities where impacts may differ.

Topographic features are isolated areas of moderate to high relief that provide habitat for hard-bottom communities of high biomass and moderate diversity. These features provide shelter and food for large numbers of commercially and recreationally important fish. There are 37 named topographic features in the Gulf of Mexico with specific BOEM protections, including the Flower Garden Banks National Marine Sanctuary. The BOEM has created “No Activity Zones” around topographic features in order to protect these habitats from disruption because of oil and gas activities. A “No Activity Zone” is a protective perimeter drawn around each feature that is associated with a specific isobath (depth contour) surrounding the feature in which structures, drilling rigs, pipelines, and anchoring are not allowed. These “No Activity Zones” are areas where activity is prohibited based on BOEM policy. Notice to Lessees and Operators (NTL) 2009-G39 recommends that drilling should not occur within 152 m (500 ft) of a “No Activity Zone” of a topographic feature.

The northeastern portion of the central Gulf of Mexico is a region of low to moderate relief known as the “Pinnacle Trend” at the outer edge of the Mississippi-Alabama shelf between the Mississippi River and De Soto Canyon. Fish are attracted to these outcrops that provide hard substrate for sessile invertebrates to attach. The NTL 2009-G39 recommends that no bottom-disturbing activities occur within 30 m (100 ft) of any hard bottoms/pinnacles with a relief of 8 ft (2 m) or greater.

Potentially sensitive biological features are features that have moderate to high relief (8 ft [2 m] or higher), provide hard surface for sessile invertebrates, attract fish, but are not located within Pinnacle-designated blocks or the “No Activity Zone” of topographic features. No bottom-disturbing activities that may cause impact to these features are permitted.

Impacts that occur to hard-bottom shelf habitats as a result of a blowout would depend on the type of blowout, distance from the blowout, relief of the biological feature, and surrounding physical characteristics of the environment (e.g., turbidity). The NTL 2009-G39 recommends the use of buffers to prevent blowouts in the immediate vicinity of a hard-bottom habitat or its associated biota. Much of the oil released from a blowout would rise to the sea surface, therefore minimizing the impact to benthic communities by direct oil exposure. However, small droplets of oil that are entrained in the water column for extended periods of time may migrate into “No Activity Zones.” Although these small oil droplets will not sink themselves, they may attach to suspended particles in the water column and then be deposited on the seafloor (McAuliffe et al., 1975). These long-term impacts, such as reduced recruitment success, reduced growth, and reduced coral cover, as a result of impaired recruitment, are discussed in Section 3.2.2.6. Also, if the blowout were to occur beneath the seabed, suspension and subsequent deposition of disturbed sediment may smother localized areas of benthic communities, possibly including organisms within No Activity Zones or other hard-bottom substrate.

Benthic communities on a hard-bottom feature exposed to large amounts of resuspended and deposited sediments following a catastrophic, subsurface blowout could be subject to sediment suffocation, exposure to resuspended toxic contaminants, and reduced light availability. Impacts to corals as a result of sedimentation would vary based on coral species, the height to which the coral grows, degree of sedimentation, length of exposure, burial depth, and the coral’s ability to clear the sediment. Impacts may range from sublethal effects such as reduced growth, alteration in form, and reduced recruitment and productivity to slower growth to death (Rogers, 1990).

The initial blowout impact would be greatest to communities located in clear waters that experience heavy sedimentation. Reef-building corals are sensitive to turbidity and may be killed by heavy sedimentation (Rogers, 1990; Rice and Hunter, 1992). However, it is unlikely that reef-building corals would experience heavy sedimentation as a result of a blowout because drilling activity would not be allowed near sensitive organisms in the “No Activity Zones,” based on the lease stipulations as described in NTL 2009-G39. The most sensitive organisms are also typically elevated above soft sediments, making them less likely to be buried. It is possible, however, for potentially sensitive biological features outside of “No Activity Zones” or Pinnacle-designated blocks to experience some turbidity or sedimentation impacts. Corals may also experience discoloration or bleaching as a result of sediment exposure, although recovery from such exposure may occur within 1 month (Wesseling et al., 1999).

Initial impacts would be much less extreme in a turbid environment (Rogers, 1990). For example, the Pinnacle Trend community exists in a relatively turbid environment, starting just 65 km (40 mi) east of the mouth of the Mississippi River and trending to the northeast. Sediment from a blowout, if it occurred nearby, may have a reduced impact on these communities compared with an open-water reef community, as these organisms are more tolerant of suspended sediment (Gittings et al., 1992). Many of the organisms that predominate in this community also grow tall enough to withstand the sedimentation that results from their turbid environment or they have flexible structures that enable the passive removal of sediments (Gittings et al., 1992).

A portion or the entire rig may sink to the seafloor as a result of a blowout. The benthic communities (hard- or soft-bottom communities) on the seafloor upon which the rig settles would be destroyed or smothered. A settling rig may suspend sediments, which may smother nearby benthic communities as the sediment is redeposited on the seafloor. The habitats beneath the rig may be permanently lost; however, the rig itself may become an artificial reef upon which epibenthic organisms may settle. The surrounding benthic communities that were smothered by sediment would repopulate from nearby stocks through spawning recruitment and immigration.

Deepwater Habitats

The effects of a catastrophic blowout event on Gulf of Mexico benthic resources in deep water (>1,000 ft; 300 m) are similar to those on the shelf communities. The main factors are the type of blowout and the proximity to the habitat. Known deepwater communities include soft bottoms and two types of hard-bottom communities: chemosynthetic communities and deep coral communities. Many of the organisms on soft bottoms live within the sediment and have the ability to migrate upward in response to burial by sedimentation. A blowout that occurs outside the well casing can rapidly deposit 30 cm (12 in) or more of sediment within a few hundred meters and may smother much of the soft-bottom community in a localized area. In situations where soft-bottom infaunal communities are negatively impacted, recolonization by populations from neighboring soft-bottom substrate would be expected over a relatively short period of time for all size ranges of organisms, in a matter of days for bacteria, and probably less than 1 year for most macrofauna and megafauna species. Recolonization could take longer for areas affected by direct contact of concentrated oil.

The BOEM's restrictions applicable to work near deepwater hard-bottom areas (as described in NTL 2009-G40) would prevent direct negative effects from a seafloor blowout. The established policy prohibits location of wells within 2,000 ft (610 m) of a suspected hard-bottom habitat. Geophysical analyses have achieved a high degree of reliability in detecting the potential presence of hard-bottom communities in the Gulf of Mexico. In rare instances, the subtle geophysical signatures of hydrocarbon seepage that are a probable indicator of a hard-bottom community are not discovered during routine environmental analysis. Therefore, it is possible that a well could be drilled close enough for a hard-bottom community to be damaged in the event of a catastrophic blowout.

Blowouts at points above the seafloor (in the riser or on the drill platform) would have little immediate effect on deepwater seafloor communities unless the structure sinks and physically impacts the seafloor. If a structure sank directly on a hard-bottom community, at least 2,000 ft (610 m) from the well, organisms could be crushed and smothered.

2.2.3. Socioeconomic Resources

2.2.3.1. Offshore Archaeological Resources

The BOEM protects all known, discovered, and potentially historic and prehistoric archaeological resources on the OCS by requiring appropriate avoidance criteria as well as directives to investigate these resources.

Onshore archaeological resources, prehistoric and historic sites, would not be immediately impacted during the initial phase of a catastrophic blowout because the distance of a blowout site from shore is at least 3 nautical miles. However, offshore catastrophic blowouts, when compared with spills of lesser magnitude, may initially impact multiple archaeological resources. Resources adjacent to a catastrophic blowout could be damaged by the high volume of escaping gas, buried by large amounts of dispersed sediments, crushed by the sinking of the rig or platform, destroyed during emergency relief well drilling, or contaminated by the hydrocarbons.

Based on historical information, over 2,100 potential shipwreck locations have been identified in the Gulf of Mexico OCS (USDOI, MMS, 2007). This number is a conservative estimate and is heavily weighted toward post-19th century, nearshore shipwrecks, where historic records documenting the loss of the vessels were generated more consistently. Of the 2,100 recorded wrecks, only 233 records were determined to have associated spatial data possessing sufficient accuracy for BOEM's needs.

In certain circumstances, BOEM's Regional Director may require the preparation of an archaeological report to accompany the EP, DOCD, or DPP, under 30 CFR 550.194, and BSEE's Regional Director may do likewise under 30 CFR 250.194 if a potential wreck is encountered during operations. As part of the environmental reviews conducted for postlease activities, available information will be evaluated regarding the potential presence of archaeological resources within the proposed action area to determine if additional archaeological resource surveys and mitigations are warranted.

2.2.3.2. Commercial Fishing

The initial explosion and fire could endanger commercial fishermen in the immediate vicinity of the blowout. Although commercial fishing vessels in the area would likely aid in initial search-and-rescue operations, the subsequent fire could burn for over a month, during which time commercial vessels would be expected to avoid the area so as to not interfere with response activities. This could impact the livelihood and income of these commercial fishermen.

2.2.3.3. Recreational Resources and Fishing

A substantial amount of recreational activity is associated in the immediate area around shallow water oil and gas structures because these structures function as artificial reefs, promote coral growth, and attract fish. About 20 percent of the recreational fishing activity and 90 percent of the recreational diving activity in the Gulf of Mexico occurs within 300 ft (91 m) of oil and gas structures (Hiett and Milon, 2002). Therefore, an explosion and fire within 100 mi (161 km) of shore could endanger recreational fishermen and divers in the immediate vicinity of the blowout, especially if the blowout is located between water depths of 100 and 200 ft (30 and 61 m). Recreational vessels in the area would likely aid in initial search-and-rescue operations but would also be in danger during the explosion and subsequent fire. The subsequent fire could burn for more than a month, during which recreational vessels would be expected to avoid the area and not interfere with response activities. This will impact the income of recreational fishing and diving businesses. Also, if the fire and smoke is visible from recreational beaches, their recreational use may be impacted.

2.2.3.4. Human Resources, Land Use, and Environmental Justice

Fatalities and serious injuries would likely occur during the initial explosion and/or fire. Due to the large number of people (>100) working on a deepwater drilling rig or platform, dozens of fatalities and serious injuries could occur.

With the explosion >3 nautical miles from the shore and the likelihood that the resulting fire will burn for a short duration, the initial fire and/or explosion is not expected to impact land use, demographics, or economics, although some recreational beach use may be impacted (Section 2.2.2.3). Thus, the initial fire and explosion should not disproportionately affect low-income persons or minorities, and therefore, will not raise environmental justice concerns.

3. OFFSHORE SPILL (PHASE 2)

3.1. IMPACT-PRODUCING FACTORS AND SCENARIO

Phase 2 of the analysis focuses on the spill and response in Federal and State offshore waters.

3.1.1. Duration of Spill

The duration of the offshore spill from a blowout depends on the time needed for intervention and the time the remaining oil persists offshore. If a blowout occurs and the damaged surface facilities preclude well reentry operations, a relief well may be needed to regain control. The time required to drill the relief well depends on the complexity of the intervention, the location of a suitable rig, the type of operation that must be terminated to release the rig (e.g., casing may need to be run before releasing the rig), and problems mobilizing personnel and equipment to the location. A blown-out well may also be successfully capped prior to completion of relief wells, as occurred in the DWH event. Assuming the duration of previous spills including the DWH and the type of oil and water temperatures found in the Gulf of Mexico, the majority of visibly spilled oil on the surface of the water would not persist more than 30 days after the oil flow stopped (Lubchenco et al., 2010).

3.1.1.1. Shallow Water

If a blowout occurs in shallow water, the entire intervention effort including drilling relief wells could take 1-3 months. This includes 1-3 weeks to transport the drilling rig to the well site. Spilled surface oil is not expected to persist more than 1 month after the flow is stopped. Therefore, the estimated spill duration resulting from a shallow water blowout is 2-4 months.

3.1.1.2. Deep Water

If a blowout occurs in deep water, the entire intervention effort including drilling relief wells could take 3-4 months (USDOI, MMS, 2000; Regg, 2000). This includes 2-4 weeks to transport the drilling rig to the well site. Spilled surface oil is not expected to persist more than 1 month after the flow is stopped. Therefore, the estimated spill duration from a deep water blowout is 4-5 months.

3.1.2. Area of Spill

When oil reaches the sea surface, it spreads. The speed and extent of spreading depends on the type and volume that is spilled. However, a catastrophic spill would likely spread hundreds of square miles. Also, the oil slick may break into several smaller slicks, depending on local wind patterns that drive the surface currents in the spill area.

3.1.3. Volume of Spill

For this analysis, a higher flow rate is assumed for a blowout in deep water for the following reasons. After 50 years of Gulf of Mexico development, most, if not all, of the largest shallow-water prospects have been developed. As a result, reservoir pressures in shallow water are generally reduced. Although under certain conditions oil may be present with the natural gas, deeper shelf wells target natural gas. Also, because deepwater development is costly, only larger prospects with higher flow rates are currently targeted for exploration.

3.1.3.1. Shallow Water

For this analysis, an uncontrolled flow rate of 30,000 barrels per day is assumed for a catastrophic blowout in shallow water. This assumption is based upon the results of well tests in shallow water (see Section 3.1.3 above) and the maximum flow rate from the 1979 *Ixtoc* blowout, which occurred in shallow water. Using this flow rate, the total volume of oil spilled from a catastrophic blowout in shallow water is estimated at 900,000 to 3 million barrels for a spill lasting 1-3 months. In addition to the flow rate, it is assumed that any remaining diesel fuel from a sunken drilling rig or platform would also leak.

3.1.3.2. Deep Water

For the purposes of this analysis, an uncontrolled flow rate of 30,000-60,000 barrels per day is assumed for a catastrophic blowout in deep water. This flow rate is based on the assumption in Section 3.1.3 above, well test results, and the maximum flow rate estimated for the 2010 DWH event, which occurred in deep water. Therefore, total volume of oil spilled is estimated to be 2.7-7.2 million barrels over 3-4 months. In addition, deepwater drilling rigs or platforms hold a large amount of diesel fuel (10,000-20,000 barrels). Therefore, it is assumed that any remaining diesel fuel from a sunken structure would also leak and add to the spill.

3.1.4. Oil in the Environment: Properties and Persistence

The fate of oil in the environment depends on many factors, such as the source and composition of the oil, as well as its persistence (NRC, 2003). Persistence can be defined and measured in different ways (Davis et al., 2004), but the National Research Council (NRC) generally defines persistence as how long oil remains in the environment (NRC, 2003; p. 89). Once oil enters the environment, it begins to change through physical, chemical, and biological weathering processes (NRC, 2003). These processes may interact and affect the properties and persistence of the oil through

- evaporation (volatilization),
- emulsification (the formation of a mousse),
- dissolution,
- oxidation, and
- transport processes (NRC, 2003; Scholz et al., 1999).

Horizontal transport takes place via spreading, advection, dispersion, and entrainment, while vertical transport takes place via dispersion, entrainment, Langmuir circulation, sinking, overwashing, partitioning, and sedimentation (NRC, 2003). The persistence of an oil slick is influenced by the effectiveness of oil-spill response efforts and affects the resources needed for oil recovery (Davis et al., 2004). The persistence of an oil slick may also affect the severity of environmental impacts as a result of the spilled oil.

Crude oils are not a single chemical, but instead are complex mixtures with varied compositions. Thus, the behavior of the oil and the risk the oil poses to natural resources depends on the composition of the specific oil encountered (Michel, 1992). Generally, oils can be divided into three groups of compounds: (1) light-weight; (2) medium-weight; and (3) heavy-weight components. On average, these groups are characterized as outlined below in Table 2.

Table 2

Properties and Persistence by Oil Component Group

Properties and Persistence	Light-Weight	Medium-Weight	Heavy-Weight
Hydrocarbon compounds	Up to 10 carbon atoms	10-22 carbon atoms	>20 carbon atoms
API º	>31.1 º	31.1º-22.3 º	<22.3 º
Evaporation rate	Rapid (within 1 day) and complete	Up to several days; not complete at ambient temperatures	Negligible
Solubility in water	High	Low (at most a few mg/L)	Negligible
Acute toxicity	High because of monoaromatic hydrocarbons (BTEX)	Moderate because of diaromatic hydrocarbons (naphthalenes—2 ring PAH's)	Low except because of smothering (i.e., heavier oils may sink)
Chronic toxicity	None, does not persist because of evaporation	PAH components (e.g., naphthalenes—2 ring PAH's)	PAH components (e.g., phenanthrene, anthracene—3 ring PAH's)
Bioaccumulation potential	None, does not persist because of evaporation	Moderate	Low, may bioaccumulate through sediment sorption
Compositional majority	Alkanes and cycloalkanes	Alkanes that are readily degraded	Waxes, asphaltenes, and polar compounds (not significantly bioavailable or toxic)
Persistence	Low because of evaporation	Alkanes readily degrade, but the diaromatic hydrocarbons are more persistent	High; very low degradation rates and can persist in sediments as tarballs or asphalt pavements

Sources: Michel, 1992; Canadian Center for Energy Information, 2010.

Of the oil reservoirs sampled in the Gulf of Mexico OCS, the majority fall within the light-weight category, while less than one quarter are considered medium-weight and a small portion are considered heavy-weight. Oil with an API gravity of 10.0 or less would sink and has not been encountered in the Gulf of Mexico OCS and, therefore, it is not analyzed in this paper (USDOI, BOEMRE, 2010c).

Heavy-weight oil may persist in the environment longer than the other two types of oil, but the medium-weight components within oil present the greatest risks to organisms because, with the exception of the alkanes, these medium-weight components are persistent, bioavailable, and toxic (Michel, 1992).

Previous studies (e.g., Johansen et al., 2001) supported the theory that most, if not all, released oil would reach the surface of the water column. However, data and observations from the DWH event challenge that theory. While analyses are in their preliminary stages, it appears that measurable amounts of hydrocarbons (dispersed or otherwise) are being detected in the water column as subsurface "plumes" and on the seafloor in the vicinity of the release. While not all of these hydrocarbons have been definitively traced back to releases from the Macondo well (DWH event), these early measurements and results warrant a reassessment of previous theories of the ultimate fate of hydrocarbons from unintended subsurface releases. It is important to note that the North Sea experiment (Johansen et al., 2001) did not include the use of dispersants at or near the source of the subsea oil discharge.

3.1.5. Release of Natural Gas

The quality and quantity of components in natural gas vary widely by the field, reservoir, or location from which the natural gas is produced. Although there is not a "typical" makeup of natural gas, it is primarily composed of methane (NaturalGas.org, 2010).

3.1.6. Offshore Cleanup Activities

As demonstrated by the *Ixtoc* and DWH spill responses, a large-scale response effort is certain to follow a catastrophic blowout. The number of vessels and responders would increase exponentially as the spill continued.

3.1.6.1. Shallow Water

Within the first week of an oil spill originating in shallow water, 25 vessels are estimated to respond, which would steadily increase to over 3,000 by the end of the spill. This includes about 25 skimmers in the vicinity of the well at a time. In addition, recovered oil may be barged to shore from recovery vessels.

Within the first week, over 500 responders are estimated to be deployed to a spill originating in shallow water, which would steadily increase up to 25,000 before the well is capped or killed within 2-4 months.

Response to an oil spill in shallow water is expected to involve over 10,000 ft (3,048 m) of boom within the first week and would steadily increase up to 5 million feet (950 mi; 1,520 km) for use offshore and nearshore, the amount dependent upon the location of the potentially impacted shoreline, environmental considerations, and agreed upon protection strategies involving the local potentially impacted communities.

Up to 25 planes and 50 helicopters are estimated to respond per day by the end of a shallow-water spill.

Along the Gulf Coast, dispersants are preapproved for use greater than 3 nautical miles from shore and in water depths greater than 33 ft (10 m), with the exception of Florida where the water depth must be 65 ft (20 m) (USDOT, CG, 2010). However, the U.S. Environmental Protection Agency (USEPA) is presently examining these preapprovals, and restrictions are anticipated regarding the future use of dispersants for ongoing spills as a result. Changes to the dispersant use preapprovals would be expected to limit this use in the future. Under the preapprovals, it is estimated that up to a total of 35,000 barrels of dispersant would be used.[1] Aerial dispersants would likely be applied from airplanes as a mist, which settles on the oil on the water's surface. In addition to dispersants, controlled burns may also occur.

3.1.6.2. Deep Water

Within the first week of oil spill originating in deep water, 50 vessels are estimated to respond, which would steadily increase to over 7,000 by the end of the spill. This includes about 25 skimmers in the vicinity of the well at a time. In addition, recovered oil may be shuttle tankered to shore from recovery vessels.

For an oil spill in deep water, over 1,000 responders are estimated to be deployed within the first week, which would steadily increase up to 50,000 before capping or killing the well within 4-5 months.

Over 20,000 ft (6,096 m) of boom is estimated to be deployed within the first week of a deepwater spill, which would steadily increase up to 11 million feet (2,100 mi; 3,350 km) offshore and nearshore, the amount dependent upon the location of the potentially impacted shoreline, environmental considerations, and agreed upon protection strategies involving the local potentially impacted communities.

Up to 50 planes and 100 helicopters are estimated to respond per day by the end of a deepwater spill. With the exception of special Federal management areas or designated exclusion areas, dispersants have been preapproved in the vicinity of a deepwater blowout (USDOT, CG, 2010). However, USEPA is

1 At the *Ixtoc-I* well blowout in 1979, between 1 million and 2.5 million gallons of mostly Corexit dispersant products were applied over a 5-month period on the oil discharge. However, this scenario assumes a spill from a blowout in shallow water would last up to 3 months.

presently examining these preapprovals, and restrictions are anticipated regarding the future use of dispersants as a result. Under preexisting preapprovals, it is estimated that up to 50,000 barrels of dispersant could be applied (2/3 on the water surface and 1/3 subsurface, if possible). Changes to the dispersant use preapprovals would be expected to limit this use. No preapproval presently exists for the use of subsea dispersants, and approval must be obtained before each use of this technology. The use of subsea dispersants depends on the location of the blowout, as discussed in Table 1. Aerial dispersants are applied from airplanes as a mist, which settles on the oil on the water's surface. In addition to dispersants, it is estimated that 5-10 controlled burns would be conducted per day in suitable weather. About 500 burns in all would remove 5-10 percent of the oil.

3.1.6.3. Vessel Decontamination Stations

To avoid contaminating inland waterways, multiple vessel decontamination stations may be established offshore in Federal and State waters. Vessels responding to the spill and commercial and recreational vessels passing through the spill would anchor, awaiting inspection. If decontamination is required, work boats would use fire hoses to clean oil from the sides of the vessels. This could result in some oiling of otherwise uncontaminated waters. While these anchorage areas would be surveyed for buried pipelines that could be ruptured by ship anchors, they may not be surveyed adequately for benthic communities or archaeological sites. Therefore, some damage to benthic communities or archaeological sites may occur because of vessel decontamination activities associated with an oil spill in deep water (Alabama State Port Authority, 2010; State of Florida, Office of the Governor, 2010; Nodar, 2010; Unified Incident Command, 2010a-c; USDOC, NOAA, 2010a; USEPA, 2010a).

3.1.7. Severe Weather

A hurricane could accelerate biodegradation, increase the area affected by the spill, and/or slow the response effort. The Atlantic hurricane season runs from June 1st through November 30th, peaking in September. In an average Atlantic season, there are 11 named storms, 6 hurricanes, and 2 Category 3 or higher storms (USDOC, NOAA, National Weather Service, 2010a). As a result of a hurricane, high winds and seas would mix and "weather" the oil from an oil spill. This can help accelerate the biodegradation process (USDOC, NOAA, National Weather Service, 2010b). The high winds may distribute oil over a wider area (USDOC, NOAA, National Weather Center, 2010b). In the event of a hurricane, vessels would evacuate the area, delaying response efforts, including the drilling of relief wells and any well capping or collection efforts.

3.2. MOST LIKELY AND MOST SIGNIFICANT IMPACTS

The most recent EIS's prepared by this Agency for oil and gas lease sales in the Gulf of Mexico identify in detail the potential impacts from reasonably foreseeable oil spills (USDOI, MMS, 2007 and 2008). In addition to the impacts described in those documents, the most likely and most significant impacts because of the magnitude of shoreline oil as a result of a catastrophic spill are described below.

3.2.1. Physical Resources

3.2.1.1. Air Quality

In the Gulf of Mexico, evaporation from the oil spill would result in concentrations of VOC's in the atmosphere, including chemicals that are classified as being hazardous. The VOC concentrations would occur anywhere where there is an oil slick, but they would be highest at the source of the spill because the rate of evaporation depends on the volume of oil present at the surface. The VOC concentrations would decrease with distance as the layer of oil gets thinner. The lighter fractions of VOC's would be most abundant in the immediate vicinity of the spill site. The heavier compounds would be emitted over a longer period of time and over a larger area. Some of the compounds emitted could be hazardous to workers in close vicinity of the spill site. The hazard to workers can be reduced by monitoring and using protective gear, including respirators, as well as limiting exposure through limited work shifts, rotating workers out of high exposure areas, and pointing vessels into the wind. During the DWH event, air samples collected by individual offshore workers of British Petroleum (BP), the Occupational Safety and Health Administration (OSHA), and U.S. Coast Guard showed levels of benzene, toluene, ethylbenzene, and xylene that were mostly under detection levels. All samples had concentrations below the OSHA Occupational permissible exposure limits and the more stringent ACGIH (American Conference of Governmental Industrial Hygienists) threshold limit values (U.S. Dept. of Labor, OSHA, 2010a).

The VOC emissions that result from the evaporation of oil contribute to the formation of particulate matter ($PM_{2.5}$) in the atmosphere. In addition, VOC's could cause an increase in ozone levels, especially if the release were to occur on a hot, sunny day with sufficient concentrations of NO_x present in the lower atmosphere. However, because of the distance from shore, the oil slick would not normally have any effects on onshore ozone concentrations.

It is assumed that response efforts would include hundreds of in-situ or controlled burns, which would remove an estimated 5-10 percent of the volume of oil spilled. This could be as much as 720,000 barrels of oil for a spill of 60,000 barrels per day for 120 days. In-situ burning would result in ambient concentrations of CO, NO_x, SO_2, PM_{10}, and $PM_{2.5}$ very near the site of the burn and would generate a plume of black smoke. The levels of $PM_{2.5}$ could be a hazard to personnel working in the area, but this could be effectively mitigated through monitoring and relocating vessels to avoid areas of highest concentrations. In an experiment of an in-situ burn off Newfoundland, it was found that CO, SO_2, and NO_2 were measured only at background levels and were frequently below detection levels (Fingas et al., 1995). Limited amounts of formaldehyde and acetaldehyde were measured, but concentrations were close to background levels. Measured values of dioxins and dibenzofurans were at background levels. Measurements of PAH in the crude oil, the residues, and the air indicated that the PAH in the crude oil are largely destroyed during combustion (Fingas et al., 1995).

While containment operations may be successful in capturing some of the escaping oil and gas, recovery vessels may not be capable of storing the crude oil or may not have sufficient storage capacity. In this case, excess oil would be burned; captured gas cannot be stored or piped to shore so it would be flared. For example, in the DWH event, gas was flared at the rate of 100-200 million cubic feet per day and oil burned at the rate of 10,000-15,000 barrels per day. The estimated NO_x emissions are about 13 tons per day. The SO_2 emissions would be dependent on the sulfur content of the crude oil. For crude oil with a sulfur content of 0.5 percent, the estimated SO_2 emissions are about 16 tons per day. Particulate matter in the plume would also affect visibility. Flaring or burning activities upwind of a PSD Class I area, e.g., the Breton National Wilderness Area, could adversely affect air quality there because of increased levels of SO_2, PM_{10}, and $PM_{2.5}$, and because of reduced visibility.

3.2.1.2. Offshore Water Quality

The water offshore of the Gulf's coasts can be divided into two regions: the continental shelf and slope (<1,000 ft; 305 m) and deep water (>1,000 ft; 305 m). Waters on the continental shelf and slope are heavily influenced by the Mississippi and Atchafalaya Rivers, the primary sources of freshwater, sediment, nutrients, and pollutants from a huge drainage basin encompassing 55 percent of the continental U.S. (Murray, 1998). Lower salinities are characteristic nearshore where freshwater from the rivers mix with Gulf waters. The presence or extent of a nepheloid layer, a body of suspended sediment at the sea bottom (Kennett, 1982; p. 524), affects water quality on the shelf and slope. Deep waters east of the Mississippi River are affected by the Loop Current and associated warm-core (anti-cyclonic) eddies, which flush the area with clear, low-nutrient water (Muller-Karger et al., 2001). However, cold-core cyclonic eddies (counter-clockwise rotating) also form at the edge of the Loop Current and are associated with upwelling and nutrient-rich, high-productivity waters, although the extent of this flushing can vary seasonally.

While response efforts would decrease the fraction of oil remaining in Gulf waters, significant amounts of oil would remain (The Federal Interagency Solutions Group, 2010). Natural processes will physically, chemically, and biologically aid the degradation of oil (NRC, 2003). The physical processes involved include evaporation, emulsification, and dissolution, while the primary chemical and biological degradation processes include photooxidation and biodegradation (i.e., microbial oxidation). Water quality would not only be impacted by the oil, gas, and their respective components but also to some degree from cleanup and mitigation efforts, such as from increased vessel traffic and the addition of dispersants and methanol to the marine environment.

In the case of a catastrophic subsea blowout in deep water, it is assumed that large quantities of subsea dispersants would be used. As a result, clouds or plumes of dispersed oil may occur near the blowout site. Reports following the DWH event have found such plumes and have shown that the concentrations of these clouds decrease to undetectable levels within a few miles of the source (USDOC, NOAA, 2010b). Additional reporting in the coming months will enhance the understanding of the effects of subsurface plumes. Dissolved oxygen levels are a concern with any release of a carbon source, and these levels became a particular concern during the DWH event, since dispersants were used in deep waters for the first time. Thus, USEPA required monitoring protocols in order to use subsea dispersants (USDOC, NOAA, 2010c). In areas where plumes of dispersed oil were previously found, dissolved oxygen levels decreased by about 20 percent from long-term average values in the Gulf of Mexico; however, scientists reported that these levels have stabilized and are not low enough to be considered hypoxic (USDOC, NOAA, 2010d). The temporary decrease in oxygen content has been attributed to microbial degradation of the oil. Over time, as the oil continues to be degraded and diffuses, hypoxia becomes less of a concern. As reported for the DWH event, dissolved oxygen levels would likely remain above levels of immediate concern, but there would still be a need to monitor dissolved oxygen levels over time.

Toxicity of dispersed oil in the environment would depend on many factors, including the effectiveness of the dispersion, temperature, salinity, degree of weathering, type of dispersant, and degree of light penetration in the water column (NRC, 2005). The toxicity of dispersed oil is primarily because of the toxic components of the oil itself (Australian Maritime Safety Authority, 2010).

3.2.2. Biological Resources

The most recent EIS's prepared by this Agency for oil and gas lease sales in the Gulf of Mexico details potential localized impacts to specific species from reasonably foreseeable oil spills (USDOI, MMS, 2007 and 2008). However, a catastrophic event, such as a high-volume, extended-duration spill resulting from a blowout, has the potential to cause population-level impacts. Multiple Federal and State-listed, threatened and endangered species could be impacted from an extended offshore spill (USDOI, FWS, 2010a and 2010b).

3.2.2.1. Marine and Migratory Birds

During Phase 2 of a catastrophic spill, the primary concern for marine and migratory birds would be their vulnerability to oiling or ingesting oil, which is related to their behavior. Wading birds (e.g., herons, egrets, etc.) and species that feed by plunge-diving into the water to catch small fish (e.g., pelicans, gannets, terns, gulls, and pelagic birds) and those that use water as a primary means of locomotion, foraging, or resting and preening (e.g., diving ducks, cormorants, pelicans, etc.) are highly vulnerable to becoming oiled and also to ingesting oil, as are black skimmers. These birds tend to feed and concentrate in convergence zones, places in the ocean where strong opposing currents meet. In addition to concentrating prey, these zones also aggregate oil (Unified Incident Command, 2010d). Oiling interferes with the birds' ability to fly (thus to obtain food) and compromises the insulative characteristics of down and contour feathers making it difficult to maintain body heat. Attempts by the birds to remove the oil by preening causes oiled birds to ingest oil and may result in mortality.

3.2.2.2. Fish, Fisheries, and Essential Fish Habitat

Early life stages of animals are usually more sensitive to oil than adults (Boesch and Rabalais, 1987; NRC, 2005). Weathered crude oil has been shown in laboratory experiments to cause malformation, genetic damage, and even mortality at low levels in fish embryos of Pacific herring (Carls et al., 1999). There is a high probability of mortality for the eggs and larvae of Gulf fishes that come in contact with spilled oil.

Adult fish may be less at risk than earlier life stages in part because they are less likely to concentrate at the surface and may avoid contact with floating oil. There were, however, sightings of whale sharks (which are defined as "threatened" by the International Union for Conservation of Nature) swimming among slicks from the DWH spill. They were not visibly oiled, but there was concern that they could be affected because they are surface feeders (Howell, 2010). Effects of oil on organisms can include direct lethal toxicity, sublethal disruption of physiological processes (internal lesions), effects of direct coating by oil (suffocation by coating gills), incorporation of hydrocarbons in organisms causing tainting or accumulation in the food chain, and changes in biological habitat (decreased dissolved oxygen) (Moore and Dwyer, 1974).

Because natural crude oil found in the Gulf of Mexico would generally float on the surface, fish species whose eggs and larvae are found at or near the water surface are most at risk from an offshore spill. Species whose spawning periods coincide with the timing of the highest oil concentrations would be at greatest risk. If there is a subsea catastrophic blowout, it is assumed dispersants would be used. Then there could be effects on multiple life history stages and trophic levels. There is limited knowledge of the toxicity of dispersants mixed with oil to specific species or life stages of ichthyoplankton, and the likely extent of mortality because of the combination of factors is difficult to determine. The combined toxic effects of the oil and any dispersants that may be used may not be apparent unless a significant portion of a year-class is absent from next year's fishery (e.g., shrimps, crabs, snapper, and tuna).

Recent studies by USEPA using representative species provide some indication of the relative toxicity of Louisiana sweet crude oil, dispersants, and oil/dispersant mixes. Bioassays were conducted using two Gulf species—a mysid shrimp (*Amercamysis bahia*) and a small estuarine fish, the inland silverside (*Menidia beryllinina*)—to evaluate the acute toxic effects of oil, eight dispersants, and oil/dispersant mixtures. In addition, USEPA used standard *in vitro* techniques using the same dispersants to (1) evaluate acute toxicity on three cell lines over a range of concentrations and (2) evaluate effects of these dispersants on androgen and estrogen function using human cell lines (to see if they are likely to disrupt hormonal systems). All dispersants showed cytotoxicity in at least one cell type at concentrations between 10 and 110 parts per million (ppm). Results of the *in vitro* toxicity tests were similar to the whole animal tests, showing generally low dispersant toxicity. Lethal concentration (LC50) values (the concentration at which half of the test subjects die) were lower than the cell-based assays. For all eight dispersants, for both species, the dispersants alone were less toxic than the dispersant/oil mixture. Louisiana sweet crude oil alone was determined to be more toxic to both the silverside fish and the mysid shrimp than the dispersants alone. The results of the testing for disruption of androgen and estrogen function indicate that the dispersants do not show biologically significant endocrine activity via androgen or estrogen pathways (USEPA, Office of Research and Development, 2010a and 2010b).

The North Atlantic bluefin tuna is an example of a fish/fishery in the Gulf of Mexico that could be at risk to lose a year-class. It has a relatively narrow peak spawning period in April and May and floating eggs. A catastrophic blowout during the spring season could cause a negative effect to this population. The Gulf of Mexico is one of only two documented spawning grounds for the Atlantic bluefin tuna; the other is in the Mediterranean Sea. Spawning is clustered in a specific type of habitat along the continental slope. Bluefin tuna are among the most valuable fish in global markets. The International Commission for the Conservation of Atlantic Tunas (ScienceDaily, 2010) currently manages the Atlantic bluefin tuna as two distinct populations, with western Atlantic spawners of the Gulf of Mexico forming a population genetically distinct from the eastern spawners of the Mediterranean Sea. The western Atlantic stock has suffered, and a long-term rebuilding plan has failed to revive the population or the fishery. The failure of the Gulf of Mexico spawning population to rebuild and the scope of illegal and under-reported catches are of such concern that the species was considered for Appendix 1 listing (most endangered status) by the Convention of International Trade in Endangered Species (CITES) in March 2010. The NOAA made a determination on May 27, 2011, that Atlantic bluefin tuna did not warrant species protection under the ESA at that time. However, NOAA does plan to revisit this decision by early 2013 when more information will be available concerning any effects of the DWH spill (76 FR 31556). In addition, a new stock assessment will be available from the International Commission for the Conservation of Atlantic Tunas.

A catastrophic deepwater spill could release natural gases with methane as the primary component (NaturalGas.org, 2010) into the water column, but little is known about the effects of elevated methane levels on fish. Patin (1999) studied the elevated concentrations of methane resulting from a gas blowout from drilling platforms in the Sea of Asov, Ukraine, on fish. The pathological changes reported were species specific and included damages to cell membranes, organs, and tissues; modifications of protein synthesis; and other anomalies typical for acute poisoning of fish. These impacts, however, were observed at levels of 4-6 milligrams/liter of methane near the accident well. The full effect of elevated methane levels on Gulf of Mexico fishes is currently unknown.

3.2.2.3. Marine Mammals

An oil spill and related spill-response activities can impact marine mammals that come into contact with oil and remediation efforts. The marine mammals' exposure to hydrocarbons persisting in the sea may result in sublethal impacts (e.g., decreased health, reproductive fitness, longevity, and increased vulnerability to disease), some soft tissue irritation, respiratory stress from inhalation of toxic fumes, food reduction or contamination, direct ingestion of oil and/or tar, and temporary displacement from preferred habitats or migration routes. More detail on the potential range of effects to marine mammals from contact with spilled oil can be found in Geraci and St. Aubin (1990). The best available information does not provide a complete understanding of the effects of the spilled oil and active response/cleanup activities on marine mammals. For example, it is expected that the large amount of chemical dispersants being used on the oil may act as an irritant on the marine mammals' tissues and sensitive membranes.

The increased human presence after an oil spill (e.g., vessels) would likely add to changes in behavior and/or distribution, thereby potentially stressing marine mammals further and perhaps making them more vulnerable to various physiologic and toxic effects. In addition, the large number of response vessels could place marine mammals at a greater risk of vessel collisions, which could cause fatal injuries.

The potential biological removal (PBR) level is defined by the Marine Mammal Protection Act (MMPA) as the maximum number of animals, not including natural mortalities that may be removed from a marine mammal stock while allowing that stock to reach or maintain its optimum sustainable population. However, in the Gulf of Mexico, many marine mammal species have either entirely unknown PBR's or population size estimates that are more than 8 years old and therefore considered unknown. The biological significance of any injury or mortality would depend, in part, on the size and reproductive rates of the affected stocks, as well as the number, age, and size of the marine mammals affected.

According to the Consolidated Fish and Wildlife Collection Reports from the DWH event, 170 marine mammals have been collected (13 alive, 157 deceased as of April 20, 2011). Due to known low detection rates of carcasses, it is possible that the number of deaths of marine mammals is underestimated (Williams et al., 2011). The mortality estimates from the DWH event are just an example of the potential losses because of a high-volume oil spill. It is also important to note that evaluations have not yet confirmed the cause of death, and it is possible that not all carcasses were related to the DWH event. Thus, a high-volume oil spill lasting 120 days could directly impact as many individuals or more. The majority would likely be coastal or estuarine bottlenose dolphins, as was the case with the DWH event. This number represents only those marine mammals collected (either dead or alive) and does not address all potential impacts to the population. Based on these data, it is reasonable to assume that a catastrophic oil spill lasting up to 120 days could have population-level effects on many species of marine mammals (e.g., sperm whales, Bryde's whales, etc.).

3.2.2.4. Sea Turtles

Sea turtles are more likely to be affected by a catastrophic spill in shallow water than in deep water because not all sea turtles occupy a deepwater habitat. For example, Kemp's ridley sea turtles are unlikely to be in water depths of 160 ft (49 m) or greater. Hawksbill sea turtles are commonly associated with coral reefs, ledges, caves, rocky outcrops, and high energy shoals. Green sea turtles are commonly found in coastal benthic feeding grounds, although they may also be found in the convergence zones of the open ocean. Convergence zones are areas that also may collect oil. Leatherback sea turtles are commonly pelagic and are the sea turtle species most likely to be affected by a deepwater oil spill. As the spilled oil moves toward land, additional species of sea turtles are more likely to be affected.

Based on the Consolidated Fish and Wildlife Collection Reports from the DWH event, a few to over two dozen sea turtles could be impacted daily through oiling and/or collection. According to the Consolidated Fish and Wildlife Collection Report, after the DWH event, 1,149 sea turtles have been collected (536 alive, 613 deceased as of April 20, 2011). These mortality estimates from the DWH event are just an example of the potential losses because of a high-volume oil spill. It is also important to note that evaluations have not yet confirmed the cause of death, and it is possible that not all carcasses were related to the DWH event. A high-volume oil spill lasting 120 days could impact greater than 1,000 sea turtles, and the majority could be Kemp's ridley turtles, which are listed as endangered under the ESA (USDOC, NOAA, NMFS, 2010a; Unified Incident Command, 2010e). In addition, the large number of response vessels could place sea turtles at a greater risk of vessel collisions, which could cause fatal injuries.

3.2.2.5. Offshore Habitats

Sargassum mats, which are mats made from a free-floating seaweed, provide habitat for juvenile sea turtles and developing invertebrates, spawning sites for hundreds of fish species, and feeding sources for manatees. In offshore waters, both free-floating patches of *Sargassum* seaweed and spilled oil tend to accumulate in convergence zones, places in the ocean where strong opposing currents meet. Sea turtles, especially juveniles, use these areas for food and cover. Burn operations sometime occurred there because of the aggregated oil (Unified Incident Command, 2010d). Benthic resources are discussed below.

Open-water organisms, such as phytoplankton and zooplankton, are essential to the marine food web. They play an important role in regulating climate, contribute to marine snow, and are an important source of nutrients for mesopelagic and benthic habitats. An offshore oil spill would not only have an impact on these populations but also on the species that depend on them. The microbial community can also be affected by an offshore oil spill. The microbial loop is an essential part of the marine ecosystem. Changes in the microbial community because of an oil spill could have significant impacts on the rest of the marine ecosystem.

However, several laboratory and field experiments and observations have shown that impacts to planktonic and marine microbial populations are generally short lived and do not affect all groups evenly, and in some cases stimulate growth of important species (Gonzalez et al., 2009; Graham et al., 2010; Hing et al., 2011). A study by Widger et al. (2011) does not support an argument of lasting effects because of the DWH spill on coastal microbial communities and pathogens. The study had only one pre-spill and one during-spill-time point each, with no post-spill component to monitor trends. Further, the pathogens noted are commonly found in coastal waters after significant rain events and occur as a result of untreated freshwater reaching the coast (Stumpf et al., 2010; Wetz et al., 2008; Hsieh et al., 2007). The study does not address the potential that the increase in microbial pathogens are a result of storm-water runoff, and it does not address if there was a significant rain event upstream, which could have carried these terrestrial derived pathogens to the coastal zone.

3.2.2.6. Continental Shelf Benthic Resources

A spill from a shallow-water blowout could impact benthic communities on the continental shelf because of the blowout's proximity to these habitats. A spill from a deepwater blowout could also impact shelf communities if oil that was chemically dispersed at the seafloor is transported to these areas.

Soft-Bottom Benthic Communities

Soft-bottom infaunal communities that come into direct contact with oil or dispersed oil may experience sublethal and/or lethal effects. Localized areas of lethal effects would be recolonized by populations from neighboring soft-bottom substrate once the oil in the sediment has been sufficiently reduced to a level able to support marine life (Sanders et al., 1980; Lu and Wu, 2006; Ganning et al., 1984; Gómez Gesteira and Dauvin, 2000; Dean and Jewett, 2001). This initial recolonization process may be fairly rapid, but full recovery may take up to 10 years depending on the species present, substrate in the area, toxicity of oil spilled, concentration and dispersion of oil spilled, and other localized environmental factors that may affect recruitment (Kingston et al., 1995; Gesteira and Dauvin, 2000; Sanders et al., 1980; Conan, 1982). Opportunistic species would take advantage of the barren sediment, repopulating impacted areas first. These species may occur within the first recruitment cycle of the surrounding populations or from species immigration from surrounding stocks and may maintain a stronghold in the area until community succession begins (Rhodes and Germano, 1982; Sanders et al., 1980).

Long-term or low-level exposure may occur to benthic infauna as a result of oil adhering to sediment. Mesocosm experiments using long-term, low-level concentrations of No. 2 fuel oil indicate acute toxicity to meiofauna because of direct oil contact and sublethal effects from sedimented oil and byproducts of the decomposition of the sedimented oil (Frithsen et al., 1985). Long-term exposure to low levels of fuel oil was shown to affect recruitment success; meiofaunal population recovery took between 2 and 7 months (Frithsen et al., 1985). Oil entrained within sediments at the seafloor could create a layer toxic to infaunal species. This layer will persist through burial unless it is sufficiently degraded over time. Continued deposition of pelagic material could bury the layer, but it will remain intact over some timeframe as a potentially toxic or lethal horizon.

Continued localized disturbance of soft-bottom communities may occur during oil-spill response efforts. Anchors used to set booms to contain oil or vessel anchors in decontamination zones may affect infaunal communities in the response activity zone. Infaunal communities may be altered in the anchor scar, and deposition of suspended sediment may result from the setting and resetting of anchors. The disturbed benthic community should begin to repopulate from the surrounding communities during their next recruitment event and through immigration of organisms from surrounding stocks. Any decontamination activities, such as cleaning vessel hulls of oil, may also contaminate the sediments of the decontamination zone, as some oil may settle to the seabed, impacting the underlying benthic community.

If a blowout occurs at the seafloor, drilling muds (primarily barite) may be pumped into a well in order to "kill" it. If a kill is not successful, the mud (possibly tens of thousands of barrels) may be forced out of the well and deposited on the seafloor near the well site. Any organisms beneath heavy layers of the extruded drilling mud would be buried. Base fluids of drilling muds are designed to be low in toxicity and biodegradable in offshore marine sediments (Neff et al., 2000). However, as bacteria and fungi break down the drilling fluids, the sediments may be come anoxic (Neff et al., 2000). Benthic macrofaunal recovery would occur when drilling mud concentrations are reduced to levels that enable the sediment to become re-oxygenated (Neff et al., 2000). Complete community recovery from drilling mud exposure may take 3-5 years, although microbial degradation of drilling fluids, followed by an influx of tolerant opportunistic species, is anticipated to begin almost immediately (Neff et al., 2000). In addition, the extruded mud may bury hydrocarbons from the well, making them a hazard to the infaunal species and difficult to remove.

If dispersants are used at the sea surface, oil may mix into the water column, and if they are applied subsea, they can travel with currents through the water and may settle on the seafloor. If near the source, the dispersed oil could be concentrated enough to harm the benthic community. If the oil remains suspended for a longer period of time, it would be more dispersed and present at lower concentrations. Reports on dispersant usage on surface plumes indicate that a majority of the dispersed oil remains in the top 10 m (33 ft) of the water column, with 60 percent of the oil in the top 2 m (6 ft) (McAuliffe et al., 1981). Dispersant usage also reduces the oil's ability to stick to particles in the water column, minimizing sedimented oil traveling to the seafloor (McAuliffe et al., 1981). There is very little information on the behavior of subsea dispersants.

Dispersed oil reaching the benthic communities in the Gulf of Mexico would be expected to be at very low concentrations (<1 ppm) (McAuliffe et al., 1981). Such concentrations would not be life threatening to larval or adult stages at depth based on experiments conducted with benthic and pelagic test species (Scarlett et al., 2005; Hemmer et al., 2010; George-Ares and Clark, 2000). Any dispersed oil in the water column that comes in contact with benthic communities may evoke short-term negative responses by the organisms (Scarlett et al., 2005). Sublethal responses may include reduced feeding rate, erratic movement, and tentacle retraction (Scarlett et al., 2005). In addition, although dispersants were detected in waters off Louisiana after the DWH event, they were below USEPA benchmarks of chronic toxicity (OSAT, 2010). The rapid dilution of dispersants in the water column and lack of transport to the sea floor was also reported by OSAT (2010) where no dispersants were detected in sediment on the Gulf floor following the DWH event.

Oil-degrading bacteria may ameliorate the effects of oil in the water column and benthic environments. Oil-degrading bacteria was detected in the subsea oil plume following the DWH event, and although this bacteria had reduced some oxygen in the water column when it degraded the oil, the decrease in oxygen was small compared with the surrounding water column (Hazen at al., 2010). Field measurements collected from the subsea plume indicated that these dissolved oxygen levels never approached hypoxic (<1.4 mL oxygen/L water) levels (Joint Analysis Group, 2010b). The dissolved oxygen in the water column did not appear to be decreasing over time, indicating that the oil was mixing with the surrounding oxygen-rich water (Joint Analysis Group, 2010b). The dissolved reduced oxygen levels produced by the bacteria never approached the low dissolved oxygen levels that occur during a yearly hypoxic event on the continental shelf of the northern Gulf of Mexico for prolonged periods during the spring through late summer (Rabalais et al., 2002). This hypoxic event results in lower dissolved oxygen levels than what were measured in the water column and bottom waters as a result of the DWH event (Joint Analysis Group, 2010a and 2010b; Haddad and Murawski, 2010).

Once the petroleum source has been reduced, the bacteria may die and sink to the seafloor. If enough dead bacteria accumulate in an area, the degradation of these bacteria by other bacteria may result in a locally decreased oxygen levels that may impact the nearby benthic organisms.

Hard-Bottom Benthic Communities

Sensitive reef communities flourish wherever hard bottoms occur in the Gulf of Mexico. Several categories of hard bottom communities are protected by BOEM. The eastern Gulf of Mexico contains scattered, low-relief live bottoms including areas of flat limestone shelf rock. Potentially sensitive biological features are 8 ft (2 m) or more above the seafloor. The Pinnacle Trend area includes low- and high-relief features and is 60-120 m (200-400 ft) below the sea surface, and topographic features are high relief and generally 15 m (49 ft) or more below the sea surface. Their depth below the sea surface protects all of these habitats from a surface oil spill.

Although hard-bottom benthic communities are initially buffered from surface oil slicks by their depth below the sea surface, surface oil may be brought to depth through physical processes. Rough seas may mix the oil into subsurface water layers, where it may impact sessile biota. The total time during which seas are rough would help affect the amount of oil from a surface slick that would be mixed into the water column. Measurable amounts of oil have been documented down to a 10-m (33-ft) depth, although modeling exercises have indicated such oil may reach a depth of 20 m (66 ft). At this depth, however, the oil is found at concentrations several orders of magnitude lower than the amount shown to have an effect on corals (Lange, 1985; McAuliffe et al., 1975 and 1981; Knap et al., 1985).

The presence of a subsurface oil plume may affect hard-bottom communities. A majority of the oil released is expected to rise rapidly to the sea surface. However, upward movement of the oil may be reduced if methane in the oil is dissolved under high pressures, and oil droplets may become entrained deep in the water column (Adcroft et al., 2010). Subsurface plumes generated by high-pressure dissolution of oil may come in contact with hard-bottom features. A sustained spill would continuously create surface slicks and possibly subsurface spill plumes. Some of the oil in the water column will become diluted or evaporated over time, reducing any localized transport to the seafloor (Vandermeulen, 1982). In addition, microbial degradation of the oil occurs in the water column so that the oil would be less toxic when it contacts the seafloor (Hazen et al., 2010). However, a sustained spill may result in elevated exposure concentrations to hard-bottom features if the plume reaches them. The longer the spill takes to stop, the longer the exposure time and concentration may be.

Low-level exposures of corals to oil from a subsea plume may result in chronic or temporary impacts. For example, feeding activity or reproductive ability may be reduced when coral is exposed to low levels of oil; however, impacts may be temporary or unable to be measured over time. Experiments indicated that normal feeding activity of *Porites porites* and *Madracis asperula* were reduced when exposed to 50 ppm oil (Lewis, 1971). Reefs of *Siderastrea sidereal* that were oiled in a spill produced smaller gonads than unoiled reefs, resulting in reproductive stress (Guzmán and Holst, 1993).

Elevated concentrations of oil may be necessary to measure reduced photosynthesis or growth in corals. Photosynthesis of the zooxanthellae in *Diplora strigosa* exposed to approximately 18-20 ppm crude oil for 8 hours was not measurably affected, although other experiments indicate that photosynthesis may be impaired at higher concentrations (Cook and Knap, 1983). Measurable growth of *Diploria strigosa* exposed to oil concentrations up to 50 ppm for 6-24 hours did not show any reduced growth after 1 year (Dodge et al., 1984).

Corals exposed to subsea oil plumes may incorporate petroleum hydrocarbons into their tissue. Records indicate that *Siderastrea siderea*, *Diploria strigosa*, and *Montastrea annularis* accumulate oil from the water column and incorporate petroleum hydrocarbons into their tissues (Burns and Knap, 1989; Knap et al., 1982; Kennedy et al., 1992). Most of the petroleum hydrocarbons are incorporated into the coral tissues, not their mucus (Knap et al., 1982). However, hydrocarbon uptake may also modify lipid ratios of coral (Burns and Knap, 1989). If lipid ratios are modified, mucus synthesis may be impacted, adversely affecting the coral's ability to protect itself from oil through mucus production (Burns and Knap, 1989).

If dispersants are used on the seafloor or at the surface, oil may mix into the water column, and if they are applied subsea, they can travel with currents through the water, and they may contact or settle on hard bottoms. If near the source, the dispersed oil could be concentrated enough to harm the community. If the oil remains suspended for a longer period of time, it would be more dispersed and present at lower concentrations. Reports on dispersant usage on surface plumes indicate that a majority of the dispersed oil remains in the top 10 m (33 ft) of the water column, with 60 percent of the oil in the top 2 m (6 ft) (McAuliffe et al., 1981). Dispersant usage also reduces the oil's ability to stick to particles in the water column, minimizing sedimented oil traveling to the seafloor (McAuliffe et al., 1981). There is very little information on the behavior of subsea dispersants.

Dispersed oil reaching the benthic hard-bottom communities in the Gulf of Mexico would be expected to be at very low concentrations (less than 1 ppm) (McAuliffe et al., 1981). Such concentrations would not be life threatening to larval or adult stages at depth based on experiments conducted with coral. Any dispersed oil in the water column that comes in contact with corals may evoke short-term negative responses by the organisms (Wyers et al., 1986; Cook and Knap, 1983; Dodge et al., 1984).

Reductions in feeding and photosynthesis are some impacts that may occur to coral exposed to dispersed oil. Short-term, sublethal responses of *Diploria strigosa* were reported after exposure to dispersed oil at a concentration of 20 ppm for 24 hours. Although concentrations in this experiment were higher than what is anticipated for dispersed oil at depth, effects exhibited included mesenterial filament extrusion, extreme tissue contraction, tentacle retraction, and localized tissue rupture (Wyers et al., 1986). Normal behavior resumed within 2 hours to 4 days after exposure (Wyers et al., 1986). *Diploria strigosa* exposed to dispersed oil (20:1, oil:dispersant) showed an 85 percent reduction in zooxanthellae photosynthesis after 8 hours of exposure to the mixture (Cook and Knap, 1983). However, the response was short term, as recovery occurred between 5 and 24 hours after exposure and return to clean seawater. Investigations 1 year after *Diploria strigosa* was exposed to concentrations of dispersed oil between 1 and 50 ppm for periods between 6 and 24 hours did not reveal any impacts to growth (Dodge et al., 1984).

Historical studies indicate dispersed oil to be more toxic to coral species than oil or dispersant alone. The greater toxicity may be a result of an increased number of oil droplets caused by the use of dispersant, resulting in greater contact area between oil, dispersant, and water (Elgershuizen and Kruijf, 1976). The dispersant causes a higher water-soluble amount of oil to contact the cell membranes of the coral (Elgershuizen and Kruijf, 1976). The mucus produced by coral, however, can protect the organism from oil. Both hard and soft corals have the ability to produce mucus, and mucus production has been shown to increase when corals are exposed to crude oil (Mitchell and Chet, 1975; Ducklow and Mitchell, 1979). Dispersed oil, however, which has very small oil droplets, does not appear to adhere to coral mucus, and larger untreated oil droplets may become trapped by the mucus barrier (Knap, 1987; Wyers et al., 1986). However, entrapment of the larger oil droplets may increase the coral's long-term exposure to oil if the mucus is not shed in a timely manner (Knap, 1987; Bak and Elgershuizen, 1976). Additionally, more recent field studies, using more realistic concentrations of dispersants did not result in the toxicity historically reported.

Although historical studies indicated dispersed oil may be more toxic than untreated oil to corals during exposure experiments, untreated oil may remain in the ecosystem for long periods of time, while dispersed oil does not (Baca et al., 2005; Ward et al., 2003). Twenty years after an experimental oil spill in Panama, oil and impacts from untreated oil were still observed at oil treatment sites, but no oil or impacts were observed at dispersed oil or reference sites (Baca et al., 2005). Long-term recovery of the coral at the dispersed oil site had already occurred as reported in a 10-year monitoring update, and the site was not significantly different from the reference site (Ward et al., 2003).

The BOEM's policy prevents wells from being placed immediately adjacent to sensitive communities. In the event of a seafloor blowout, however, some oil could be carried to hard bottoms as a result of oil droplets, adhering to suspended particles in the water column. Oiled sediment that settles to the seafloor may affect organisms attached to hard-bottom substrates. Impacts may include reduced recruitment success, reduced growth, and reduced coral cover as a result of impaired recruitment. Experiments have shown that the presence of oil on available substrate for larval coral settlement has inhibited larval metamorphosis and larval settlement in the area. An increase in the number of deformed polyps after metamorphosis also took place because of exposure to oil (Kushmaro et al., 1997).

The majority of organisms exposed to sedimented oil, however, are anticipated to experience low-level concentrations because as the oiled sediments settle to the seafloor they are widely dispersed. Coral may also be able to protect itself from low concentrations of sedimented oil that settles from the water column. Coral mucus may not only act as a barrier to protect coral from the oil in the water column but it has also been shown to aid in the removal of oiled sediment on coral surfaces (Bak and Elgershuizen, 1976). Coral may use a combination of increased mucus production and the action of cilia to rid themselves of oiled sediment (Bak and Elgershuizen, 1976).

Oil-spill-response activity may also impact sessile benthic features. Booms anchored to the seafloor are sometimes used to control the movement of oil at the water surface. Boom anchors can physically impact corals and other sessile benthic organisms, especially when booms are moved around by waves (Tokotch, 2010). Vessel anchorage and decontamination stations set up during response efforts may also break or kill hard-bottom features as a result of setting anchors. Injury to coral reefs as a result of anchor impact may result in long-lasting damage or failed recovery (Rogers and Garrison, 2001). Effort should be made to keep vessel anchorage areas as far from sensitive benthic features as possible to minimize impact.

Drilling muds comprised primarily of barite may be pumped into a well to stop a blowout. If a "kill" is not successful, the mud (possibly tens of thousands of barrels) may be forced out of the well and deposited on the seafloor near the well site. Any organisms beneath the extruded drilling mud would be buried. Based on stipulations as described in NTL 2009-G39, a well should be far enough away from a hard-bottom community to prevent extruded drilling muds from smothering benthic communities. However, if drilling muds were to travel far enough or high enough in the water column to contact a hard-bottom community, the fluid would smother the existing community. Experiments indicate that corals perish faster when buried beneath drilling mud than when buried beneath carbonate sediments (Thompson, 1980). As discussed earlier, as the drilling fluids biodegrade, an anoxic zone surrounding the activity may occur. Recolonization would occur from the surrounding community once the area has enough oxygen to support new growth, which may take 3-5 years (Neff et al., 2000).

3.2.2.7. Deepwater Benthic Communities

It is not likely that deepwater benthic communities would be impacted by a spill from a shallow-water blowout. However, a spill resulting from a catastrophic blowout in deep water has the potential to impact offshore benthic communities because of the blowout's proximity to these habitats and the use of subsea dispersants.

Much of the oil is expected to be treated with dispersants at the sea surface and possibly subsea at the source in the event of a deepwater blowout. The dispersed oil is mixed with the water, and its movement is then dictated by local currents and the physical, chemical, and biological degradation pathways. The oil would become more dispersed, less concentrated, and more biodegraded the longer it remains suspended in the water column. Depending on how long it remained suspended in the water column, it may be thoroughly degraded by biological action before contact with the seafloor and its sensitive resources occurs (Hazen et al., 2010; Valentine et al., 2010). Biodegradation rates in colder, deepwater environments are not well understood at this time. Oil may reach the seafloor in the following ways: as microbes begin to consume the oil particles; when the dispersed oil particles may flocculate (flocculation is suspended particles collecting into larger suspended flakes), thus increasing the density of the particles such that they are no longer in isostatic balance with the surrounding water and, thus, sink to the seafloor; when larger plankton consume the bacteria-rich oil particles and their fecal pellets are excreted and distributed over the seafloor; when water currents carry a plume to contact the seafloor directly; or most likely, where the dispersed oil to adhere to other particles and sink to the seafloor. This last scenario would result in a wide distribution of small amounts of oil. This oil could be in the process of biodegradation from bacterial action that would continue on the seafloor, resulting in scattered microhabitats with an enriched carbon environment. Biodegradation processes, both on the bottom and in the water column, would be expected to cause at least some reduction of normal ambient dissolved oxygen levels; however, this has yet to be observed at a level that would be detrimental to animal respiration (Hazen et al., 2010).

Deepwater Soft-Bottom Benthic Communities

Soft bottoms are the overwhelming majority of the deep-sea environment. Large amounts of oil would only affect these deep environments if dispersants are used. As described above, the toxic effects of dispersed oil would continue to decrease as the concentration of oil is reduced via dispersion, localized mixing, and biodegradation. As with shelf habitats, the only soft bottom that is expected to suffer significant effects would be soft bottoms in the immediate vicinity of a seafloor blowout in which some oil is mixed into the sediment. In situations where soft-bottom infaunal communities are negatively impacted, recolonization by populations from neighboring soft-bottom substrate would be expected over a relatively short period of time for all size ranges of organisms—a matter of days for bacteria and probably less than 1 year for most macrofauna and megafauna species. This could take longer for areas affected by direct oil contact in higher concentrations.

Deepwater Coral Benthic Communities

There have been no experiments showing the response of deepwater corals to oil exposure. Experiments with shallow tropical corals indicate that corals have a high tolerance to oil exposure. The mucus layers on coral resist penetration of oil and slough off the contaminant. Longer exposure times and areas of tissue where oil adheres to the coral are more likely to result in tissue damage and death of polyps. Corals with branching growth forms appear to be more susceptible to damage from oil exposure (Shigenaka, 2001). The most common deepwater coral, *Lophelia pertusa*, is a branching species. Tests with shallow tropical gorgonians indicate relatively low toxic effects to the coral (Cohen et al., 1977), suggesting deepwater gorgonians may have a similar response. Response of deepwater coral to oil exposure from a catastrophic spill would vary, depending on the level of exposure. Exposure to widely dispersed oil adhering to organic detritus and partially degraded by bacteria may be expected to result in little effect. Direct contact with plumes of relatively fresh dispersed oil droplets in the vicinity of the incident could cause death of affected coral polyps through exposure and potential feeding on oil droplets by polyps. Median levels of exposure to dispersed oil in a partly degraded condition may result in effects similar to those of shallow tropical corals, with often no discernable effects other than temporary contraction and some sloughing. The health of corals may be degraded by the necessary expenditure of energy as the corals respond to oiling (Shigenaka, 2001). Communities exposed to more concentrated oil may experience detrimental effects, including death of affected organisms, tissue damage, lack of growth, interruption of reproductive cycles, and loss of gametes. Many invertebrates associated with deepwater coral communities, particularly the crustaceans, would likely be more susceptible to damage from oil exposure. The recolonization of severely damaged or destroyed communities could take years or decades. However, because of the scarcity of deepwater hard bottoms and the comparatively low surface area, it is unlikely that a sensitive habitat would be located near a seafloor blowout, or if near, that concentrated oil would contact the site.

Deepwater Chemosynthetic Benthic Communities

Chemosynthetic communities in the GOM are adapted to cold seep habitats where oil, methane, and hydrogen sulfide seep up through the seafloor. If contacted by low quantities of well-dispersed oil undergoing biodegradation, chemosynthetic communities may experience little negative effect. Exposure may be similar to normal conditions for these communities and may be within the normal variation of habitat conditions. However, oil contact could cause some fluctuation in organism health, resulting in slower growth or delayed spawning. Since these organisms grow slowly, sublethal effects could eliminate a year or more of normal growth. Communities exposed to more concentrated oil may experience detrimental effects, including death of affected organisms, tissue damage, lack of growth, interruption of reproductive cycles, and loss of gametes. Other invertebrates associated with chemosynthetic communities, particularly the crustaceans, would likely be more susceptible to damage from oil exposure. Recolonization of severely damaged or destroyed communities could take years or decades.

3.2.3. Socioeconomic Resources

3.2.3.1. Offshore Archaeological Resources

Due the response methods (i.e., subsea dispersants) and magnitude of the response (i.e., thousands of vessels), a catastrophic blowout and spill have a greater potential to impact offshore archaeological resources than other accidental events.

Deep Water

In contrast to smaller spills or spills in shallow water, the use of large quantities of subsea dispersants could be used for a catastrophic subsea blowout in deep water. This could result in currently unknown effects from dispersed oil droplets settling to the seafloor. Though information on the actual impacts to submerged cultural resources is inconclusive at this time, oil settling to the seafloor could come in contact with archaeological resources. At present, there is no evidence of this having occurred. A recent experimental study has suggested that, while the degradation of wood in terrestrial environments is initially retarded by contamination with crude oil, at later stages, the biodeterioration of wood was accelerated (Ejechi, 2003). While there are different environmental constraints that affect the degradation of wood in terrestrial and waterlogged environments, soft-rot fungal activity, one of the primary wood degrading organisms in submerged environments, was shown to be increased in the presence of crude oil. There is a possibility that oil from a catastrophic blowout could come in contact with wooden shipwrecks and artifacts on the seafloor and accelerate their deterioration.

Ancillary damages from vessels associated with oil-spill response activities (e.g., anchoring) in deep water are unlikely because of the use of dynamically positioned vessels responding to a deepwater blowout. If response and support vessels were to anchor near a deepwater blowout site, the potential to damage undiscovered vessels in the area would be high because of the required number and the size of anchors and the length of mooring chains needed to safely secure vessels. Additionally, multiple offshore vessel decontamination stations would likely be established in shallow water outside of ports or entrances to inland waterways, as seen for the DWH event. The anchoring of vessels could result in damage to both known and undiscovered archaeological sites; the potential to impact archaeological resources increases as the density of anchoring activities in these areas increases.

Shallow Water

The potential for damaging archaeological resources increases as the oil spill and related response activities progress landward. In shallower waters, most of the damage would be associated with oil cleanup and response activities. Thousands of vessels would respond to a shallow-water blowout and would likely anchor, potentially damaging both known and undiscovered archaeological sites. Additional anchoring would be associated with offshore vessel decontamination stations, as described above. As the spill moves into the intertidal zone, the chance of direct contact between the oil and archaeological resources increases. As discussed above, this could result in increased degradation of wooden shipwrecks and artifacts.

Additionally, in shallower waters, shipwrecks often act as a substrate to corals and other organisms, becoming an essential component of the marine ecosystem. These organisms often form a protective layer over the shipwreck, virtually encasing the artifacts and hull remains. If these fragile ecosystems were destroyed as a result of the oil spill and the protective layer removed, the shipwreck would then be exposed to increased degradation until it reaches a new level of stasis with its surroundings.

Regardless of water depth, because oil is a hydrocarbon, heavy oiling could contaminate organic materials associated with archaeological sites, resulting in erroneous dates from standard radiometric dating techniques (e.g., ^{14}C-dating). Interference with the accuracy of ^{14}C-dating would result in the loss of valuable data necessary to understand and interpret the sites.

3.2.3.2. Commercial Fishing

In 2008, the Gulf of Mexico provided over 33 percent of the commercial fishery landings in the continental U.S. (excluding Alaska), with nearly 1.3 billion pounds valued at nearly $660 million (USDOC, NMFS, 2010).

Even though sensory and chemical testing may show no detectable oil or dispersant odors or flavors and the results could be well below the levels of concern, NOAA Fisheries would be expected to close large portions of the Gulf of Mexico during a high-volume spill as a precautionary measure to ensure public safety and to assure consumer confidence in Gulf seafood (USDOC, NOAA, NOAA Fisheries Service, 2010a). Up to 30-40 percent of the Gulf of Mexico Exclusive Economic Zone (EEZ) could be closed to commercial fishing as the spill continues and expands (USDOC, NOAA, NOAA Fisheries Service, 2010b). This area could represent 50-75 percent of the Gulf seafood production (Flynn, 2010). The size of the closure area may peak about 50 days into the spill and persist another 2-3 months until the well is killed or capped and the remaining oil is recovered or dissipates. During this period, portions or all of individual State waters would also be closed to commercial fishing.

The economic impacts of closures on commercial fishing are difficult to predict because they are dependent on the season and would vary by fishery. If fishers cannot make up losses throughout the remainder of the season, a substantial part of their annual income would be lost. In some cases, commercial fishers will move to areas still open to fishing, but at a greater cost because of longer transit times. Marketing issues are also possible; even if the catch is uncontaminated, the public may lack confidence in the product.

3.2.3.3. Recreational Fishing

Up to 30-40 percent of the Gulf of Mexico EEZ could be closed to recreational fishing as the spill continues and expands (USDOC, NOAA, NOAA Fisheries, 2010b). The size of the closure area could peak about 50 days into the spill and continue for another 2-3 months until the well is killed or capped and the remaining oil is recovered or dissipates. During this period, portions or all of individual State waters would also be closed to recreational fishing.

In 2008, over 24 million recreational fishing trips were taken; these trips generated about $12 billion in sales, over $6 billion in value-added impacts, and over 100,000 jobs (USDOC, NOAA, NMFS, 2010b). About 33 percent of the total Gulf catch came on trips that fished primarily in Federal and State waters (Pritchard, 2009). Recreational fishing is focused in the summer months. During this time, scheduled tournaments would be hard to reschedule. If the spill affected that time of year, normal direct income and indirect income to the communities that host these tournaments would be lost for that year. If a catastrophic spill occurs in the summer, a substantial number of recreational fishing trips would not occur and the economic benefits they generate would be lost for that year.

3.2.3.4. Tourism and Recreational Resources

While the spill is still offshore, there could be some ocean-dependent recreation that is affected (e.g., fishing, diving), as discussed above. In addition, there may be some effects due either to perceived damage to onshore recreational resources that has not yet materialized or to general hesitation on the part of travelers to visit the overall region because of the spill. For example, studies during the DWH oil spill show that perceptions can influence recreational activity, even if an oil spill has not yet damaged physical resources in an area (The Knowland Group, 2010; Market Dynamics Research Group, 2010). However, the majority of the impacts of a catastrophic spill would occur once the spill has contacted shore, as discussed in Section 4.2.3.4.

3.2.3.5. Employment and Demographics

In contrast to a less severe accidental event, suspension of some oil and gas activities would be likely following a catastrophic event. Depending on the duration and magnitude, this could impact hundreds of oil-service companies that supply the steel tubing, engineering services, drilling crews, and marine supply boats critical to offshore exploration. An interagency economic report estimated that the 6-month suspension, as a result of the DWH event, may have directly and indirectly resulted in up to 8,000-12,000 fewer jobs along the Gulf Coast (USDOC, Economics and Statistics Administration, 2010). Most of these jobs were not permanently lost as a result of the suspension and returned following the resumption of deepwater drilling in the Gulf of Mexico. These estimates are lower than earlier estimates of 15,000-60,000 rig and associated service jobs being at risk (Hargreaves, 2010; Louisiana Mid-Continent Oil and Gas Association, 2010; Zeller, 2010; Jindal, 2010).

Whatever the number, much of the employment loss would be concentrated in coastal oil-service parishes in Louisiana (St. Mary, Terrebonne, Lafourche, Iberia, and Plaquemines) and counties/parishes where drilling-related employment is most concentrated (Harris County, Texas, in which Houston is located, and Lafayette Parish, Louisiana) (Nolan and Good, 2010; U.S. Dept. of Labor, BLS, 2010). There would be additional economic impacts to commercial and recreational fishing, as discussed in Sections 3.2.3.2 and 3.2.3.3. This impact is also expected to be more heavily concentrated in smaller businesses than in the larger companies (USDOC, Economics and Statistics Administration, 2010).

Demographic impacts are unlikely from temporary job losses.

3.2.3.6. Land Use and Coastal Infrastructure

Impacts to tourism and recreational resources are addressed in Section 3.2.3.4. Possible fisheries closures are addressed in Sections 3.2.3.2 and 3.2.3.3. While still offshore, a catastrophic oil spill would not impact other land use or coastal infrastructure.

3.2.3.7. Environmental Justice

The environmental justice policy, based on Executive Order 12898 of February 11, 1994, directs agencies to incorporate into NEPA documents an analysis of potentially disproportionate and detrimental environmental and health effects of their proposed actions on minorities and low-income populations and communities. While the spill is still offshore, the primary environmental justice concern would be large commercial fishing closures disproportionately impacting minority fishers. In the event of a catastrophic spill, Federal and State agencies would be expected to close substantial portions of the Gulf to commercial and recreational fishing (USDOC, NOAA, 2010g). While oystering occurs “onshore,” oyster beds are also likely to be closed to harvests during Phase 2 of a catastrophic spill because of concerns about oil contamination and increased freshwater diversions to mitigate oil intrusion into the marshes (see Sections 3.2.3.2 and 3.2.3.3). These closures would directly impact commercial fishermen and oystermen, and indirectly impact such downstream activities as shrimp processing facilities and oyster shucking houses. The mostly African-American communities of Phoenix, Davant, and Point a la Hache in Plaquemines Parish are home to families with some of the few black-owned oyster leases, which because of freshwater diversion projects for coastal restoration have already been threatened (Mock, 2010).

The Gulf Coast hosts multiple minority and low-income groups whose use of natural resources of the offshore and coastal environments make them vulnerable to fishing closures. While not intended as an inventory of the area’s diversity, we have identified several Gulf Coast populations of particular concern. An estimated 20,000 Vietnamese fishermen and shrimpers live along the Gulf Coast; by 1990, over 1 in 20 Louisiana fishers and shrimpers had roots in Southeast Asia even though they comprised less than half a percent of the State’s workforce (Bankston and Zhou, 1996). Vietnamese account for about one-third of all the fishermen in the central Gulf of Mexico (Ravitz, 2010). Islaños, African Americans, and Native American groups are also engaged in commercial fishing and oystering. Historically, Vietnamese and African Americans have worked in the fish processing and oyster shucking industries. Shucking houses particularly, have provided an avenue into the mainstream economy for minority groups.

Therefore, fishing closures during Phase 2 of a catastrophic spill impacting the central Gulf of Mexico would disproportionately affect such minority groups as the Vietnamese, Native Americans, African Americans, and Islaños (Hemmerling and Colten, 2003).

4. ONSHORE CONTACT (PHASE 3)

4.1. IMPACT-PRODUCING FACTORS AND SCENARIO

4.1.1. Duration

The duration of the shoreline oiling is measured from initial shoreline contact until the well is capped or killed and the remaining oil dissipates offshore. The time needed to cap or kill a well may vary, depending on the well's water depth. Depending on the spill's location in relation to winds and currents and the well's distance to shore, oil could reach the coast within 1 week to 1 month, based on evidence from previous spills in the Gulf of Mexico OCS. While it is assumed that the majority of spilled oil would dissipate offshore within 30 days of stopping the flow, some oil may remain in coastal areas until cleaned, as seen in Louisiana following the DWH event (The State of Louisiana, 2010b-d).

4.1.1.1. Shallow Water

Due to the distance from shore, oil spilled as a result of a blowout in shallow water could reach shore within 1-3 weeks and could continue until the well is killed or capped (1-3 months) and the oil dissipates offshore (1 month). Therefore, it is estimated that shoreline oiling would likely occur for 1-4 months following a catastrophic blowout.

4.1.1.2. Deep Water

As discussed in Section 3.1.1, intervention is more difficult and would take longer in deeper water. In general, most of the deep water in the Gulf of Mexico is located far from shore and, therefore, it is assumed that oil would reach shore within 2-4 weeks. While most deep water is located far from shore, some areas of deep water are located relatively nearshore so that oil could reach shore earlier.

The length of shoreline oiled would continue to increase until the well is killed or capped (3-4 months) and the oil dissipates offshore (1 month). Therefore, shoreline oiling could occur for 3 to more than 4 months following a catastrophic blowout.

4.1.2. Volume of Oil

In the event of a catastrophic spill, not all of the oil spilled would contact shore. The amount of oil recovered and chemically or naturally dispersed would vary. For example, the following are recovery and cleanup rates from previous high-volume, extended spills:

- 10-40 percent of oil recovered or cleaned up (including burned, chemically dispersed, and skimmed);
- 25-40 percent of oil naturally dispersed, evaporated, or dissolved; and
- 20-65 percent of the oil remains available for biodegradation offshore or inshore contact.

In the case of the DWH event, the "Expected" scenario, developed by the Oil Budget Calculator Science and Engineering Team of The Federal Interagency Solutions Group, suggests that more than one quarter (29%) was naturally or chemically dispersed into Gulf waters, while burning, skimming, and direct recovery from the wellhead removed one quarter (25%) of the oil released. Less than one quarter (23%) of the total oil naturally evaporated or dissolved. The residual amount, just under one quarter (23%), remained in the Gulf of Mexico as a light sheen, as tarballs that have washed ashore or are buried in sand and other sediments (The Federal Interagency Solutions Group, 2010).

For planning purposes, USCG estimates that 5-30 percent of oil will reach shore in the event of an offshore spill (33 CFR 154, Appendix C, Table 2). Using the USCG assumptions, a catastrophic spill could still result in a large amount of oil reaching shore.

4.1.3. Length of Shoreline Contacted

While larger spill volumes increase the chance of oil reaching the coast, other factors that influence the length and location of shoreline contacted include the duration of the spill and the well's location in relation to winds, currents, and the shoreline. As seen with the DWH spill, as the spill continued, the length of oiled shoreline at any one time increased by orders of magnitude as follows:

Duration of Spill	Length of Shoreline Oiled[1]
30 days	0-50 miles
60 days	50-100 miles
90 days	100-1,000 miles
120 days	>1,000 miles[2]

[1] Not cumulative.
[2] Length was extrapolated.
Source: Operational Science Advisory Team, 2011.

Dependent upon winds and currents throughout the spill event, already impacted areas could be re-oiled.

4.1.3.1. Shallow Water

While a catastrophic spill from a shallow-water blowout is expected to be lower in volume than a deepwater blowout, as explained in Section 3.1, the site would be closer to shore, allowing less time for oil to be weathered, dispersed, and recovered. This could result in a more concentrated and toxic oiling of the shoreline.

4.1.3.2. Deep Water

While a catastrophic spill from a deepwater blowout is expected to have a much greater volume than a shallow-water blowout (see Section 3.1), the site would be farther from shore, allowing more time for oil to be weathered, dispersed, and recovered. This could result in a broader, patchier oiling of the shoreline.

Translocation of the spilled oil via winds and currents is also a factor in the length of shoreline contacted. For example, oil could enter the Loop Current and then the Gulf Stream. However, the longer it takes oil to travel, the more it would degrade, disperse, lose toxicity, and break into streamers and tarballs (USDOC, NOAA, Office of Response and Restoration, 2010d).

4.1.4. Severe Weather

The Atlantic hurricane season runs from June 1st through November 30th, peaking in September. In an average Atlantic season, there are 11 named storms, 6 hurricanes, and 2 Category 3 or higher storms (USDOC, NOAA, National Weather Service, 2010a). In the event of a hurricane, vessels would evacuate the area, delaying response efforts, including the drilling of relief wells. The storm surge may push oil to the coastline and inland as far as the surge reaches, or the storm surge may remove the majority of oil from shore, as seen in some of the previous spills reviewed.

Movement of oil during a hurricane would depend greatly on the track of the hurricane in relation to the slick. A hurricane's winds rotate counter-clockwise. In general, a hurricane passing to the west of the slick could drive oil to the coast, while a hurricane passing to the east of the slick could drive the oil away from the coast.

4.1.5. Onshore Cleanup Activities

As described in Section 3.1, a large-scale response effort would be expected for a catastrophic blowout. The number of vessels and responders would increase exponentially as the spill continued. In addition to the response described in Section 3.1.6, the following response is also estimated to occur once the spill contacts the shore.

An exponential increase in the length of shoreline impacted would likely overwhelm response efforts.

4.1.5.1. Shallow Water

- There would be 5-10 staging areas established.
- Weathering permitting, about 200-300 skimmers could be deployed near shore to protect coastlines.

4.1.5.2. Deep Water

- There would be 10-20 staging areas established.
- Weather permitting, about 500-600 skimmers could be deployed near shore to protect coastlines. As seen in Louisiana following the DWH event, a few hundred coastal skimmers could still be in operation a few months after the well is capped or killed (The State of Louisiana, 2010e).

4.2. MOST LIKELY AND MOST SIGNIFICANT IMPACTS

The most recent EIS's prepared by this Agency for oil and gas lease sales in the Gulf of Mexico identify in detail the potential impacts from reasonably foreseeable oil spills (USDOI MMS, 2007 and 2008). The most likely and significant onshore impacts caused by a catastrophic spill are described below.

4.2.1. Physical Resources

4.2.1.1. Air Quality

As the spill nears shore, there would be low-level concentrations of odor-causing pollutants associated with evaporative emissions from the oil spill. These may cause temporary eye, nose, or throat irritation, nausea, or headaches, but the doses are not thought to be high enough to cause long-term harm (USEPA, 2010b). However, responders could be exposed to levels higher than OSHA permissible exposure levels (U.S. Department of Labor, OSHA, 2010b). During the DWH oil spill, USEPA took air samples at various onshore locations along the length of the Gulf coastline. All except three measurements of benzene were below 3 parts per billion (ppb). The highest level was 91 ppb. Emissions of benzene to the atmosphere result from gasoline vapors, auto exhaust, and chemical production and user facilities. Ambient concentrations of benzene up to and greater than 5 ppb have been measured in industrial areas such as Houston Texas, in various urban areas during rush hour, and inside the homes of smokers (USDHHS, 2007). The following daily median benzene air concentrations were reported in the Volatile Organic Compound National Ambient Database (1975-1985): remote (0.16 ppb); rural (0.47 ppb); suburban (1.8 ppb); urban (1.8 ppb); indoor air (1.8 ppb); and workplace air (2.1 ppb). The outdoor air data represent 300 cities in 42 states, while the indoor air data represent 30 cities in 16 states (Shah and Singh, 1988).

During the DWH event, air samples collected by BP, OSHA, and USCG near shore showed levels of benzene, toluene, ethylbenzene, and xylene that were mostly under detection levels. Among the 15,000 samples taken by BP, there was only one sample where benzene exceeded the OSHA Occupational permissible exposure limits. All other sample concentrations were below the more stringent ACGIH threshold limit values (U.S. Department of Labor, OSHA, 2010a). All measured concentrations of toluene, ethylbenzene, and xylene were well within the OSHA permissible exposure levels and ACGIH threshold limit values.

4.2.1.2. Coastal Water Quality

Water quality governs the suitability of waters for plant, animal, and human use. Water quality is important in the bays, estuaries, and nearshore coastal waters of the Gulf because these waters provide feeding, breeding, and/or nursery habitat for many commercially significant invertebrates and fishes, as well as sea turtles, birds, and marine mammals. A catastrophic spill would significantly impact coastal water quality in the Gulf of Mexico. In the Gulf of Mexico, water quality prior to the DWH event was rated as fair while sediment quality was rated as poor (USEPA, 2008). In addition, the coastal habit index, a rating of wetlands habitat loss, was also rated as poor. Both the sediment quality and the coastal habitat index affect water quality.

Though response efforts would decrease the amount of oil remaining in Gulf waters and reduce the amount of oil contacting the coastline, significant amounts of oil would remain. Coastal water quality would be impacted not only by the oil, gas, and their respective components but also to some degree from cleanup and mitigation efforts. Increased vessel traffic, hydromodification, and the addition of dispersants and methanol in an effort to contain, mitigate, or clean up the oil may also tax the environment.

The use of dispersants as a response tool involves a tradeoff. The purpose of chemical dispersants is to facilitate the movement of oil into the water column in order to encourage weathering and biological breakdown of the oil (i.e., biodegradation) (NRC, 2005; Australian Maritime Safety Authority, 2010). Thus, the tradeoff is generally considered to be between the shoreline and surface of the water versus the water column and benthic resources (NRC, 2005). If the oil moves into the water column and is not on the surface of the water, it is less likely to reach sensitive shore areas (USEPA, 2010c). Since sea birds are often on the surface of the water or in shore areas, dispersants are also considered to be very effective in reducing the exposure of sea birds to oil (Australian Maritime Safety Authority, 2010). In addition to dispersion being enhanced by artificial processes, oil may also be dispersed from natural processes. For instance, microbial metabolism of crude oil results in the dispersion of oil (Bartha and Atlas, 1983). Dispersion has both positive and negative effects. The positive effect is that the oil, once dispersed, is more available to be degraded. The negative effect is that the oil, once dispersed, is more available to microorganisms, which temporarily increases the toxicity (Bartha and Atlas, 1983). Toxicity of dispersed oil in the environment will depend on many factors, including the effectiveness of the dispersion, temperature, salinity, the degree of weathering, type of dispersant, and degree of light penetration in the water column (NRC, 2005). The toxicity of dispersed oil is primarily because of the toxic components of the oil itself (Australian Maritime Safety Authority, 2010).

Oxygen and nutrient concentrations in coastal waters vary seasonally. The zone of hypoxia (depleted oxygen) on the Louisiana-Texas shelf occurs seasonally and is affected by the timing of freshwater discharges from the Mississippi and Atchafalaya Rivers, which carry nutrients to the surface waters. The hypoxic conditions continue until local wind-driven circulation mixes the water again. The 2010 hypoxic zone could not be linked to the DWH event in either a positive or a negative manner (LUMCON, 2010). Nutrients from the Mississippi River nourished phytoplankton and attributed to the formation of the hypoxic zone.

4.2.2. Biological Resources

Recent EIS's prepared by this Agency for oil and gas lease sales in the Gulf of Mexico detail the potential localized impacts to individuals from reasonably foreseeable oil spills. However, a catastrophic event, such as a high-volume, extended-duration spill resulting from a blowout, has the potential to cause population level impacts, as described below.

Dozens of Federal and State-listed threatened and endangered species, including marine mammals, sea turtles, fish, and birds, could continue to be impacted during Phase 3 of a catastrophic oil spill as oil and response activities persist. Additional species could be impacted in extreme conditions (i.e., oil is pushed onto beaches or into rivers or marshes because of a hurricane) (USDOI, FWS, 2010a and 2010b).

4.2.2.1. Coastal and Marine Birds

Gulf coastal habitats are essential to the annual cycles of many species of breeding, wintering, and migrating waterfowl, wading birds, shorebirds, and songbirds. For example, the northern Gulf Coast supports a disproportionately high number of beach-nesting bird species (USDOI, FWS, 2010c). Once oil contacts shore, a few dozen to over a hundred birds could be impacted daily by oiling and/or collection. By extrapolating the number of birds impacted as a result of the DWH event, a spill lasting 120 days could result in direct mortality of over 7,000 birds (USDOI, FWS, 2010d). This number does not reflect total realized mortality but rather only the actual number of birds recovered as of October 2010. This number represents a small fraction of total bird mortality because of carcasses sinking, being scavenged, drifting outside the search zone, or simply going undetected because of wind, current, weather, and habitat factors (Ford et al., 1987; Piatt et al., 1990; Fowler and Flint, 1997; Flint et al., 1999; Wiese and Robertson, 2004; Byrd et al., 2009). In an early review of oil-related mortality for seabirds, Dunnett et al. (1982) provided an estimate of 10 percent, and 60 percent of the dead birds may be recovered under typical field conditions. Piatt and Ford (1996, Table 1) summarized recovery rates from 17 carcass-drift experiments, indicating a range of 0-59 percent of carcasses being recovered. Using data from the *Exxon Valdez* oil spill, Piatt and Ford (1996) estimated recovery rates from joint probability and Monte Carlos simulations of only 8.0 percent and 6.9 percent, respectively.

The timing and location of the spill are the two primary factors for determining the severity of impacts on birds. The worst impacts to oiled birds or to those birds that have ingested oil with their prey would be if the oil spill occurs during the nesting season. An oil spill during nesting season could result in the loss of entire colonies of breeding birds on barrier islands surrounded by oil, along with the potential loss of all eggs and nestlings. Losses of shorebirds could occur through direct oiling of beaches on which nests are located, by oil covering the feeding sites near the nesting locations, or by the deaths of oiled parents, leaving eggs or hatchlings unprotected and unfed.

Endangered and Threatened Birds

Four species listed as endangered or threatened by the U.S. Fish and Wildlife Service that could be affected by a catastrophic oil spill are the piping plover (*Charadrius melodus*), Mississippi sandhill crane (*Grus Canadensis pulla*), whooping crane (*Grus americana)*, and wood stork (*Mycteria americana)*. The Midwest Population of piping plovers, which nests along the Great Lakes, is listed as endangered while the Atlantic Coast and Northern Great Plains Populations are listed as threatened. The critical habitat for the plover is found within the wintering area, which includes areas along the Gulf Coast from Texas to Florida (LeDee et al., 2008, Figure 1; Haig et al., 2005, Figure 1), where they feed on aquatic insects, invertebrates, and small crustaceans along the advancing and retreating water line of the beaches. Unknown numbers of piping plovers could therefore become oiled or have their feeding areas oiled if a spill occurred during the time of year, roughly October through March, when plovers are present (Haig et al., 2005, Figure 1 and Table 2).

The cranes and wood stork are tall wading birds. The whooping crane is found in Texas, Louisiana, and Florida, and the wood stork is found in Alabama, Florida, Georgia, and South Carolina. The only self-sustaining wild population nests in the Northwest Territories and adjacent areas of Alberta, Canada, primarily within the boundaries of Wood Buffalo National Park. These birds winter in coastal marshes and estuarine habitats along the Gulf Coast in the Aransas National Wildlife Refuge in Texas, and they represent the majority of the world's population of free-ranging whooping cranes. A total of 10 whooping cranes were reintroduced to Louisiana in the White Lake Conservation Area (about 17 mi [27 km] from the Gulf Coast) during the winter of 2011 as a nonessential experimental population. The Mississippi sandhill crane population was listed as endangered on June 4, 1973, under the Endangered Species Act. This nonmigratory species is found only in Mississippi, but historically it may have ranged in Louisiana, Mississippi, Alabama, Georgia, and Florida (USDOI, FWS, 1973, 1991; Tacha et al., 1992).

Both the whooping and sandhill crane species use marsh habitats and eat small fish, frogs, mollusks, snails, insects, crustaceans, and aquatic invertebrates. Thus, they could both become oiled directly if oil reaches the marshes. They could also ingest oil along with their primary prey items, and their prey could be substantially reduced because of oil, resulting in a decline in health and reproduction in both species of wading birds. However, both species of cranes are located somewhat away from the shoreline of the open Gulf of Mexico and would not be likely to be affected by a catastrophic spill unless it worked its way into estuarine marshes.

The U.S. breeding population of wood storks was listed as endangered for Alabama, Florida, Georgia, and South Carolina under the Endangered Species Act on February 24, 1984, because of the overall impact of human activities on breeding colonies. Alhough it likely has a low probability of oiling from a catastrophic spill due to its selection of more inland freshwater marshes, it may forage in coastal, brackish, or saltwater marshes, thus increasing its probability of oiling in the case where spilled oil is pushed into the rivers and marshes because of hurricanes, tropical storms, and the associated storm surge.

4.2.2.2. Fish, Fisheries, and Essential Fish Habitat

The life history of estuarine-dependent species involves spawning on the continental shelf, transportation of eggs, larvae or juveniles back to the estuary nursery grounds and migration of the adults back to the sea for spawning (Deegan, 1989; Beck et al., 2001). Estuaries in the Gulf of Mexico are extremely important nursery areas and are considered essential fish habitat for fish and aquatic life (Beck et al., 2001). Oiling of these areas, depending on the severity, can destroy nutrient-rich marshes and erode coastlines that have been significantly damaged by recent hurricanes.

The Gulf of Mexico supports a wide variety of finfish, and most of the commercial finfish resources are linked either directly or indirectly to the estuaries that ring the Gulf of Mexico. Darnell et al. (1983) observed that the density distribution of fish resources in the Gulf was highest nearshore off of the central Gulf Coast. For all seasons, the greatest abundance occurred between Galveston Bay and the mouth of the Mississippi River. Monthly ichthyoplankton collections over the years 2004-2006 offshore of Alabama have confirmed that peak seasons for ichthyoplankton concentrations on the shelf are spring and summer (Hernandez et al., 2010). Therefore, if a catastrophic blowout occurs in the spring and summer seasons, it could cause greater harm to fish populations and not just individual fish.

Oyster beds could be damaged by freshwater diversions that release tens of thousands of cubic feet of freshwater per second for months in an effort to keep oil out of the marshes. Adult oysters survive well physiologically in salinities from those of estuarine waters (about 7.5 parts per thousand sustained) to full strength seawater (Davis, 1958). While oysters may tolerate small changes in salinity for a few weeks, a rapid decrease in salinity over months would kill oysters. In the event of a catastrophic oil spill, the year’s oyster production would be lost because of exposure to freshwater and/or oil. Depending on the severity, oyster beds could take 2-5 years to recover (Burdeau, 2010).

4.2.2.3. Marine Mammals

Section 3.2.2 discusses the most likely and most significant impacts to the offshore marine mammal community. A high-volume oil spill lasting 120 days could directly impact over 20 species of marine mammals. As a spill enters coastal waters, manatees and coastal and estuarine dolphins would be the most likely to be affected.

Manatees primarily inhabit open coastal (shallow nearshore) areas and estuaries, and they are also found far up in freshwater tributaries. During warmer months, manatees are common along the Gulf Coast of Florida from the Everglades National Park northward to the Suwannee River in northwestern Florida, and they are less common farther westward. In winter, the Gulf of Mexico subpopulations move southward to warmer waters. The winter range is restricted to waters at the southern tip of Florida and to waters near localized warm-water sources, such as power plant outfalls and natural springs in west-central Florida. Manatees are infrequently found as far west as Texas (Powell and Rathbun, 1984; Rathbun et al., 1990; Schiro et al., 1998). If a catastrophic oil spill reached the Florida coast when manatees were in or near coastal waters, the spill could have population-level effects.

It is possible that manatees could occur in coastal areas where vessels traveling to and from the spill site could affect them. A manatee present where there is vessel traffic could be injured or killed by a vessel strike (Wright et al., 1995). Due to the large number of vessels responding to a catastrophic spill both in coastal waters and traveling through coastal waters to the offshore site, manatees would have an increased risk of collisions with boats. Vessel strikes are the primary cause of death of manatees.

There have been no experimental studies and only a few observations suggesting that oil impacts have harmed any manatees (St. Aubin and Lounsbury, 1990). Types of impacts to manatees and dugongs from contact with oil include (1) asphyxiation because of inhalation of hydrocarbons, (2) acute poisoning because of contact with fresh oil, (3) lowering of tolerance to other stress because of the incorporation of sublethal amounts of petroleum components into body tissues, (4) nutritional stress through damage to food sources, and (5) inflammation or infection and difficulty eating because of oil sticking to the sensory hairs around their mouths (Preen, 1989, in Sadiq and McCain, 1993; Australian Maritime Safety

Authority, 2003). For a population whose environment is already under great pressure, even a localized incident could be significant (St. Aubin and Lounsbury, 1990). Spilled oil might affect the quality or availability of aquatic vegetation, including seagrasses, upon which manatees feed. The 2009 Stock Assessment Report (USDOI, FWS, 2009) for the Florida stock of West Indian manatees estimates that there is a minimum population estimate of 3,802 individuals based on a single synoptic survey of warm-water refuges in January 2009. The manatee's potential biological removal is the maximum number of animals, not including natural mortalities, that may be removed from the population or stock while allowing that stock to reach or maintain its optimum sustainable population and is approximately 12 individuals. Therefore, if a catastrophic spill and response vessel traffic occurred near manatee habitats in the eastern Gulf of Mexico, population level impacts could occur because the possibility exists for the number of mortalities to exceed the potential biological removal.

Bottlenose dolphins were the most affected species of marine mammals from the DWH event. There were 171 marine mammals collected as of April 20, 2010 (the majority of which were deceased). This includes 155 bottlenose dolphins, 2 *Kogia* spp., 2 melon-headed whales, 6 spinner dolphins, 2 sperm whales, and 4 unknown species (USDOC, NOAA, NOAA Fisheries, 2011). It is also important to note that evaluations have not yet confirmed the cause of death, and it is possible that not all carcasses were related to the DWH event. Bottlenose dolphins can be found throughout coastal waters in the Gulf of Mexico. Like manatees, dolphins could be affected, possibly to population level, by a catastrophic oil spill if it reaches the coast (as well as affecting them in the open ocean), through direct contact, inhalation, ingestion, and stress, as well as through collisions with cleanup vessels.

4.2.2.4. Sea Turtles

Out of the five species of sea turtle that occur in the Gulf of Mexico, only three nest in this area. The largest nesting location for the Kemp's ridley sea turtle is in Rancho Nuevo, Mexico, but they also nest in Texas. Loggerhead sea turtles nest in all states around the Gulf of Mexico. There are also records of nesting colonies of hawksbill sea turtles in the Yucatan Peninsula of Mexico (Plotkin et al., 1995; OBIS-SEAMAP, 2009). Kemp's ridley, loggerhead, and hawksbill sea turtles are therefore most likely to be affected by a catastrophic oil spill when there is onshore contact.

Female sea turtles seasonally emerge during the warmer summer months to nest on beaches. Thousands of sea turtles nest along the Gulf Coast, and turtles could build nests on oiled beaches. Nests could also be disturbed or destroyed by cleanup efforts. Untended booms could wash ashore and become a barrier to sea turtle adults and hatchlings (USDOC, NOAA, 2010e). Hatchlings, with a naturally high mortality rate, could traverse the beach through oiled sand and swim through oiled water to reach preferred habitats of *Sargassum* floats. Response efforts could include mass movement of eggs from hundreds of nests or thousands of hatchlings from Gulf Coast beaches to the east coast of Florida or to the open ocean to prevent hatchlings entering oiled waters (Jernelöv and Lindén, 1981; USDOI, FWS, 2010e). Due to poorly understood mechanisms that guide female sea turtles back to the beaches where they hatched, it is uncertain if relocated hatchlings would eventually return to the Gulf Coast to nest (Florida Fish and Wildlife Conservation Commission, 2010). Therefore, shoreline oiling and response efforts may affect future population levels and reproduction (USDOI, NPS, 2010). Sea turtle hatchling exposure to, fouling by, or consumption of tarballs persisting in the sea following the dispersal of an oil slick would likely be fatal.

4.2.2.5. Terrestrial Mammals and Reptiles

Beach Mice

Seven subspecies of the field mouse, collectively known as beach mice, live along the Gulf Coast. Five subspecies of beach mice (Alabama, Perdido Key, Choctawhatchee, St. Andrew, and Anastasia Island) are listed as State and federally endangered; the southeastern beach mouse is listed as federally threatened; and the Santa Rosa beach mouse is a Federal species of concern. Beach mice are restricted to the coastal barrier sand dunes along the Gulf Coast of Alabama and Florida. Erosion caused by the loss of vegetation because of oiling would likely cause more damage than the direct oiling of beach mice, because of degradation or loss of habitat. In addition, vehicular traffic and activity associated with cleanup can trample or bury beach mice nests and burrows or cause displacement from preferred habitat.

Improperly trained personnel and vehicle and foot traffic during shoreline cleanup of a catastrophic spill would disturb beach mouse populations and would degrade or destroy habitat.

The Alabama, Choctawhatchee, St. Andrew, and Perdido Key beach mice are already designated as protected species under the Endangered Species Act because of the loss of coastal habitat (USDOI, MMS, 2007). The species' coastal habitat is designated as their critical habitat. For example, the endangered Alabama beach mouse's (*Peromyscus polionotus ammobates*) habitat is 1,211 acres (490 hectares) of frontal dunes covering just 10 mi (16 km) of shoreline designated as critical habitat (USDOI, FWS, 2007). Critical habitat is the specific geographic areas that are essential for the conservation of a threatened or endangered species. With the potential oiling of over 1,000 mi (1,609 km) of shoreline, the entire critical habitat for a subspecies of beach mice could be completely oiled. Thus, destruction of the remaining habitat because of a catastrophic spill and cleanup activities would increase the threat of extinction of several subspecies of beach mice.

Diamondback Terrapin

The Texas diamondback terrapin (*Malaclemys terrapin littoralis*) and the Mississippi diamondback terrapin (*Malaclemys terrapin pileata*) are two subspecies of terrapin that occur in the Gulf of Mexico, and they are Federal species of concern. The former's range runs from Louisiana through Texas, while the latter's includes Louisiana, Mississippi, Alabama, and Florida (USDOI, FWS, 2010f). Terrapins inhabit brackish waters including coastal marshes, tidal flats, creeks, and lagoons behind barrier beaches (Hogan, 2003). Their diet consists of fish, snails, worms, clams, crabs, and marsh plants (Cagle, 1952). Spending most of their lives at the aquatic-terrestrial boundary in estuaries, terrapins are susceptible to habitat destruction from oil-spill cleanup efforts as well as direct contact with oil. However, most impacts cannot be quantified at this time. Even after the oil is no longer visible, terrapins may still be exposed while they forage in the salt marshes lining the edges of estuaries, where oil may have accumulated under the sediments and within the food chain. Terrapin nests can also be disturbed or destroyed by cleanup efforts. The range of the possible chronic effects from oil and dispersants contact including lethal or sublethal oil-related injuries may include skin irritation from the oil or dispersants, respiratory problems from the inhalation of volatile petroleum compounds or dispersants, gastrointestinal problems caused by the ingestion of oil or dispersants, and damage to other organs because of the ingestion or inhalation of these chemicals.

4.2.2.6. Coastal Habitats

A spill from a catastrophic blowout lasting up to 120 days could impact over 1,000 mi (1,609 km) of shoreline. Shoreline oiling would vary between heavy, moderate, light, and occasional tarballs. Due to the length of shoreline that could potentially be oiled and the sensitivity of the Gulf Coast, a high-volume, extended-duration spill could cause extensive habitat degradation. Loss of vegetation could lead to erosion and permanent landloss.

In some previous spills reviewed, a strong storm removed the majority of oil from shore. However, storm surges may carry oil into the coastline and inland as far as the surge reaches. In addition, four significant hurricanes (Katrina, Rita, Gustav, and Ike) have made landfall along the Texas/Louisiana coast in the last 6 years, greatly degrading the coastal beaches, marshes, and barrier islands, making them more susceptible to a catastrophic spill.

Coastal Barrier Beaches and Associated Dunes

Barrier islands make up more than two-thirds of the northern Gulf of Mexico shore. Each of the barrier islands is either high profile or low profile, depending on the elevations and morphology of the island (Morton et al., 2004). The distinguishing characteristics of the high- and low-profile barriers relate to the width of the islands along with the continuity of the frontal dunes. Low-profile barriers are narrow with discontinuous frontal dunes easily overtopped by storm surge, which makes the island susceptible to over wash and secondarily to erosion. This over wash can create channels to bring sand onto the island or into lagoons formed on these islands. High-profile barrier islands are generally wider than the low-profile islands and have continuous, vegetated, frontal dunes with elevations high enough to prevent over wash from major storm surge and, therefore, are less susceptible to erosion. The sand stored in these high-profile dunes allows the island to withstand prolonged erosion and therefore prevents breaching, which could result in damaging the island core.

As a result of a catastrophic spill, many of the barrier islands and beaches would receive varying degrees of oiling. Oil disposal on sand and vegetated sand dunes would have little deleterious effects on the existing vegetation or on the recolonization of the oiled sands by plants (Webb, 1988). The depth of oiling would be variable, based on the wave environment and sediment source at a particular beach head. Layering of oil and sand could occur if it was not cleaned before another tidal cycle. However, most areas of oiling are expected to be light, and sand removal during cleanup activities should be minimized. In areas designated as natural wilderness areas (e.g., Breton National Wildlife National Refuge and Gulf Islands National Seashore), land managers may require little to no disruption of the natural system. In these environments it is preferred to let the oil degrade naturally without aggressive and intrusive cleanup procedures. Manual rather than mechanized removal techniques will be used in these areas and only if heavy oiling has occurred. Thus, these areas may not be treated as thoroughly as other shorelines.

Once oil has reached the beaches and barrier islands and becomes buried or sequestered, it becomes difficult to treat. During wave events when the islands and beaches erode, the oil can become remobilized and transported. Thus, the fate of oil is not as simple as either reaching land, becoming sequestered, or being treated; but must be considered in terms of a continuing process of sequestration, remobilization, and transport.

For spilled oil to move onto beaches or across dunes, strong southerly winds must persist for an extended time prior to or immediately after the spill to elevate water levels. Strong winds, however, would reduce the impact severity at a landfall site because they would accelerate the processes of oil-slick dispersal, spill spreading, and oil weathering.

Due to the distance of beaches from deepwater blowout and the combination of weathering and dispersant treatment of the oil offshore, the toxicity of the oil reaching shore should be greatly reduced, thereby minimizing the chances of irreversible damage to the impacted areas. A blowout in shallower waters near shore may have equal or greater impacts because of a shorter period of weathering and dispersion prior to shoreline contact, even though a smaller volume of spilled oil is expected.

Vessel traffic in close proximity to barrier islands has been shown to move considerably more bottom sediment than tidal currents, thus increasing coastal and barrier island erosion rates. If staging areas are in close proximity to these islands, recovery time of the barrier islands could be greatly extended because of the magnitude of vessels responding to a catastrophic spill.

Wetlands

Coastal wetland habitats in the Gulf of Mexico occur as bands around waterways; broad expanses of saline, brackish, and freshwater marshes; mud and sand flats; and forested wetlands of cypress-tupelo swamps and bottomland hardwoods. A spill from a catastrophic blowout could oil a few to several hundreds of acres of wetlands depending on the depth of inland penetration (Burdeau and Collins, 2010). This would vary from moderate to heavy oiling.

The NOAA Environmental Sensitivity Index (ESI) ranks shorelines according to their sensitivity to oil, the natural persistence of oil, and the expected ease of cleanup after an oil spill. These factors cause oil to persist in coastal and estuarine areas (USDOI, MMS, 2010). According to the ESI, the most sensitive shoreline types (i.e., sheltered tidal flats, vegetated low banks, salt/brackish-water marshes, freshwater marshes/swamps, and scrub-shrub wetlands) tend to accumulate oil and are difficult to clean, thus causing oil to persist in these coastal and estuarine areas (USDOI, MMS, 2010).

In case of catastrophic spills in the GOM, preemptive oil-response strategies would be initiated and include the deployment of oil booms, skimmer ships, and barge barriers to protect the beaches and the wetlands behind them. Boom deployment must also include plans for monitoring and maintaining the protective booms systems to assure that these systems are installed and functioning properly and that they are not damaging the wetlands they are trying to protect. In most cases, the beach face would take the most oil; however, in areas where the marsh is immediately adjacent to the beach face or embayments, or in the case of small to severe storms, marshes would be oiled. For example, in Alabama, Mississippi, and Florida, severe weather could push oil into the tidal pools and back beach areas that support tidal marsh vegetation.

Previous studies of other large spills have shown that, when oil has a short residence time in the marsh and it is not incorporated into the sediments, the marsh vegetation has a good chance of survival, even though aboveground die-off of marsh vegetation may occur (Mendelssohn et al., 2002). However, if reoiling occurs after the new shoots from an initial oiling are produced, such that the new shoots are killed, then the marsh plants may not have enough stored energy to produce a second round of new shoots. Longer term damage may result from continued reoiling than from a temporally continuous oiling (Lin et al, 2002; Lin and Mendelssohn, 2009). Other studies noted the utilization of dispersants in the proper dosages results in a reduction in marsh damage from oiling (Lin and Mendelssohn, 2009). The works of several investigators (Webb et al., 1981 and 1985; Alexander and Webb, 1983 and 1987; Lytle, 1975; Delaune et al., 1979; Fischel et al., 1989) evaluated the effects of potential spills to area wetlands. For wetlands along the central Louisiana coast, the critical oil concentration is assumed to be 0.025 gallons per ft^2 (1.0 liter per m^2) of marsh. Concentrations less than this may cause diebacks for one growing season or less, depending upon the concentration and the season during which contact occurs. The duration and magnitude of a spill resulting from a catastrophic blowout could result in concentrations above this critical level and would result in longer term effects to wetland vegetation, including some plant mortality and loss of land.

Due to the distance of deep water from shore, the possibility of a spill from a deepwater blowout reaching coastal wetlands with the toxicity to significantly impact the coastal wetlands is low because of the response procedures implemented during a catastrophic spill. The utilization of nearshore booming protection for beaches and wetlands, in combination with offshore skimming, burning, and dispersal treatments for the oil near the spill site, would result in capture and detoxification of the majority of oil reaching shore. Therefore, a spill from a shallow-water blowout is more likely to contribute to wetland damage.

The activity of oil cleanup can result in additional impacts on wetlands if not done properly. During the DWH event, aggressive onshore and marsh cleanup methods were not utilized.

Submerged Vegetation

Approximately 500,000 hectares (1.25 million acres) of submerged seagrass beds are estimated to exist in exposed, shallow coastal waters and embayments of the northern Gulf of Mexico, and over 80 percent of this area is in Florida Bay and Florida coastal waters (Beck et al., 2006; Carlson and Madley, 2006). Submerged vegetation distribution depends on an interrelationship between a number of environmental factors that include temperature, water depth, turbidity, salinity, turbulence, and substrate suitability (Sheridan and Minello, 2003). Marine seagrass beds generally occur in shallow, relatively clear, protected waters with predominantly sand bottoms (Short et al., 2001). Freshwater submerged aquatic vegetation (SAV) species occur in the low-salinity waters of coastal estuaries (Castellanos and Rozas, 2001). Seagrasses and freshwater SAV's provide important habitat for immature shrimp, black drum, spotted sea trout, juvenile southern flounder, and several other fish species and provide a food source for species of wintering waterfowl (Castellanos and Rozas, 2001; Short et al., 2001; Caldwell, 2003). These areas would have considerable impact from various cleanup efforts, such as increased vessel traffic. Although many of the beds are protected by extensive barrier islands, severe storms can cause inundation and overwashing of these islands, resulting in oiling of the seagrass beds if the storm occurred during an oil spill. In addition, boom anchors could damage seagrass beds (USDOC, NOAA, 2010e). It is assumed that there would be a decrease in submerged vegetation and a negative impact on the bed communities in a highly affected area. If bays and estuaries accrue oil, there is an assumption that there would be a decrease in seagrass cover and negative community impacts. Depending on the species and environmental factors, seagrasses may exhibit minimal impacts from a spill; however, communities within the beds could accrue greater negative outcomes (Jackson et al., 1989; Taylor et al., 2006). Community effects could range from direct mortality because of smothering or indirect mortality from loss of food sources and loss of habitat because of a decrease in ecological performance of the entire system (Zieman et al., 1984).

4.2.3. Socioeconomic Resources

4.2.3.1. Onshore Archaeological Resources

Regardless of the water depth in which the catastrophic blowout occurs, it is assumed that more than 1,000 mi (1,609 km) of shoreline could be oiled to some degree. Onshore prehistoric and historic sites would be impacted to some extent by a high-volume spill from a catastrophic blowout that reaches shore. Sites on barrier islands could suffer the heaviest impact (McGimsey, personal communication, 2010). A few prehistoric sites in Louisiana, located inland from the coastline in the marsh and along bayous, could experience some light oiling. As discussed above, impacts would include the loss of ability to accurately date organic material from archaeological sites because of contamination. Efforts to prevent coastal cultural resources from becoming contaminated by oil would likely be overwhelmed in the event of a hurricane and by the magnitude of shoreline impacted. The most significant damage to archaeological sites could be related to cleanup and response efforts. Fortunately, important lessons were learned from the *Exxon Valdez* spill in Alaska in 1989, in which the greatest damage to archaeological sites was related to cleanup activities and looting by cleanup crews rather than from the oil itself (Bittner, 1996). As a result, cultural resources were recognized as significant early in the response, and archaeologists are, at present, embedded in Shoreline Cleanup Assessment Teams (SCAT) and are consulting with cleanup crews. Historic preservation representatives are present at both the Joint Incident Command as well as each Area Command under the general oversight of the National Park Service to coordinate response efforts (Odess, personal communication, 2010). Despite these efforts, some archaeological sites suffered damage from looting or from spill cleanup activities (most notably the parade ground at Fort Morgan, Alabama) (Odess, personal communication, 2011).

4.2.3.2. Commercial Fishing

In addition to closures in Federal waters, portions of individual State waters would also be closed to commercial fishing. The economic impacts of closures on commercial fishing are complicated to predict because it is dependent on season and would vary by fishery. If fishers cannot make up losses in the remainder of the season, a substantial part of their annual income will be lost. In some cases, commercial fishers may move to areas still open to fishing, but at a greater cost because of longer transits.

4.2.3.3. Recreational Fishing

In addition to closures in Federal waters, portions to of individual State waters would also be closed to recreational fishing. More than 67 percent of the total Gulf catch came on trips that fished primarily in inland waters (Pritchard, 2009). In 2008, over 24 million recreational fishing trips were taken, which generated about $12 billion in sales, over $6 billion in value added impacts, and over 100,000 jobs (USDOC, NOAA, NMFS, 2010b). The majority of recreational fishing occurs in the summer months. During this time, scheduled fishing tournaments are held and would be hard to reschedule. If the spill affected the summer months, normal direct income and indirect income to the communities that host these tournaments would be lost for that year. If a catastrophic spill occurs in the summer, the majority of recreational fishing trips would not occur and economic benefits they generate would be lost for that year.

4.2.3.4. Tourism and Recreational Resources

Tourism and recreation are integral components of the economy of the Gulf of Mexico. Visitors to Texas, Louisiana, Mississippi, Alabama, and Florida spent approximately $145 billion in 2008 (U.S. Travel Association (2008). This spending helped to support approximately 2.4 million jobs in recreation-based industries statewide (U.S. Dept. of Labor, 2010a). Roughly 600,000 of these jobs are in counties and parishes that are directly along the coast, making them particularly vulnerable to a catastrophic event and the likely associated decrease in tourism. Recreation jobs account for 14.8 percent of Gulf Coast employment, greater than the national average of 12.4 percent (QCEW Fact Sheet). The coastal counties and parishes that have the highest concentration of recreation workers (over 10,000 workers) in each state are as follows: Cameron, Nueces, and Galveston Counties (Texas); Jefferson and Orleans Parishes (Louisiana); Harrison County (Mississippi); Mobile and Baldwin Counties (Alabama); and Escambia, Okaloosa, Bay, Pasco, Pinellas, Hillsborough, Manatee, Sarasota, Lee, Collier, Broward, and Miami-Dade Counties (Florida). Gulf Coast recreational employment is reasonably cyclical, with the peak months during the past few years occurring between March and June (U.S. Dept. of Labor, 2010b).

A catastrophic spill has the potential to significantly impact the Gulf Coast recreation and tourism industries. The water-dependent and beach-dependent components of these industries would be particularly vulnerable. This is particularly true for some of the nature parks and island resources directly along the coast, such as Padre Island National Seashore (Texas), Dauphin Island (Alabama), and the Gulf Islands National Seashore (Mississippi/Florida). Kaplan and Whitman (unpublished) attempt to isolate the economic significance of the recreational resources in the Gulf of Mexico that are particularly relevant to OCS oil and gas activities. They found roughly 60,000 jobs that were dependent on these activities in 2005, although there is uncertainty with this estimate, because of measurement issues and events that have occurred since their data collection period (most notably Hurricane Katrina).

In analyzing the potential impacts of a catastrophic spill, one must also consider the range of activities that depend on the base resources that may be affected. For example, the restaurant and lodging industries are particularly important to the Gulf economy. They are also sensitive to general tourism trends in any particular area. However, the economic impacts on these sectors from a spill may be partially offset because of an influx of cleanup and relief workers. Finally, one should consider the economic context in which a catastrophic event occurs. The DWH event occurred in the context of an economy that was only beginning to recover from a very deep recession. In difficult economic times, recreation workers may be more prone to being laid off in response to a catastrophic event. Workers may also find it more difficult to transition between jobs, which can increase the severity of the economic effects. In a recession, tourism also may be more sensitive both to actual damage and to perceptions of economic problems within a region.

4.2.3.5. Employment and Demographics

By the end of a catastrophic spill, up to 50,000 personnel would be expected to have responded to protect the shoreline and wildlife and to cleanup vital coastlines. The degree to which new cleanup jobs offset job losses would vary greatly from county to county (or parish to parish). However, these new jobs would not make up for lost jobs, in terms of dollar revenue. In most cases, cleanup personnel are paid less (e.g., $15-$18 per hour compared with roughly $45 per hour on a drilling rig), resulting in consumers in the region having reduced incomes overall and thus, investing less money in the economy (Aversa, 2010). Permanent demographic impacts are unlikely from these temporary jobs.

There would be additional economic impacts to tourism and both recreational and commercial fishing, as discussed in Sections 4.2.3.2 through 4.2.3.4 above.

4.2.3.6. Land Use and Coastal Infrastructure

In the event of a catastrophic spill, impacts on land use and infrastructure would be temporary and variable in nature. These impacts include land use in staging areas, waste disposal locations and capacities, and potential delays because of vessel decontamination stations near ports, as described below.

Up to 20 staging areas and as many as 50,000 responders would likely result in increased traffic congestion and some possible competing land-use issues near the staging areas, depending on the real estate market at the time of the event. Some infrastructure categories, such as vessels, ports, docks and wharves, would likely become very engaged in response activities and this could result in a shortage of space and functionality at infrastructure facilities if ongoing drilling activities were simultaneously occurring. However, if a drilling suspension was enacted, like the one related to the DWH event, conflicting demands on infrastructure facilities would likely fail to materialize (Dismukes, personal communication, 2010a).

In the category of waste disposal, the impacts would be more visible as thousands of tons of oily liquid and solid wastes from the oil-spill cleanup are disposed of in onshore landfills. The USEPA, in consultation with the U.S. Coast Guard, would likely issue solid-waste management directives to address the issue of contaminated materials and solid or liquid wastes that are recovered as a result of cleanup operations (USEPA, 2010d and 2010e).

For navigation and port use, there is also the potential for delays in cargo handling and slow vessel traffic because of decontamination operations at various sites along the marine transportation system

(USDOT, 2010). However, most cleanup activities would be complete within a year of the event, so impacts would be expected to be limited in duration (Dismukes, personal communication, 2010b).

4.2.3.7. Environmental Justice

While most coastal populations along the Gulf of Mexico coast are not generally minority or low income, several communities on the coasts of St. Mary, Lafourche, Terrebonne, St. Bernard, and Plaquemines Parishes have minority or low-income population percentages that are higher than their state average. These minority populations are predominately Native American, Islaños, or African American. For example, a few counties or parishes along the Gulf Coast have more than a 2-percent Native American population (USDOI, MMS, 2007); about 2,250 Houma Indians (a State of Louisiana recognized tribe) are concentrated in Lafourche Parish, Louisiana, comprising 2.4 percent of the parish's population, and about 800 Chitimacha (a federally recognized tribe) make up 1.6 percent of St. Mary Parish's population. While these are not significant numbers on their own, viewed in the context of Louisiana's overall 0.6 percent Native American average, these communities take on greater environmental justice importance.

Gulf Coast minority and low-income groups are particularly vulnerable to the coastal impacts of a catastrophic oil spill due to their greater than average dependence on the natural resources in the offshore and coastal environments. Besides their economic reliance on commercial fishing and oystering, coastal low-income and minority groups rely heavily on these fisheries and other traditional subsistence fishing, hunting, trapping, and gathering activities to augment their diets and household incomes (see Hemmerling and Colton, 2003, for an evaluation of environmental justice considerations for south Lafourche Parish). Regular commuting has continued this reliance on the natural resources of the coastal environments even when populations have been forced to relocate because of landloss and the destruction from recent hurricane events.

State fishery closures because of a catastrophic oil spill would disproportionately affect minority and low-income groups. Shoreline impacts would generate additional subsistence-related effects. Therefore, these minority groups would be disproportionately affected if these coastal areas were impacted by a catastrophic spill and the resulting response.

5. POST-SPILL, LONG-TERM RECOVERY (PHASE 4)

5.1. IMPACT-PRODUCING FACTORS AND SCENARIO

During the final phase a catastrophic blowout and spill, it is presumed that the well has been capped or killed and cleanup activities are concluding. While it is assumed that the majority of spilled oil would be dissipated within 30 days of stopping the flow (Lubchenco et al., 2010), oil has the potential to persist in the environment long after a spill event and has been detected in sediment 30 years after a spill (USDOI, FWS, 2004). On sandy beaches, oil can sink deep into the sediments. In tidal flats and salt marshes, oil may seep into the muddy bottoms (USDOI, FWS, 2010g).

5.2. MOST LIKELY AND MOST SIGNIFICANT IMPACTS

At this point in the scenario, the spill has been stopped and long-term recovery begins. There is a great deal of uncertainty regarding the long-term impacts of a catastrophic spill in the Gulf of Mexico. The most likely and most significant impacts, as described below, will likely relate to the continued exposure of organisms to the spilled oil, oil components, and dispersants remaining in the air, water, and sediments, as well as the effects of continued cleanup efforts.

A catastrophic spill can have long-term impacts on Gulf of Mexico ecosystems. An ecosystem is a geographically specified system of organisms, including humans, their environment, and the processes that control their dynamics. Ecosystems involve complex connections between organisms, their environment, and the processes that drive the system (USDOC, NOAA, 2010f). In some cases, marine ecosystems may take decades to fully recover or may recover to alternative states (Ragen, 2010).

5.2.1. Physical Resources

5.2.1.1. Air Quality

There would be some residual air quality impacts after the well is capped or "killed." As most of the oil would have been burned, evaporated, or weathered over time, air quality would return to pre-oil spill conditions. While impacts to air quality are expected to be localized and temporary, as discussed in Sections 2.2.1.1, 3.2.1.1, and 4.2.1.1, adverse effects that may occur from the exposure of humans and wildlife to air pollutants could have long-term consequences.

5.2.1.2. Coastal and Offshore Water Quality

The leading source of contaminants that impairs coastal water quality in the Gulf of Mexico is urban runoff. Urban runoff can include suspended solids, heavy metals, pesticides, oil, grease, and nutrients (such as from lawn fertilizer). Urban runoff increases with population growth, and the Gulf Coast region has experienced a 103 percent population growth since 1970 (USDOC, NOAA, NOS, 2008). Other pollutant source categories include (1) agricultural runoff, (2) municipal point sources, (3) industrial sources, (4) hydromodification (e.g., dredging), and (5) vessel sources (e.g., shipping, fishing, and recreational boating). The NRC (2003, Table I-4, p. 237) estimated that, on average, approximately 26,324 barrels of oil per year entered Gulf waters from petrochemical and oil refinery industries in Louisiana and Texas. The Mississippi River introduced approximately 3,680,938 barrels/year (NRC, 2003, Table I-9, p. 242) into the waters of the Gulf. Hydrocarbons also enter the Gulf of Mexico through the result of natural seeps in the Gulf of Mexico at a rate of approximately 980,392 barrels per year (a range of approximately 560,224-1,400,560 barrels/year) (NRC, 2003, p. 191). Produced water (formation water) is, by volume, the largest waste stream from the oil and gas industry that enters Gulf waters. The NRC has estimated the quantity of oil in produced water entering the Gulf per year to be 473,000 bbl (NRC, 2003, p. 200, Table D-8).[2] These sources total about 5.5 million barrels of oil per year that routinely enters Gulf of Mexico waters. In comparison, a catastrophic spill of 30,000-60,000 barrels per day for 90-120 days would spill a total of 2.7-7.2 million barrels of oil. When added to the other sources of oil listed above, this would result in a 48- to 129-percent increase in the volume of oil entering the water during the year of the spill. In addition, the oil from a spill will be much more concentrated in some locations than the large number of other activities that release oil into the Gulf of Mexico. Section 3.1.4 discusses the properties and persistence of oil in the environment.

5.2.2. Biological Resources

As described below, long-term consequences on biological resources can include impaired reproduction, which can potentially impact population levels. Oil has the potential to persist in the environment long after a spill event and has been detected in sediment 30 years after a spill (USDOI, FWS, 2004). On sandy beaches, oil can sink deep into the sediments. In tidal flats and salt marshes, oil may seep into the muddy bottoms. Oil in these systems has the potential to have long-term impacts on fish and wildlife populations.

Some animals may survive initial exposure to spilled oil but may accumulate high levels of contaminants in their bodies that can be passed on to predators, in a process known as bioaccumulation (USDOI, FWS, 2010g).

5.2.2.1. Coastal and Marine Birds

There is a high probability of underestimating the impacts of oil spills on avian species potentially encountering oil, particularly seabirds. Despite being oiled, some birds are able to fly and may later be killed by the oil, far from the spill location. Often overlooked and understudied are the long-term, sublethal, chronic effects because of sublethal exposure to oil. These effects may persist for years after exposure, reducing the capacity of affected individuals within the population to recover, because of

2 These numbers were generated from converting the units reported in the noted reference and do not imply any level of significance.

effects that may range from minor physiological disorders through damage to vital organs (i.e., liver and kidney) (Alonso-Alvarez et al., 2007). The long-term impacts of potential food stress for bird species from an altered ecosystem because of a catastrophic spill are unknown, but disturbances to the ecosystem can cause long-term sublethal impacts, including malnourishment and decreased reproductive success, which could have severe impacts to bird populations as seen after the *Exxon Valdez* catastrophic spill (Piatt and Anderson, 1996). Birds are top predators in the Gulf of Mexico and require a substantial supply of prey species to sustain their populations. Sublethal effects of oil could ultimately result in reductions in long-term survival or lower reproductive success for some species of birds (Fry et al., 1986; Leighton, 1993; Esler et al., 2000; Golet et al., 2003; Velando et al., 2010). In addition, even light oiling of avian eggs transferred via contact with contaminated breast feathers from an incubating female can be toxic to developing embryos (Albers, 1980; Albers and Heinz, 1983). Effects such as delayed sexual maturity of most seabird species, loss of breeding-age individuals, particularly females, may have long-term, population-level effects. Long-term, sublethal, chronic effects may exceed immediate losses because of direct mortality (i.e., oiled birds) if such residual effects influence a significant proportion of the population or disproportionately impact an important population segment (Newton, 1998; Peterson et al., 2003; Alonso-Alvarez et al., 2007). Depending on the effects, some populations could take years or decades before reaching a full recovery, and some may never recover.

5.2.2.2. Fish, Fisheries, and Essential Fish Habitat

In addition to possible small fish kills because of direct impacts (as described under Phases 2 and 3), a catastrophic spill could affect fish populations in the long term. Due to a catastrophic spill, a significant portion of a year class of fish could be absent from the following year's fishery, reducing overall population numbers. However, sublethal impacts, especially for long-lived species (e.g., snapper and grouper), could be masked by reduced fishing pressure because of closures. In addition, healthy fish resources and fishery stocks depend on ideal habitat (essential fish habitat) for spawning, breeding, feeding, and growth to maturity. Thus, a catastrophic spill that affects these areas could result in long-term impacts, including destruction to a portion of their habitats.

5.2.2.3. Marine Mammals

Even after the spill is stopped, oilings or deaths of marine mammals would still likely occur because of oil and dispersants persisting in the water, past marine mammal/oil or dispersant interactions, and ingestion of contaminated prey. The animals' exposure to hydrocarbons persisting in the sea may result in sublethal impacts (e.g., decreased health, reproductive fitness, and longevity; and increased vulnerability to disease) and some soft tissue irritation, respiratory stress from inhalation of toxic fumes, food reduction or contamination, direct ingestion of oil and/or tar, and temporary displacement from preferred habitats or migration routes. A catastrophic oil spill could lead to increased mortalities, resulting in potential population-level effects for some species/populations (USDOC, NOAA, NMFS, 2010c).

5.2.2.4. Sea Turtles

Sea turtles take many years to reach sexual maturity. Green sea turtles reach maturity between 20 and 50 years of age; loggerheads may be 35 years old before they are able to reproduce; and hawksbill sea turtles typically reach lengths of 27 inches for males and 31 inches for females before they can reproduce (USDOC, NOAA, NMFS, 2010d). Declines in the food supply for sea turtles, which include invertebrates and sponge populations, could also affect sea turtle populations. While all of the pathways that an oil spill or the use of dispersants can affect sea turtles is poorly understood, some pathways may include the following: (1) oil or dispersants on the sea turtle's skin and body can cause skin irritation, chemical burns, and infections; (2) inhalation of volatile petroleum compounds or dispersants can damage the respiratory tract and lead to diseases; (3) ingesting oil or dispersants may cause injury to the gastrointestinal tract; and (4) chemicals that are inhaled or ingested may damage internal organs. In most foreseeable cases, exposure to hydrocarbons persisting in the sea following the dispersal of an oil slick would result in sublethal impacts (e.g., decreased health, reproductive fitness, and longevity and increased vulnerability to disease) to sea turtles. Other possible internal impacts might include harm to the liver, kidney, and brain function, as well as cause anemia and immune suppression, or could lead to reproductive failure or death. As discussed in Section 4.2.2, shoreline oiling and response efforts may affect future population levels and reproduction (USDOI, NPS, 2010). The deaths of subadult and adult sea turtles may also drastically reduce the population.

5.2.2.5. Terrestrial Mammals and Reptiles

Beach Mice

Within the last 20-30 years, the combination of habitat loss because of beachfront development, isolation of remaining beach mouse habitat areas and populations, and destruction of remaining habitat by tropical storms and hurricanes has increased the threat of extinction of several subspecies of beach mice. Destruction of the remaining habitat because of a catastrophic spill and cleanup activities would increase the threat of extinction.

Diamondback Terrapin

Habitat destruction, road construction, and drowning in crab traps are the most recent threats to diamondback terrapins. Tropical storms, hurricanes, and beach erosion threaten their preferred nesting habitats. Destruction of the remaining habitat because of a catastrophic spill and response efforts could drastically affect future population levels and reproduction.

5.2.2.6. Coastal Habitats

Coastal habitats serve important ecological functions, and the loss of vegetation in coastal areas could lead to erosion and permanent landloss.

Coastal Barrier Beaches and Associated Dunes

Oil or its components that remain in the sand after cleanup may be (1) released periodically when storms and high tides resuspend or flush beach sediments, (2) decomposed by biological activity, or (3) volatilized and dispersed.

The protection once afforded to inland marshes by coastal barrier beaches has been greatly reduced because of decreased elevations and the continued effect of subsidence, sea-level rise, and saltwater intrusion. A catastrophic spill has the potential to contribute to this reduction.

The cleanup impacts of a catastrophic spill could result in short-term (up to 2 years) adjustments in beach profiles and configurations as a result of sand removal and disturbance during cleanup operations. Some oil contact to lower areas of sand dunes is expected. These contacts would not result in significant destabilization of the dunes. The long-term stressors to barrier beach communities caused by the physical effects and chemical toxicity of an oil spill may lead to decreased primary production, plant dieback, and hence further erosion.

Wetlands

Wetlands serve a number of important ecological functions. For example, Louisiana's coastal wetlands support more than two-thirds of the wintering waterfowl population of the Mississippi Flyway, including 20-25 percent of North America's puddle duck population. Therefore, loss of wetlands would also impact a significant portion of the waterfowl population.

The duration and magnitude of a spill resulting from a catastrophic blowout could result in high concentrations of oil that would result in long-term effects to wetland vegetation, including some plant mortality and loss of land. This would add to continuing impacts of other factors, such as hurricanes, subsidence, saltwater intrusion, and sea-level rise. The wetlands along the Gulf Coast have already been severely damaged by the 2005 and 2008 hurricane seasons, leaving the mainland less protected. It was estimated in 2000 that coastal Louisiana would continue to lose land at a rate of approximately 2,672 ha/yr (10 mi^2/yr) over the next 50 years. Further, it was estimated that an additional net loss of 132,794 ha (512 mi^2) may occur by 2050, which is almost 10 percent of Louisiana's remaining coastal wetlands (Barras et al., 2003). Barras (2006) indicated an additional 217 mi^2 (562 km^2) of land lost during the 2005 hurricane season. A catastrophic spill occurring nearshore would contribute further to this landloss. Following Hurricanes Katrina and Rita, another series of hurricanes (Gustav and Ike) made landfall along the Louisiana and Texas coasts in September 2008. Hurricane Gustav made landfall as a Category 2 storm near Cocodrie, Louisiana, pushing large surges of saline water into the fresh marshes and coastal swamps of Louisiana from Grand Isle westward. While Hurricane Gustav did not impact the quantity of wetlands that Hurricanes Katrina and Rita impacted, it did have a severe and continuing effect on the coastal barrier islands and the wetlands associated with backshore (back of the island) and foreshore (front of the island). While Hurricane Gustav affected the eastern portion of the Louisiana coast closer to Grand Isle and Houma, Hurricane Ike concentrated on Louisiana's western coast. The Texas coast received the brunt of Hurricane Ike where it made landfall slightly east of Galveston. The storm surge basically removed the dune systems and significantly lowered the beach elevations along the eastern portion of the Texas coast near Galveston and the Bolivar Peninsula. The erosion and wash-over associated with Hurricane Ike's tidal surge breeched beach ridges and opened the inland freshwater ponds and their associated wetlands to the sea. As a result of the four successive storms, the Louisiana and Texas coasts have lost protective elevations, barrier islands, and wetlands, and they now have the potential for transitioning to a less productive salt-marsh system in areas where fresh-marsh systems once existed.

In addition, a poorly executed oil cleanup can result in additional impacts. Aggressive onshore and marsh cleanup methods have not yet been utilized and probably would not be initiated until the oil spill has been stopped. Depending on the marsh remediation methods used, further impacts to the wetlands may occur from cleanup activities. Boat traffic in marsh areas from the thousands of response vessels associated with a catastrophic spill would produce an incremental increase in erosion rates, sediment resuspension, and turbidity (i.e., an adverse but not significant impact to coastal wetland and seagrass habitats.)

5.2.2.7. Open-Water Habitats

Submerged Vegetation

If bays and estuaries accrue oil, there is an assumption that there would be a decrease in seagrass cover and negative community impacts. Submerged vegetation serves important ecological functions. For example, seagrasses and freshwater SAV's provide important habitat for immature shrimp, black drum, spotted sea trout, juvenile southern flounder, and several other fish species, and they provide a food source for species of wintering waterfowl (Castellanos and Rozas, 2001; Short and Coles, 2001; Caldwell, 2003). Therefore, loss of submerged vegetation would impact these species.

Sargassum

Oceanographic processes that concentrate *Sargassum* into mats and rafts would also concentrate toxic substances. Therefore, it may be assumed that *Sargassum* would be found in areas where oil, dispersants, and other chemicals have accumulated following a catastrophic spill. The ultimate effects of toxins to *Sargassum* are unclear; however, it is evident that the accumulation provides a toxic environment for associated species, especially those that use the *Sargassum* as areas of refuge for larvae or other developmental stages (Unified Incident Command, 2010d). There would be noticeable effects on species that eat the plant material, such as sea turtles, and the death rate of *Sargassum* may be increased because of toxic substances, which would contribute to a major decline in its biomass. This would decrease available habitat for associated organisms and indirectly affect the survival rate and recruitment for associated fish species. The severity and duration of any toxic effects would be dependent on both the physical properties of the toxic components and their biological effects, such as how long it might take them to degrade, their solubility in water, and the degree that they accumulate in biological tissue.

5.2.2.8. Benthic Habitats

Shelf Habitats

In situations where soft-bottom infaunal communities are negatively impacted, recolonization by populations from neighboring soft-bottom substrate would be expected over a relatively short period. Recolonization would begin with recruitment and immigration of opportunistic species from surrounding stocks. More complex communities would follow with time. Repopulation could take longer for areas affected by direct oil contact in higher concentrations.

Hard-bottom communities exposed to large amounts of resuspended sediments following a catastrophic, subsurface blowout could be subject to sediment suffocation, exposure to resuspended toxic contaminants, and reduced light penetration. The greatest impacts would occur to communities that exist in clear water with very low turbidity. The consequences of a blowout along, directly on, or near one of these features could be long lasting, although the occurrence of a blowout near such sensitive communities is unlikely because of stipulations described in NTL 2009-G39 prevents drilling activity near sensitive hard-bottom habitats. Impacts would more likely be from low-level or long-term exposure. This type of exposure has the potential to greatly impact coral reef communities, resulting in impaired reef health. Impacts to a community in more turbid waters would be greatly reduced, as the species are tolerant of suspended sediments, and recovery would occur quicker.

Deepwater Soft-Bottom Benthic Communities

In situations where soft-bottom infaunal communities are negatively impacted, recolonization by populations from neighboring soft-bottom substrate would be expected over a relatively short period of time for all organisms ranging from a matter of days for bacteria and probably less than 1 year for most macrofauna and megafauna species. This could take longer for areas affected by direct oil contact in higher concentrations.

Deepwater Coral Benthic Communities

Deepwater corals are expected to be resistant to oiling, with little effect from low exposure. Many invertebrates associated with deepwater coral communities, particularly the crustaceans, would likely be more susceptible to damage from oil exposure. Recolonization of severely damaged or destroyed communities could take years to decades.

Deepwater Chemosynthetic Benthic Communities

While chemosynthetic communities that receive low quantities of well-dispersed oil undergoing biodegradation would likely experience little negative effect, recolonization of severely damaged or destroyed communities could take years to decades.

5.2.3. Socioeconomic Resources

5.2.3.1. Offshore and Onshore Archaeological Resources

While it is unlikely (Section 2.2.3.1), a known shipwreck could be impacted by the blowout itself or the subsequent oil spill; impacts (i.e., contamination) from the release of large quantities of dispersants associated with a deepwater, catastrophic blowout are possible. Because a site cannot be avoided unless its location in known, undiscovered shipwrecks are at a much higher risk as a result of a blowout. Long-term effects of oiling of prehistoric and historic archaeological resources are poorly understood; however, damage to the protective layer of corals and other organisms on shipwreck sites by oiling could alter the surrounding site dynamics and increase their degradation. In addition, onshore habitat degradation could lead to erosion, which would increase exposure to and subsidence of prehistoric and historic sites. Unlike biological resources that have the potential to recover, damage to archaeological resources from the spill or cleanup activities would be irreversible, leading to loss of important archaeological data needed for proper study and interpretation. Archaeological sites also provide recreational opportunities both offshore and onshore; therefore, the loss of a site would also have impacts on recreation.

5.2.3.2. Commercial Fishing

The Gulf is an important biologic and economic area in terms of seafood production and recreational fishing. According to NOAA, there are 3.2 million recreational fishermen in the Gulf of Mexico region who took 24 million fishing trips in 2008. Commercial fishermen in the Gulf harvested more than 1 billion pounds of finfish and shellfish in 2008 (USDOC, NOAA, 2010g). The economic impacts of closures on commercial fishing are complicated to predict because the economic effects are dependent on season and would vary by fishery. If fishers cannot make up losses in the remainder of the season, a substantial part of their annual income could be lost. While the commercial fishing industry of Texas did not sustain measurable direct or indirect economic effects following the 1979 *Ixtoc* blowout and spill (Restrepo et al., 1982), there is a documented phenomenon that, long after an incident, the perception of tainted fish and shellfish from the impacted area persists (Keithly and Diop, 2001). It is reasonable to assume that a negative perception could impact the value of commercial fish resources for several seasons.

5.2.3.3. Recreational Fishing

In 2008, over 24 million recreational fishing trips were taken in the Gulf of Mexico, which generated about $12 billion in sales, over $6 billion in value-added impacts, and over 100,000 jobs (USDOC, NOAA, NMFS, 2010b). Unlike commercial fishing, recreational fishing is concentrated during the summer months. Therefore, a catastrophic spill occurring at the beginning of the recreational fishing season and continuing through the season would result in the loss of millions of recreational fishing trips and billions in subsequent sales. For example, during the summer months, scheduled fishing tournaments are held that would be hard to reschedule. Normal direct income and indirect income to the communities that host these tournaments would be lost for that year.

5.2.3.4. Tourism and Recreational Resources

The longer-term implications of a catastrophic event on tourism would depend on the extent to which any structural/ecological damage can be repaired, as well as on the extent to which public confidence in the tourism industry can be restored. For example, a catastrophic oil spill would likely affect the fish populations in the affected waters to some extent. The most direct impact of this would be decreased recreational fishing activity in a region to the extent that the fish population has decreased. However, a region would not fully recover from the event until confidence in fishing is restored and the remaining fish population recovers. In addition, restaurants in the region would be impacted to the extent to which they are perceived to use seafood products caught or raised in contaminated waters. Similarly, although beaches can be decontaminated not long after a spill has been stopped, lingering perceptions can be expected to negatively impact tourism.

Oxford Economics (2010) conducted a study of recent catastrophic events in order to estimate the longer-term economic implications of the DWH oil spill. They estimate that the long-term economic damage from the spill could be between $7.6 and $22.7 billion. Analyzing previous oil spills and other catastrophic events, they also suggest that it could take 15-36 months for the tourism industry to recover to pre-spill levels. Given Florida’s dependence on fishing and beach activities (as well as the overall size of its economy), this study suggests that the State would bear the majority of the economic damage from the spill. This study also points out the complicated set of economic and psychological forces that ultimately determine the extent to which the tourism and recreation industries would recover from a catastrophic oil spill.

5.2.3.5. Employment and Demographics

While a catastrophic spill could immediately impact several Gulf States for several months through fishing closures, loss of tourism, and any suspension of oil and gas activities, anticipating the long-term economic and employment impacts in the Gulf of Mexico is a difficult task. Many of the potentially affected jobs, like fishing charters, are self-employed. Thus, they would not necessarily file for unemployment and will not be included in business establishment surveys used to estimate State unemployment levels. In addition, unemployment numbers in states are based on nonagricultural jobs, and the fishing industry is considered within the agriculture category. On the other side, it is also a challenge to estimate how many of these displaced workers have been hired to clean up the spill. For example, while thousands of vessels of opportunity would be active in the spill response, not all of these would be displaced commercial fishermen from the affected areas. The positive employment impacts related to response activities are likely to be shorter term than the negative impacts discussed above.

Catastrophic spills have a huge regional economic impact, as seen recently in the DWH event. It is estimated that the total economic consequences of the DWH event will lead to a net loss of just under $20 billion for the U.S. economy in 2010, which would lower U.S. economic growth in 2010 by roughly 0.1 percent and would reduce growth to a greater extent in the four states most affected.

5.2.3.6. Land Use and Coastal Infrastructure

Based on the rapid recovery of infrastructure that was heavily damaged by the catastrophic 2005 hurricane season, there are not expected to be any long-term impacts to land use and coastal infrastructure as a result of a catastrophic oil-spill event. However, BOEM would continue to monitor the post-spill, long-term recovery phase of the DWH event for any changes that indicate otherwise. A catastrophic spill could generate up to 60,000 tons of oil-impacted solid materials disposed in landfills along the Gulf Coast. This waste may contain debris, beach or marsh material (sand/silt/clay), vegetation, and personal protection equipment collected during cleanup activities. This would be equivalent to 2-6 years of waste produced from OCS oil and gas activities in the Gulf of Mexico (Dismukes et al., 2007). However, landfill capacity is not expected to be an issue at any phase of the oil-spill event or the long-term recovery. According to USEPA, existing landfills that are receiving oil-spill waste from the DWH event have plenty of capacity to handle the expected waste volumes. The oil-spill waste that is being disposed of in landfills represents less than 7 percent of the total daily waste normally accepted at these landfills (USEPA, 2010a).

It is not expected that any long-term, land-use impacts would arise from properties that are utilized for restoration activities and would somehow have their future economic use compromised. The rise or fall of property values would not be solely a function of some kind of economic impact from a catastrophic oil-spill event. There are many other factors that influence the value of property and its best economic use. It is not clear from past experiences whether vegetation loss or erosion created by a spill could result in changes in land use. The amount and location of erosion and vegetation loss can be influenced by the time of year the spill occurs, its location, and weather patterns, including hurricane landfalls (Dismukes, personal communication, 2010a).

5.2.3.7. Environmental Justice

After the spill is stopped, the primary environmental justice concerns relate to possible long-term health impacts to cleanup workers, a predominately minority population, and to possible disposal of oil-impacted solid waste in predominantly minority areas.

Suspension of Oil and Gas Activities

An analysis of socioeconomic characteristics shows that people of Cajun ethnicity in the Gulf States, often found to be of a comparatively low socioeconomic status and to work jobs in the textile and oil industries (Henry and Bankston, 1999). Past studies suggest that a healthy offshore petroleum industry also indirectly benefits low-income and minority populations (Tolbert, 1995). One BOEM study in Louisiana found income inequality decreased during the oil boom of the 1980's and increased with the decline (Tolbert, 1995). Although we know that many oil- and gas-related service industries are cutting costs and putting off maintenance to defer massive layoffs in response to the oil-spill-caused deepwater drilling suspension and the slowed schedule for shallow-water drilling permits, we do not fully understand their long-term impacts.

Onshore and Offshore Cleanup Workers

By the end of a catastrophic spill, up to 50,000 personnel would be expected to be responding to the spill. The majority of these are field responders (United Incident Command, 2010f). As seen by the DWH event, the racial composition of cleanup crews was so conspicuous that Ben Jealous, the president of the National Association for the Advancement of Colored People (NAACP), sent a public letter to BP Chief Operations Officer Tony Hayward on July 9, 2010, demanding to know why African Americans were over-represented in "the most physically difficult, lowest paying jobs, with the most significant exposure to toxins" (NAACP, 2010). While regulations require the wearing of protective gear and only a small percentage of cleanup workers suffer immediate illness and injuries (Center for Disease Control, 2010), exposure could have long-term health impacts (e.g., increased rates of some types of cancer) (Savitz and Engel, 2010; Kirkeleit et al., 2008). Of the 38 accidents involving supertankers and resulting in large oil spills throughout the world, only seven studies on the repercussions of the exposure of spilled oils on human health have been completed. Aguilera et al. (2010) compiled and reviewed these studies for patterns of health effects and found evidence of the relationship between exposure and "acute physical, psychological, genotoxic, and endocrine effects in the exposed individuals." Acute symptoms from exposure to oil, dispersants, and degreasers include headaches, nausea, vomiting, diarrhea, sore eyes, runny nose, sore throat, cough, nose bleeds, rash, blisters, shortness of breath, and dizziness (Sathiakumar, 2010). The USEPA's monitoring data have so far shown that the use of dispersants during the DWH event did not result in a presence of chemicals that surpassed human health benchmarks (Trapido, 2010). Longitudinal epidemiological studies of possible long-term health effects from exposure to either the DWH oil spill or dispersants, such as the possible bioaccumulation of toxins in tissues and organs, are lacking and the potential for the long-term human health effects are largely unknown (although the National Institutes of Health has proposed such a study).

Prior research on post-spill cleanup efforts found that the duration of cleaning work was a risk factor for acute toxic symptoms and that seamen had the highest occurrence of toxic symptoms compared with volunteers or paid workers. Therefore, participants in the "Vessels of Opportunity" program, which recruited local boat owners (including Cajun, Houma Indian, and Vietnamese fishermen) to assist in cleanup efforts, would likely be one of the most exposed groups. African Americans are thought to have made up a high percentage of the cleanup workforce. The OSHA released two matrices of gear requirements for onshore and offshore Gulf operations that are organized by task (OSHA, 2010a). Of past oil-spill workers, uninformed and poorly informed workers were at more risk of exposure and symptoms, demonstrating the importance of education and proper training of workers (Sathiakumar, 2010). Therefore, a catastrophic spill could disproportionately affect seamen and onshore workers such as Cajuns, Vietnamese, Houma Indian, and African Americans.

During a recent National Institute of Environmental Sciences workshop regarding the health effects of the DWH oil spill, Chairperson Nancy E. Adler pointed to the uncertainty regarding health effects and these types of events, "While studies of previous oil spills provide some basis for identifying and mitigating the human health effects of these exposures, the existing data are insufficient to fully understand and predict the overall impact of hazards from the DWH oil spill on the health of individuals—including workers, volunteers, residents, visitors, and special populations" (Institute of Medicine, 2010). In order to address these data gaps, the National Institute of Environmental Sciences plans to begin a prospective study of the mental and physical health of about 50,000 workers who helped battle the spill.

Solid-Waste Disposal

Following a catastrophic spill, environmental justice concerns arise related to the disposal of cleanup-related wastes near minority and/or low-income communities (Schleifstein, 2010). It is estimated a catastrophic spill could generate up to 60,000 tons of oil-impacted solid materials that would be disposed in landfills along the Gulf Coast. While no new landfills would be built because of a catastrophic spill, the use of existing landfills might exacerbate existing environmental justice issues. For example, Mobile, Alabama, and Miami, Florida, are majority minority urban centers with a majority of minority residents living within a 1-mi (1.6-km) radius of chosen landfills or liquid processing centers. While only a small percentage of DWH waste was sent to these facilities—13 percent of the liquid waste to Liquid Environmental Solutions in Mobile and only 0.28 percent of the total liquid waste to Cliff Berry in

Miami—they could potentially receive more for future spills. For example, of the nine landfills approved by USEPA for oil-impacted solid materials, more than half of the waste was disposed of in four landfills that were located in areas where minority groups comprised the majority of the population (Hernandez, 2010). Disposal procedures for the DWH event involved sorting waste materials into standard "waste stream types" at small, temporary stations, and then sending each type to existing facilities that were licensed to dispose of them. The location of temporary sorting stations was linked to the location of containment and cleanup operations. Hence, future locations of any sorting stations are not predictable since they would be determined by the needs of cleanup operations. However, waste disposal locations were determined by the specializations of existing facilities and by contractual relationships between them and the cleanup and containment firms. Louisiana received about 82 percent of the DWH liquid waste recovered; of this, 56 percent was manifested to mud facilities located in Venice, Plaquemines Parish, Louisiana, and Port Fourchon, Lafourche Parish, Louisiana, and then transferred to a processing facility in Port Arthur, Texas. The waste remaining after processing was sent to deep well injection landfills located in Fannett and Big Hill, Texas. The sites located in Venice and Port Fourchon, Louisiana, and Port Arthur, Fannett, and Big Hill, Texas, have low-minority populations but a few of these areas have substantial poverty rates relative to State and county means. Although, in the case of the DWH event, most of the cleanup occurred in the CPA and disposal occurred in both the CPA and WPA; this would likely happen should a future spill event occur in the CPA.

6. CUMULATIVE ENVIRONMENTAL AND SOCIOECONOMIC IMPACT

Like the recent, devastating hurricane seasons of 2005 and 2008, the DWH event has changed the environmental baseline of the Gulf of Mexico. Another catastrophic oil spill would make the resources of the Gulf even more susceptible to further impacts, adding to the cumulative effects of an already sensitive ecosystem.

The Gulf Coast has survived major natural and manmade disasters (i.e., hurricanes and oil spills), through which the people and environmental resources of the Gulf of Mexico and the Gulf Coast have repeatedly demonstrated their resiliency. While environmental and socioeconomic resources may recover from a natural or manmade disaster if given enough time between disasters, disasters happening in unison or within short periods of each other would make recovery more difficult.

The magnitude of OCS and non-OCS activity in the Gulf of Mexico is so immense that routine activities associated with a single OCS oil and gas activity (e.g., single lease sale, single well) have a minor to no incremental contribution to the impacts of cumulative activities. However, a catastrophic blowout and spill would have a major contribution to cumulative impacts.

7. SUMMARY OF IMPACTS

7.1. SUMMARY OF IMPACTS FROM PHASE 1 (INITIAL EVENT)

The initial phase of the catastrophic event analyzed in the Gulf of Mexico is a blowout causing an explosion and fire, possibly resulting in the sinking of the drilling rig or platform, which could potentially cause injuries and fatalities because of the explosion, fire, and structure failure. Impacts during Phase 1 would be limited to workers on the drilling rig or platform and response vessels and environmental resources in the immediate vicinity of the blowout. Air quality impacts include the emission of pollutants from the oil and the fire that are hazardous to human health and that can possibly be fatal if it involves high concentrations of H_2S or other highly toxic gases. Water quality impacts include localized water quality effects, which could include the release of a large amount of methane gas and the disturbance of a large amount of sediments over an extended area, if the blowout occurs outside the wellbore, below the seafloor.

An explosion would kill any birds resting on the platform, including birds protected under the Migratory Bird Treaty Act. Eruption of gases and fluids may generate significant pressure waves and noise to injure or kill individual animals in the vicinity, including federally listed threatened and endangered species under the ESA or MMPA. A shock wave underwater may also impact commercial and recreational fisheries in the area. Benthic communities beyond avoidance zones could be smothered. In addition to a large number of fatalities and injuries of people on the drilling rig or platform itself, commercial and recreational fishers and divers near the blowout could be injured or killed. The blowout could also damage any unidentified archaeological sites nearby.

7.2. SUMMARY OF IMPACTS FROM PHASE 2 (OFFSHORE SPILL)

The second phase of the catastrophic event analyzed is an extended, offshore spill estimated to last 1-4 months for a blowout in shallow water and 3-5 months for a blowout in deep water, because of more difficult intervention. A large-scale response effort would be expected for a catastrophic spill, including tens of thousands of responders, several thousand vessels, and the release of a large amount of dispersants.

A catastrophic spill has the potential to cause population level impacts to offshore biological resources. Multiple Federal and State-listed, threatened and endangered species could be impacted in the water column or at the sea surface. In addition, natural processes (e.g., flocculation) and human intervention (i.e., subsea dispersants) could expose benthic communities and archaeological sites to oil. Additionally, known and previously undiscovered archaeological sites and benthic habitats could be damaged by bottom-disturbing activities associated with the response effort, including the anchoring of vessels. Pollutants in the spilled oil that are hazardous to response workers without protective equipment would be emitted into the air through evaporation and through in-situ or controlled burns of oil slicks.

Socioeconomic impacts would begin while the spill is still offshore. A large portion of the Gulf of Mexico EEZ and most of State waters could be closed to commercial and recreational fishing for several months, possibly causing the loss of revenue for an entire season or year. These closures may predominately affect minority or ethnic groups. Tourism may also be impacted because of either perceived damage to recreational resources that has not yet materialized or to general hesitation on the part of travelers to visit the overall region because of the spill. Suspension of some oil and gas activities would possibly follow a catastrophic event, temporarily affecting jobs in the oil and gas industry.

7.3. SUMMARY OF IMPACTS FROM PHASE 3 (ONSHORE CONTACT)

The third phase of the catastrophic event analyzed is oiling of the shoreline. Exponential increase of the length of impacted shoreline is expected as the spill would continue over several months, which would likely overwhelm response efforts. Because of longer intervention times, a deepwater blowout and spill could impact over 1,000 mi (1,609 km) of shoreline. While a catastrophic spill from a shallow-water blowout is expected to be a lower volume than a deepwater blowout, the site would generally be located closer to shore, allowing less time for oil to be weathered, dispersed, and recovered. This could result in more concentrated and toxic oiling of several hundred miles of shoreline for more than 2 months.

The severity of oiling would vary between heavy, moderate, light, and occasional tarballs. However, because of the length of shoreline that could be potentially oiled and the sensitivity of the Gulf Coast, a catastrophic spill could cause extensive habitat degradation. Loss of vegetation could lead to erosion and permanent landloss. Though response efforts (including the use of skimmers and booms) would decrease the amount of oil contacting the coastline, significant amounts of oil would remain to impact coastal water quality. Gulf of Mexico water quality is already rated as fair to poor, according to USEPA. Depending on timing and location, a catastrophic spill has the potential to cause population-level impacts on biological resources. Dozens of Federal and State-listed, threatened and endangered species could be impacted. Impacts on air quality may have adverse effects on oil-spill responders.

While cultural resources were recognized as significant early in the response and archaeologists are at present embedded in SCAT teams and consulting with cleanup crews, efforts to prevent coastal cultural resources from becoming contaminated by oil would likely be overwhelmed by the magnitude of shoreline impacted and/or in the event of a hurricane during the spill cleanup efforts. In addition to closures in Federal waters, portions to all of individual State waters would also be closed to commercial and recreational fishing. The economic impact of these closures would have a disproportional effect on minority and low-income groups, and shoreline impacts would generate additional subsistence-related effects. A catastrophic spill also has the potential to significantly impact the Gulf Coast recreation and tourism industries, particularly water-dependent and beach-dependent components of these industries. An influx of cleanup and relief workers would not fully offset economic impacts. The influx a large number of responders and the creation of staging areas because of a catastrophic spill would have temporary impacts (e.g., increased traffic congestion and some possible competing land-use issues) on land use and infrastructure. In addition, there is a potential for delays in cargo handling and slow vessel traffic because of decontamination operations at various sites along the marine transportation system.

7.4. Summary of Impacts from Phase 4 (Long-Term Impacts)

Phase 4 focuses on the long-term impacts of a catastrophic oil spill. While impacts to air and water quality may be shorter term, a catastrophic spill can have impacts on Gulf of Mexico ecosystems long after the well is capped or killed and cleanup activities have concluded. In some cases, marine ecosystems may take decades to fully recover or may recover to alternative states.

Coastal and offshore habitats serve important ecological functions. Onshore, the loss of vegetation could lead to erosion and permanent landloss. Offshore, repopulation of benthic communities could take longer for areas affected by direct oil contact in higher concentrations. For birds, fish, marine mammals and sea turtles, damage of habitats, loss of reproductively capable adults as well as juveniles, and sublethal impacts from oil exposure can lead to impaired reproduction. This can potentially reduce population levels. For example, a catastrophic spill could decrease available habitat for associated organisms and indirectly affect the survival rate and recruitment for associated fish species. In the case of birds, long-term, sublethal, chronic effects may exceed immediate losses because of direct mortality (i.e., oiled birds) if such residual effects influence a significant proportion of the population or disproportionately impact an important population segment. A catastrophic spill could cause the destruction of the remaining habitat of certain onshore species, such as the diamondback terrapin or beach mice.

A catastrophic spill can also have long-term impacts on socioeconomic resources. Positive employment impacts related to response activities are likely to be shorter term than the negative impacts. Catastrophic spills have a huge regional economic impact (billions of dollars), as recently seen with the DWH event. The longer-term implications for commercial and recreational fishing and tourism depend on the extent and perception of environmental damage. After the spill is stopped, the primary environmental justice concerns would be long-term health impacts of predominately minority workers and the disposal of oil-impacted solid waste in predominantly minority areas. Long-term impacts to land use and coastal infrastructure are not expected. Unlike biological or other socioeconomic resources that have the potential to recover, damage to archaeological resources from the spill or cleanup activities would be irreversible, leading to the loss of important archaeological data needed for proper study and interpretation.

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9. REFERENCES

Adcroft, A., R. Hallberg, J.P. Dunne, B.L. Samuels, J.A. Galt, C.H. Barker, and B. Payton. 2010. Simulations of underwater plumes of dissolved oil in the Gulf of Mexico. Geophysical Research Letters. Vol. 37. 5 pp.

Aguilera, F., J. Méndez, E. Pásaro, and B. Laffon. 2010. Review on the effects of exposure to spilled oils on human health. Journal of Applied Toxicology 30:291–301. doi:10.1002/jat.1521.

Alabama State Port Authority. 2010. Spill continues to impact Gulf Coastal States, Port of Mobile will remain open. Media Update, July 2, 2010. Internet website: http://www.asdd.com/pdf/ASPA_PortofMobile_OilSpillUpdate_07022010.pdf. Accessed November 10, 2011.

Albers, P.H. 1980. Transfer of crude oil from contaminated water to bird eggs. Environmental Research 22:307-314.

Albers, P.H. and G.H. Heinz. 1983. FLIT-MLO and No. 2 fuel oil: Effects of aerosol applications to mallard eggs on hatchability and behavior of ducklings. Environmental Research 30:381-388.

Alexander, S.K. and J.W. Webb. 1983. Effects of oil on growth and decomposition of *Spartina alterniflora*. In: Proceedings, 1983 Oil Spill Conference. . .February 28-March 3, 1983, San Antonio, TX. Washington, DC: American Petroleum Institute. Pp. 529-532.

Alexander, S.K. and J.W. Webb. 1987. Relationship of *Spartina alterniflora* growth to sediment oil content following an oil spill. In: Proceedings, 1987 Oil Spill Conference. . .April 6-9, 1988, Baltimore, MD. Washington, DC: American Petroleum Institute. Pp. 445-450.

Alonso-Alvarez, C., I. Munilla, M. López-Alonso, and A. Veland. 2007. Sublethal toxicity of the *Prestige* oil spill on yellow-legged gulls. Environ. Int. 54:773-781.

Australian Maritime Safety Authority. 2010. Oil spill dispersants: Top 20 frequently asked questions (FAQs). Internet website: http://www.amsa.gov.au/Marine_Environment_Protection/National_plan/General_Information/Dispersants_Information/FAQ_Oil_Spills_Dispersants.asp. Accessed November 10, 2011.

Aversa, J. 2010. Oil spill's economic damage may not go beyond Gulf. Internet website: http://www.businessweek.com/ap/financialnews/D9GK80MG0.htm. Accessed November 17, 2011.

Baca, B., G.A. Ward, C.H. Lane, and P.A. Schuler. 2005. Net environmental benefit analysis (NEBA) of dispersed oil on nearshore tropical ecosystems derived from the 20 year "TROPICS" field study. In:

Proceedings 2005 International Oil Spill Conference. May 15-19, 2005, Miami Beach, FL. Washington, DC: American Petroleum Institute.

Baird, P.H. 1990. Concentrations of seabirds at oil-drilling rigs. Condor 92:768-771.

Bak, R.P.M. and J.H.B.W. Elgershuizen. 1976. Patterns of oil-sediment rejection in corals. Marine Biology 37:105-113.

Bankston, C.L. and M. Zhou. 1996. Go fish: The Louisiana Vietnamese and ethnic entrepreneurship in an extractive industry. National Journal of Sociology 10(1): 37-55.

Barras, J.A. 2006. Land area change in coastal Louisiana after the 2005 hurricanes: A series of three maps. U.S. Dept. of the Interior, Geological Survey. Open File Report 06-1274.

Barras, J.A., S. Beville, D. Britsch, S. Hartley, S. Hawes, J. Johnston, P. Kemp, Q. Kinler, A. Martucci, J. Porthouse, D. Reed, K. Roy, S. Sapkota, and J. Suhayda. 2003. Historical and projected coastal Louisiana land changes: 1978-2050. U.S. Dept. of the Interior, Geological Survey. Open File Report 03-334.

Bartha, R. and R.M. Atlas. 1983. Transport and transformations of petroleum: Biological processes. In: Boesch, D.F. and N.N. Rabalais, eds). Long-term environmental effects of offshore oil and gas development. Taylor and Francis, Abingdon.

Beck, M.W., K.L. Heck, Jr., K.W. Able, D.L. Childers, D.B. Eggleston, B.M. Gillanders, B. Halpern, C.G. Hays, K. Hoshino, T.J. Minello, R.J. Orth, P.F. Sheridan, and M.P. Weinstein. 2001. The identification, conservation, and management of estuarine and marine nurseries for fish and invertebrates. BioScience 51(8):633-641.

Beck, W.W., W.L. Kruczynski, and P.F. Sheridan. 2006. Conclusion. In: Handley, D.A, D. Altsman, and R. DeMay, eds. 2006. Seagrass status and trends in the northern Gulf of Mexico: 1940-2002. Scientific Investigations Report 2006-5287. U.S. Environmental Protection Agency 855-R-04-003. Internet website: http://pubs.usgs.gov/sir/2006/5287/. Accessed November 10, 2011.

Bittner, J.E. 1996. Cultural resources and the *Exxon-Valdez* oil spill: An overview. Proceedings of the *Exxon-Valdez* Oil Spill Symposium. American Fisheries Society Symposium 18:814-818.

Boesch, D.F. and N.N. Rabalais, eds. 1987. Long-term environmental effects of offshore oil and gas development. London: Elsevier Applied Science Publishers. 696 pp.

Burdeau, C. 2010. Widespread oyster deaths found on Louisiana reefs. The Associated Press. July 17, 2010. Internet website: http://www.nola.com/news/gulf-oil-spill/index.ssf/2010/07/widespread_oyster_deaths_found.html. Accessed November 10, 2011.

Burdeau C. and J. Collins. 2010. Marshes fouled by Gulf of Mexico oil spill show signs of regrowth. The Associated Press. August 12, 2010. Internet website: http://www.nola.com/news/gulf-oil-spill/index.ssf/2010/08/marshes_fouled_by_gulf_of_mexi.html. Accessed November 10, 2011.

Burns, K.A. and A.H. Knap. 1989. The Bahía Las Minas oil spill: Hydrocarbon uptake by reef building corals. Marine Pollution Bulletin 20(8):391-398.

Byrd, G.V., J.H. Reynolds, and P.L. Flint. 2009. Persistence rates and detection probabilities of bird carcasses on beaches of Unalaska Island, Alaska, following the wreck of the M/V *Selendang Ayu*. Marine Ornithology 37:197-204.

Caetano, M., M.J. Madureira, and C. Vale. 2003. Metal remobilization during resuspension of anoxic contaminated sediment: Short-term laboratory study. Water, Air, and Soil Pollution 143:23-40.

Cagle, F.R. 1952. A Louisiana terrapin population (*Malaclemys*). Copeia 1952:74-76.

Caldwell, A.B. 2003. Do terraces and coconut mats affect seeds and submerges aquatic vegetation at Sabine National Wildlife Refuge? Master's thesis, Louisiana State University, Baton Rouge, LA. 41 pp. Internet website: http://etd.lsu.edu/docs/available/etd-0625103-110131/unrestricted/Caldwell_thesis.pdf. Accessed November 10, 2011.

Canadian Center for Energy Information. 2010. What are oil sands and heavy oil? Internet website: http://www.centreforenergy.com/AboutEnergy/ONG/OilsandsHeavyOil/Overview.asp?page=1. Accessed November 10, 2011.

Carls, M.G., S.D. Rice, and J. Hose. 1999. Sensitivity of fish embryos to weathered crude oil: Part 1. Low-level exposure during incubation causes malformations, genetic damage and mortality in larval Pacific herring (*Clupea pallashi*). Environmental Toxicology and Chemistry 18(3):481-493.

Carlson, P.R., Jr. and K. Madley. 2006. Statewide summary for Florida. In: Handley, D.A, D. Altsman, and R. DeMay, eds. 2006. Seagrass status and trends in the northern Gulf of Mexico: 1940-2002. Scientific Investigations Report 2006-5287. U.S. Environmental Protection Agency 855-R-04-003. Internet website: http://pubs.usgs.gov/sir/2006/5287/. Accessed November 10, 2011.

Castellanos, D.L. and L.P. Rozas. 2001. Nekton use of submerged aquatic vegetation, marsh, and shallow unvegetated bottom in the Atchafalaya River Delta, a Louisiana tidal freshwater ecosystem. Estuaries 24(2):184-197.

Centers for Disease Control and Prevention. 2010. NIOSH report of BP illness and injury data (April 23 – June 6, 2010). Internet website: http://www.cdc.gov/niosh/topics/oilspillresponse/pdfs/NIOSHRept-BPInjuryandIllnessDataApril23-June6.pdf. Accessed November 10, 2011.

Clark Atlanta University. Environmental Justice Resource Center. 2010. BP waste oil spill waste disposal correction. Internet website: http://www.ejrc.cau.edu/GulfCorrection8-24-2010.html. Accessed November 10, 2011.

Cook, B.B. and A.H. Knap. 1983. The effects of crude oil and chemical dispersant on photosynthesis in the brain coral, *Diploria strigosa*. Marine Biology 78:21-27.

Conan, G. 1982. The long-term effects of the *Amoco Cadiz* oil spill. Philosophical Transactions of the Royal Society of London. Series B, Biological Sciences 297(1087).

Council of Environmental Quality (CEQ). 2010. Report regarding the Minerals Management Service's National Environmental Policy Act policies, practices, and procedures as they relate to Outer Continental Shelf oil and gas exploration and development. 41 pp. Internet website: http://www.whitehouse.gov/sites/default/files/microsites/ceq/20100816-ceq-mms-ocs-nepa.pdf. Posted August 16, 2010. Accessed November 10, 2011.

Darnell, R.M., R.E. Defenbaugh, and D. Moore. 1983. Atlas of biological resources of the continental shelf, northwestern Gulf of Mexico. U.S. Dept. of the Interior, Bureau of Land Management, New Orleans, LA. BLM Open File Report No. 82-04.

Davis, H.C. 1958. Survival and growth of clam and oyster larvae at different salinities. Biological Bulletin, Marine Biological Laboratory 114(3):296-307.

Davis, B., D.S. Etkin, M. Landry, and K. Watts. 2004. Determination of oil persistence: A historical perspective. Proc. Fifth Biennial Freshwater Spills Symposium. Internet website: http://www.environmental-research.com/erc_papers/ERC_paper_19.pdf. Accessed November 10, 2011.

Dean, T.A. and S.C. Jewett. 2001. Habitat-specific recovery of shallow subtidal communities following the *Exxon Valdez* oil spill. Ecological Applications 11(5):1456-1471.

Deegan, L.A. 1989. Nekton, the free-swimming consumers. In: Day, J.W. Jr., C.A.S. Hall, W.M. Kemp, and A. Yanez-Arancibia, eds. Estuarine ecology. New York, NY: Wiley and Sons, Inc. 400 pp.

Delaune, R.D., W.H. Patrick, and R.J. Bureh. 1979. Effect of crude oil on a Louisiana *Spartina alterniflora* salt marsh. Environ. Poll. 20:21-31.

Dismukes, D. 2010a. Personal communication. Associate Director, LSU Center for Energy Studies, Baton Rouge, LA. September 1, 2010.

Dismukes, D. 2010b. Personal communication. Associate Director, LSU Center for Energy Studies, Baton Rouge, LA. August 30, 2010.

Dismukes, D.E., M. Barnett, D. Vitrano, and K. Strellec. 2007. Gulf of Mexico OCS oil and gas scenario examination: Onshore waste disposal. U.S. Dept. of the Interior, Minerals Management Service, Gulf of Mexico OCS Region, New Orleans, LA. OCS Report MMS 2007-051. 5 pp.

Dodge, R.E., S.C. Wyers, A.H. Knap, H.R. Frith, T.D. Sleeter, and S.R. Smith. 1984. The effects of oil and oil dispersants on hermatypic coral skeletal growth (extension rate). Coral Reefs 3:191-198.

Ducklow, H.W. and R. Mitchell. 1979. Composition of mucus released by coral reef Coelenterates. Limnology and Oceanography 24(4):706-714.

Dunnet, G.M., D.J. Crisp, G. Conan, and W.R.P. Bourne. 1982. The long-term effects of oil pollution on marine populations, communities and ecosystems. Philosophical Transactions of the Royal Society of London. Series B, Biological Sciences 297(1087):413-427. Internet website: http://www.jstor.org/stable/2396584. Accessed November 10, 2011.

Dunstan, W. M., L.P. Atkinson, J. Natoli. 1975. Stimulation and inhibition of phytoplankton growth by low molecular weight hydrocarbons. Marine Biology, 08-01.

Eccleston, C.H. 2008. NEPA and environmental planning: Tools, techniques, and approaches for practitioners. Boca Raton, FL: CRC Press. 447 pp.

Ejechi, B.O. 2003. Biodegradation of wood in crude oil-polluted soil. World Journal of Microbiology & Biotechnology 19(8):799-804. ISSN: 0959-3993.

Elgershuizen, J.H.B.W. and H.A.M. deKruijf. 1976. Toxicity of crude oils and a dispersant to the stony coral *Madracis mirabilis*. Marine Pollution Bulletin 7(2):22-25.

Energy Resources Co. Inc. (ERCO). 1982. IXTOC oil spill assessment: Executive summary. U.S. Dept. of the Interior, Bureau of Land Management, Contract No. AA851-CTO-71. Cambridge, MA. 39 pp. Internet website: http://www.gomr.mms.gov/PI/PDFImages/ESPIS/3/3977.pdf. Accessed November 10, 2011.

Esler, D., J.A. Schmutz, R.L. Jarvis, and D.M. Mulcahy. 2000. Winter survival of adult female harlequin ducks in relation to history of contamination by the *Exxon Valdez* oil spill. Journal of Wildlife Management 64:839-847.

Fanning, K., K.L. Carder, and P.R. Betzer. 1982. Sediment resuspension by coastal waters: A potential mechanism for nutrient re-cycling on the ocean's margins. Deep-Sea Research 29:953-965.

Fingas, M., F. Ackerman, P. Lambert, K. Li, Z. Wang, J. Mullin, L. Hannon, D. Wang, A. Steenkammer, R. Hiltabrand, R. Turpin, and P. Campagna. 1995. The Newfoundland offshore burn experiment: Further results of emissions measurement. In: Proceedings of the Eighteenth Arctic and Marine Oilspill Program Technical Seminar, Volume 2, June 14-16, 1995, Edmonton, Alberta, Canada. Pp. 915-995.

Fischel, M., W. Grip, and I.A. Mendelssohn. 1989. Study to determine the recovery of a Louisiana marsh from an oil spill. In: Proceedings, 1989 Oil Spill Conference, February 13-16, 1989, San Antonio, TX. Washington, DC: American Petroleum Institute. Pp. 383-387.

Flint, P.L., A.C. Fowler, and R.F. Rockwell. 1999. Modeling losses of birds associated with the oil spill from the M/V *Citrus* off St. Paul Island, Alaska. Ecological Modeling 117:261-267.

Florida Fish and Wildlife Conservation Commission. 2010. Sea turtle nests to be moved Friday. News Release, June 22, 2010. 2 pp. Internet website: http://myfwc.com/news/news-releases/2010/july/22/news_10_x_oilspill34/. Accessed November 17, 2011.

Flynn, D. 2010. NOAA closes Gulf spill area to fishing. Food safety news. May 3, 2010. Internet website: http://www.foodsafetynews.com/2010/05/noaa-closes-spill-area-to-fishing/. Accessed November 10, 2011.

Ford, R.G., G.W. Page, and H.R. Carter. 1987. Estimating mortality of seabirds from oil spills. In: Proceedings of the 1987 Oil Spill Conference. Washington, DC: American Petroleum Institute. Pp. 747-751.

Fowler, A.C. and P.L. Flint. 1997. Persistence rates and detection probabilities of oiled King Eider carcasses on beaches of St. Paul Island, Alaska. Marine Pollution Bulletin 34:522-526.

Frithsen, J.B., R. Elmgren, and D.T. Rudnick. 1985. Responses of benthic meiofauna to long-term, low-level additions of No. 2 fuel oil. Marine Ecology Progress Series 23:1-14.

Fry, D.M., J. Swenson, L.A. Addiego, C.R. Grau, and A. Kang. 1986. Reduced reproduction of wedge-tailed shearwaters exposed to weathered Santa Barbara crude oil. Archives of Environmental Contamination and Toxicology 15:453-463.

Ganning, B., D.J. Reish, and D. Straughan. 1984. Recovery and restoration of rocky shores, sandy beaches, tidal flats, and shallow subtidal bottoms impacted by oil spill. In: Cairns, J., Jr. and A.L. Buikema, Jr., eds. Restoration of habitats impacted by oil spills. Boston, MA.

George-Ares, A. and J.R. Clark. 2000. Aquatic toxicology of two Corexit® registered dispersants. Chemosphere 40(8):897-906.

Geraci, J.R. and D.J. St. Aubin, eds. 1990. Sea mammals and oil: Confronting the risks. San Diego, CA: Academic Press.

Gesteria, J.L.G. and J.C. Dauvin. 2000. Amphipods are good bioindicators of the impact of oil spills on sift-bottom macrobenthic communities. Marine Pollution Bulletin 40(11):1017-1027.

Gittings, S.R., T.J. Bright, W.W. Schroeder, W.W. Sager, J.S. Laswell, and R. Rezak. 1992. Invertebrate assemblages and ecological controls on topographic features in the northeast Gulf of Mexico. Bulletin of Marine Science 50(3):435-455.

Golet, G.H., P.E. Seisner, A.D. McGuire, D.D. Roby, J.B. Fischer, K.J. Kuletz, D.B. Irons, T.A. Dean, S.C. Jewett, and S.H. Newman. 2003. Long-term direct and indirect effects of the *Exxon Valdez* oil spill on pigeon guillemots in Prince William Sound, Alaska. Marine Ecology Progress Series 241:287-304.

Gómez Gesteira, J.L. and J.C. Dauvin. 2000. Amphipods are good bioindicators of the impact of oil spills on soft-bottom macrobenthic communities. Marine Pollution Bulletin 40(11):1017-1027.

González, J, F.G. Figueiras, M. Aranguren-Gassis, B.G. Crespo, E. Fernández, X.A.G. Morán, and M. Nieto-Cid. 2009. Effect of a simulated oil spill on natural assemblages of marine phytoplankton enclosed in microcosms. Estuarine, Coastal and Shelf Science 83(3):265-276.

Graham, W.M., R.H. Condon, R.H. Carmichael, I. D'Ambra, H.K. Patterson, L.J. Linn, and F.J. Hernandez, Jr. 2010. Oil carbon entered the coastal planktonic food web during the *Deepwater Horizon* oil spill. Environ. Res. Lett. 5 045301:1-6.

Guzmán, H.M. and I. Holst. 1993. Effects of chronic oil-sediment pollution on the reproduction of the Caribbean reef coral *Siderastrea siderea*. Marine Pollution Bulletin 26:276-282.

Guzman, H.M., J.B.C. Jackson, and E. Weil. 1991. Short-term ecological consequences of a major oil spill on Panamanian subtidal reef corals. Coral Reefs 10:1-12.

Haddad, R. and S. Murawski. 2010. Analysis of hydrocarbons in samples provided from the cruise of the R/V *Weatherbird II*, May 23-26, 2010. U.S. Dept. of Commerce, National Oceanographic and Atmospheric Administration, Silver Spring, MD. 14 pp.

Haig, S.M., C.L. Ferland, F.J. Cuthbert, J. Dingledine, J.P. Goossen, A. Hecht, and N. McPhillips. 2005. A complete species census and evidence for regional declines in piping plovers. Journal of Wildlife Management 69:160-173.

Hamilton, P. 1990. Deep currents in the Gulf of Mexico. Journal of Physical Oceanography 20:1087-1104.

Hargreaves, S. 2010. Drilling ban: Jobs at stake. Internet website: http://money.cnn.com/2010/06/24/news/economy/drilling_jobs_at_stake/index.htm?postversion=2010062410. Accessed November 10, 2011.

Hazen, T.C., E.A. Dubinsky, T.Z. DeSantis, G.L. Andersen, Y.M. Picento, N. Singh, J.K. Jansson, A. Probst, S.E. Borglin, J.L. Fortney, W.T. Stringfellow, M. Bill, M.S. Conrad, L.M. Tom, K.L. Chavarria, T.R. Alusi, R. Lamendella, D.C. Joyner, C. Spier, J. Baelum, M. Auer, M.L. Zelma, R. Chakraborty, E.L. Sonnenthal, P. D'haeseleer, H.N. Holman, S. Osman, Z. Lu, J.D. Van Nostrand, Y. Deng, J. Zhou, and O.U. Mason. 2010. Deep-sea oil plume enriches indigenous oil-degrading bacteria. Science Express. August 24, 2010.

Hemmer, M.J., M.G. Barron, and R.M. Greene. 2010. Comparative toxicity of Louisiana sweet crude oil (LSC) and chemically dispersed LSC to two Gulf of Mexico aquatic test species. U.S. Environmental Protection Agency, Office of Research and Development. July 31, 2010.

Hemmerling, S.A. and C.E. Colten. 2003. Environmental justice considerations in Lafourche Parish, Louisiana: Final report. U.S. Dept. of the Interior, Minerals Management Service, Gulf of Mexico OCS Region, New Orleans, LA. OCS Study MMS 2003-038. 348 pp.

Henry, J.M. and C.L. Bankston III. 1999. Louisiana Cajun ethnicity: Symbolic or structural? Sociological Spectrum: Mid-South Sociological Association, 1521-0707, 19(2):223-248.

Hernandez, D. 2010. Here's where BP is dumping its oil spill waste. ColorLines. August 4 2010. Internet website: http://colorlines.com/archives/2010/08/heres_where_bp_is_dumping_its_oil_spill_waste.html. Accessed November 17, 2011.

Hernandez, F.J., S. Powers, and W. Graham. 2010. Seasonal variability in ichthyoplankton abundance and seasonal composition in the northern Gulf of Mexico off Alabama. Fish Bull 108:193-207.

Hiett, R.L. and J.W. Milon. 2002. Economic impact of recreational fishing and diving associated with offshore oil and gas structures in the Gulf of Mexico: Final report. U.S. Dept. of the Interior, Minerals Management Service, Gulf of Mexico OCS Region, New Orleans, LA. OCS Study MMS 2002-010. 98 pp.

Hing, L.S., T. Ford, P. Finch, M. Crane, and D. Morritt. 2011. Laboratory stimulation of oil-spill effects on marine phytoplankton. Aquat. Toxicol. 103(1-2):32-7.

Hogan, J.L. 2003. Occurrence of the diamondback terrapin (*Malaclemys terrapin littoralis*) at South Deer Island in Galveston Bay, Texas, April 2001–May 2002. U.S. Dept. of the Interior, Geological Survey. USGS Open File Report 03-022. 30 pp.

Howell, K. 2010. Gulf spill roundup. *Greenwire*, July 2, 2010.

Hsieh, J.L., J.S. Fries, and R.T. Noble. 2007. *Vibrio* and phytoplankton dynamics during the summer of 2004 in a eutrophying estuary. Ecological Applications 17(5):S102-S109.

Institute of Medicine. 2010. Assessing the effects of the Gulf of Mexico oil spill on human health: A summary of the June 2010 workshop. Washington, DC: The National Academies Press. Internet website: http://www.iom.edu/Reports/2010/Assessing-the-Effects-of-the-Gulf-of-Mexico-Oil-Spill-on-Human-Health.aspx. Accessed November 10, 2011.

Jackson, J.B.C., J.D. Cubit, B.D. Keller, V. Batista, K. Burns, H.M. Caffey, R.L. Caldwell, S.D. Garrity, C.D. Getter, C. Gonzalez, H.M. Guzman, K.W. Kaufmann, A.H. Knap, S.C. Levings, M.J. Marshall, R. Steger, R.C. Thompson, and E. Weil. 1989. Ecological effects of a major oil spill on Panamanian coastal marine communities. Science 243:37-44.

Jernelöv, A. and O. Lindén. 1981. *Ixtoc I*: A case study of the world's largest oil. Ambio 10(6):299-306.

Jindal, Governor Bobby. 2010. Governor Jindal letter to President Obama and Secretary Salazar: Severe impacts of moratorium on deepwater drilling. Internet website: http://emergency.louisiana.gov/Releases/06032010-letter.html. Accessed November 10, 2011.

Johansen, O., H. Rye, and C. Cooper. 2001. DeepSpill JIP—field study of simulated oil and gas blowouts in deep water. In: Proceedings from the Fifth International Marine Environment Modeling Seminar, October 9-11, 2001, New Orleans, LA. 377 pp.

Joint Analysis Group. 2010a. Review of R/V *Brooks McCall* data to examine subsurface oil. Internet website: http://www.noaa.gov/sciencemissions/PDFs/JAG_Report_1_BrooksMcCall_Final_June20.pdf. Accessed November 10, 2011.

Joint Analysis Group. 2010b. Review of preliminary data to examine oxygen levels in the vicinity of MC525#1. May 8 to August 9, 2010. Internet website: http://www.noaa.gov/sciencemissions/PDFs/JAG_Oxygen_Report%20(FINAL%20090410).pdf. Accessed November 10, 2011.

Kaplan, M.F. and C. Whitman. Unpublished. Measuring the economic impact of tourism and recreation industries on Gulf Coast communities—Relationship between OCS development and coastal resources (2008). U.S. Dept. of the Interior, Minerals Management Service, Gulf of Mexico OCS Region, New Orleans, LA. U.S. Dept. of the Interior, Minerals Management Service, Gulf of Mexico OCS Region, New Orleans, LA. Contract No. 1435-01-99-CA-30951-18261. x + 164 pp.

Kennedy, C.J., N.J. Gassman, and P.J. Walsh. 1992. The fate of benzo[a]pyrene in the Scleractinian corals *Favia fragrum* and *Montastrea annularis*. Marine Biology 113:313-318.

Keithly, W and H. Diop. 2001. The demand for eastern oysters, Crassostrea virginica, from the Gulf of Mexico in the presence of *Vibrio vulnificus*. Marine Fisheries Review 63(1):47-53.

Kingston, P.F., I.M.T. Dixon, S. Hamilton, and D.C. Moore. 1995. The impact of the *Braer* oil spill on the macrobenthic infauna of the sediments off the Shetland Islands. Marine Pollution Bulletin 30(7):445-459.

Kirkeleit J., T. Riise, M. Bråtveit and B.E. Moen. 2008. Increased risk of acute myelogenous leukemia and multiple myeloma in a historical cohort of upstream petroleum workers exposed to crude oil. Cancer Causes Control. 2008 Feb, 19(1):13-23. Epub 2007 Sep 29. Internet website: http://www.ncbi.nlm.nih.gov/pubmed/17906934. Accessed November 10, 2011.

Kirsch, E.M. and J.G. Sidle. 1999. Status of the interior population of least tern. Journal of Wildlife Management 63:470-483.

Knap, A.H. 1987. Effects of chemically dispersed oil on the brain coral, *Diploria strigosa*. Marine Pollution Bulletin 18(3):119-122.

Knap, A.H., J.E. Solbakken, R.E. Godge, T.D. Sleeter, S.C. Wyers, and K.H. Palmork. 1982. Accumulation and elimination of (9-14C) phenanthrene in the reef-building coral (*Diploria strigosa*). Bulletin of Environmental Contamination and Toxicology 28:281-284.

Knap, A.H., S.C. Wyers, R.E. Dodge, T.D. Sleeter, H.R. Frith, S.R. Smith, and C.B. Cook. 1985. The effects of chemically and physically dispersed oil on the brain coral, *Diploria strigosa* (Dana)—a summary review. In: Proceedings 1985 Oil Spill Conference, Los Angeles, CA. (USCG/API/EPA) API Publ. No. 4385:547-551.

Knowland Group, The. 2010. Survey data. Internet website: http://www.hotelnewsresource.com/article46295.html. Accessed November 10, 2011.

Kushmaro, A., G. Henning, D.K. Hofmann, and Y. Benayahu. 1997. Metamorphosis of *Heteroxenia fuscescens* Plaunlae (Cnidaria: Octocorallia) is inhibited by crude oil: A novel short term toxicity bioassay. Marine Environmental Research 43(4):295-302.

Lange, R. 1985. A 100 ton experimental oil spill at Halten Bank, off Norway. In: Proceedings, 1985 Oil Spill Conference. . .February 25-28, 1985, Los Angeles, CA. Washington, DC: American Petroleum Institute.

LeDee, O.E., F.J. Cuthbert, and P.V. Bolstad. 2008. A remote sensing analysis of coastal habitat composition for a threatened shorebird, the piping plover (*Charadrius melodus*). Journal of Coastal Research 24:719-726.

Leighton, F.A. 1993. The toxicity of petroleum oils to birds. Environ. Rev. 1:92-103.

Lewis, J.B. 1971. Effects of crude oil and oil spill dispersant on coral reefs. Marine Pollution Bulletin 2:59-62.

Lin, Q., I.A. Mendelssohn, M.T. Suidan, K. Lee, and A.D. Venosa. 2002. The dose-response relationship between No. 2 fuel oil and the growth of the salt marsh grass, *Spartina alterniflora*. Marine Pollution Bulletin 44:897-902.

Lin Q. and I. Mendlessohn. 2009. Potential of restoration and phytoremediation with *Juncus roemerianus* for diesel-contaminated coastal wetlands. Ecological Engineering 8 January 2009, pp. 85-91. Internet website: http://www.sciencedirect.com/science?_ob=ArticleURL&_udi=B6VFB-4V2J6J8-4&_user=10&_coverDate=01%2F08%2F2009&_rdoc=1&_fmt=high&_orig=search&_origin=search&_sort=d&_docanchor=&view=c&_searchStrId=1619317074&_rerunOrigin=scholar.google&_acct=C000050221&_version=1&_urlVersion=0&_userid=10&md5=e4e701499ce803ec8e0d60bf57c2d99c&searchtype=a. Accessed November 10, 2011.

Louisiana, The State of. 2010a. Report on oil sightings throughout coastal Louisiana. Press Release. September 17, 2010. Internet website: http://emergency.louisiana.gov/Releases/91710Sightings.html. Accessed November 10, 2011.

Louisiana, The State of. 2010b. Report on oil sightings throughout coastal Louisiana. Press Release. September 16, 2010. Internet website: http://emergency.louisiana.gov/Releases/091610Sightings.html. Accessed November 10, 2011.

Louisiana, The State of. 2010c. Report on oil sightings throughout coastal Louisiana. Press Release. September 14, 2010. Internet website: http://emergency.louisiana.gov/Releases/91410Sightings.html. Accessed November 10, 2011.

Louisiana, The State of. 2010d. Report on oil sightings throughout coastal Louisiana. Press Release. September 13, 2010. Internet website: http://emergency.louisiana.gov/Releases/91310Sightings.html. Accessed November 10, 2011.

Louisiana, The State of. 2010e. Report on coastal skimming activities in Louisiana. Press Release. September 17, 2010. Internet website: http://emergency.louisiana.gov/Releases/91710Skimming.html. Accessed November 10, 2011.

Louisiana Mid-Continent Oil and Gas Association. 2010. Impact of President Obama's order halting work on 33 exploratory wells in the deepwater Gulf of Mexico. Internet website: http://www.theoildrum.com/node/6595. Accessed November 17, 2011.

Louisiana Universities Marine Consortium (LUMCON). 2010. 2010 Dead zone—one of the largest ever. LUMCON News. Internet website: http://www.gulfhypoxia.net/research/Shelfwide%20Cruises/2010/PressRelease2010.pdf. Accessed November 17, 2011.

Lu, L. and R.S.S. Wu. 2006. A field experimental study on recolonization and succession of macrobenthic infauna in defaunated sediment contaminated with petroleum hydrocarbons. Estuarine, Coastal and Shelf Science 68:627-634.

Lubchenco, J., M. McNutt, B. Lehr, M. Sogge, M. Miller, S. Hammond, and W. Conner. 2010. BP *Deepwater Horizon* oil budget: What happened to the oil? 5 pp. Internet website:http://www.restorethegulf.gov/sites/default/files/imported_pdfs/posted/2931/Oil_Budget_description_8_3_FINAL.844091.pdf. Accessed November 10, 2011.

Lytle, J.S. 1975. Fate and effects of crude oil on an estuarine pond. In: Proceedings, Conference on Prevention and Control of Oil Pollution, San Francisco, CA. Pp. 595-600.

Market Dynamics Research Group. 2010. Importance of leisure travel attributes and perceptions of Louisiana. Internet website: http://www.louisianatravel.com/.

McAuliffe, C.D., A.E. Smalley, R.D. Groover, W.M. Welsh, W.S. Pickle, and G.E. Jones. 1975. Chevron Main Pass Block 41 oil spill: Chemical and biological investigation. In: Proceedings, 1975 Conference on Prevention and Control of Oil Pollution, March 25-27, 1975, San Francisco, CA. Washington, DC: American Petroleum Institute.

McAuliffe, C.D., B.L. Steelman, W.R. Leek, D.F. Fitzgerald, J.P. Ray, and C.D. Barker. 1981. The 1979 southern California dispersant treated research oil spills. In: Proceedings 1981 Oil Spill Conference. March 2-5, 1981, Atlanta, GA. Washington, DC: American Petroleum Institute. Pp. 269-282.

McGimsey, C. 2010. Personal communication. Discussion with the State Archaeologist, Louisiana Division of Archaeology, Department of Culture, Recreation, and Tourism with regard to effects of the oil spill on cultural resources.

Mechalas, B.J. 1974. Pathways and environmental requirements for biogenic gas production in the ocean. In: Kaplan, I.R., ed. Natural Gases in Marine Sediments. Marine Science, Volume 3. New York, NY: Plenum Press.

Michel, J. 1992. Chapter 2. Oil behavior and toxicity. In: Introduction to coastal habitats and biological resources for spill response. U.S. Dept. of Commerce, National Oceanic and Atmospheric Administration, Office of Response and Restoration. NOAA Report No. HMRAD 92-4. Internet website: http://response.restoration.noaa.gov/type_subtopic_entry.php?RECORD_KEY%28entry_subtopic_type%29=entry_id,subtopic_id,type_id&entry_id(entry_subtopic_type)=275&subtopic_id(entry_subtopic_type)=8&type_id(entry_subtopic_type)=2. Accessed November 10, 2011.

Mitchell, R. and I. Chet. 1975. Bacterial attack of corals in polluted seawater. Microbial Ecology 2:227-233.

Mock, B. 2010. Boats moored by the BP oil spill, a long-threatened community of black fishers fears for its future. The Lens: Investigating New Orleans and the Gulf Coast. Internet website: http://www.projectnola.com/component/content/article/86-the-lens/90049-boats-moored-by-the-bp-oil-spill-a-long-threatened-community-of-black-fishers-fears-for-its-future. Accessed November 10, 2011.

Moore, S.F. and R.L. Dwyer. 1974. Effects of oil on marine organisms: A critical assessment of published data. Water Research 8:819-827.

Morton R.A., T.L. Miller, and L.J. Moore. 2004. Historical shoreline changes along the US Gulf of Mexico: A summary of recent shoreline. U.S. Dept. of the Interior, Geological Survey. Open File Report 2004-1089. Internet website: http://pubs.usgs.gov/of/2004/1089/references.html. Accessed November 10, 2011.

Murray, S.P. 1998. An observational study of the Mississippi/Atchafalaya coastal plume: Final report. U.S. Dept. of the Interior, Minerals Management Service, Gulf of Mexico OCS Region, New Orleans, LA. OCS Study MMS 98-0040. 513 pp.

National Association for the Advancement of Colored People (NAACP). 2010. NAACP blasts BP for oil spill response. July 10, 2010.

National Research Council (NRC). 2003. Oil in the sea III: Inputs, fates, and effects (Committee on Oil in the Sea: J.N. Coleman, J. Baker, C. Cooper, M. Fingas, G. Hunt, K. Kvenvolden, J. McDowell, J. Michel, K. Michel, J. Phinney, N. Rabalais, L. Roesner, and R.B. Spies). Washington, DC: National Academy Press. 265 pp.

National Research Council (NRC). 2005. Oil spill dispersants: Efficacy and effects. Washington, DC: National Academy Press. 377 pp.

NaturalGas.org. 2010. Background. Internet website: http://www.naturalgas.org/overview/background.asp. Accessed November 10, 2011.

Neff, J.M., S. McKelvie, and R.C. Ayers, Jr. 2000. Environmental impacts of synthetic based drilling fluids. U.S. Dept. of the Interior, Minerals Management Service, Gulf of Mexico OCS Region, New Orleans, LA. OCS Study MMS 2000-064. 118 pp.

Newton, I. 1998. Population limitation in birds. San Diego, CA: Academic Press.

Nodar, J. 2010. Gulf tanker decontaminated before entering Mississippi. The Journal of Commerce Online. May 26, 2010. Internet website: http://www.joc.com/maritime/tanker-requires-cleaning-entering-mississippi-river. Accessed November 10, 2011.

Nolan, B. and A. Good. 2010. Moratorium in wake of Gulf oil spill idles much more than rigs, workers. Internet website: http://www.nola.com/news/gulf-oil-spill/index.ssf/2010/07/moratorium_in_wake_of_gulf_oil.html. Accessed November 10, 2011.

OBIS-SEAMAP. 2009. Sea turtle nesting sites: OBIS-SEAMAP. State of the World's Sea Turtles (SWOT). 2009. Internet website: http://seamap.env.duke.edu/swot. Accessed November 10, 2011.

Odess, D. 2010. Personal communication. Telecon regarding Section 106 in relation to response to the oil spill.

Odess, D. 2011. Personal communication. Trustees Meeting January 12, 2011, New Orleans, LA.

Office of the Governor, State of Florida. 2010. Gulf oil spill situation update. Florida Releases. July 18, 2010. Internet website: http://www.thegovmonitor.com/world_news/united_states/florida-releases-july-18-2010-gulf-oil-spill-situation-update-35721.html. Accessed November 10, 2011.

Operational Science Advisory Team (OSAT). 2010. Summary report for sub-sea and sub-surface oil and dispersant detection: Sampling and monitoring. Unified Area Command, New Orleans, LA. Released on December 17, 2010. Internet website: http://www.restorethegulf.gov/sites/default/files/documents/pdf/OSAT_Report_FINAL_17DEC.pdf. Accessed November 18, 2011.

Operational Science Advisory Team (OSAT-2). 2011. Summary report for fate and effects of remnant oil remaining in the beach environment. Annex B: Spatial oil distribution. 35 pp. Internet website: http://www.restorethegulf.gov/sites/default/files/u316/OSAT-2%20Report%20no%20ltr.pdf. Accessed November 10, 2011.

Oxford Economics. 2010. Potential impact of the Gulf oil spill on tourism. Internet website: http://www.ustravel.org/sites/default/files/page/2009/11/Gulf_Oil_Spill_Analysis_Oxford_Economics_710.pdf. Accessed November 10, 2011.

Patin, S. 1999. Gas impacts on fish and other marine organisms. In: Environmental impact of the offshore oil and gas industry. New York, NY: EcoMonitor Publishing. 425 pp.

PCCI Marine and Environmental Engineering (PCCI). 1999. Oil spill containment, remote sensing and tracking for deepwater blowouts: Status of existing and emerging technologies, final report. Prepared for U.S. Dept. of the Interior, Minerals Management Service, Alexandria, VA. Purchase Order Number 1435-01-98-PO-15135. Internet website: http://www.boemre.gov/tarprojects/311/311AA.pdf. Accessed November 18, 2011.

Peterson, C.H., S.D. Rice, J.W. Short, D. Esler, J.L. Bodkin, B.E. Ballachey, and. D.B. Irons. 2003. Long-term ecosystem response to the *Exxon Valdez* oil spill. Science 302:2082-2086.

Piatt, J.F. and R.G. Ford. 1996. How many seabirds were killed by the *Exxon Valdez* oil spill? In: Rice, S.D., R.B. Spies, D.A. Wolfe, and B.A. Wright, eds. Proceedings of the *Exxon Valdez* oil spill symposium. Am. Fisheries Soc. Symposium 18, Bethesda, MD. Pp. 712-719.

Piatt, J.F., H.R. Carter, and D.N. Nettleship. 1990. Effects of oil pollution on marine bird populations. In: White, J., ed. The effects of oil on wildlife: Research, rehabilitation and general concerns. Hanover, PA: Sheridan Press.

Plotkin, P.T., ed. 1995. National Marine Fisheries Service and U.S. Fish and Wildlife Service Status reviews for sea turtles listed under the Endangered Species Act of 1973. U.S. Dept. of Commerce, National Marine Fisheries Service, Silver Spring, MD.

Powell, J.A. and G.B. Rathbun. 1984. Distribution and abundance of manatees along the northern coast of the Gulf of Mexico. Northeast Gulf Sci. 7:1-28.

Pritchard, E.S., ed. 2009. Fisheries of the United States: 2008. U.S. Dept. of Commerce, National Marine Fisheries Service, Office of Science and Technology, Fisheries Statistics Division, Silver Spring, MD.

Rabalais, N.N., R.E. Turner, and W.J. Wiseman, Jr. 2002. Gulf of Mexico hypoxia, A.K.A. "The Dead Zone." Annual Review of Ecological Systems 33:235-263.

Ragen, T.J. 2010. Testimony of Timothy J. Ragen, Executive Director, U.S. Marine Mammal Commission, before the House Subcommittee on Insular Affairs, Oceans, and Wildlife, regarding the *Deepwater Horizon* oil spill and its effects on marine mammals. June 10, 2010. 8 pp. Internet website: http://www.mmc.gov/testimony/pdf/testimony_061010.pdf. Accessed November 10, 2011.

Rathbun, G.B., J.P. Reid, and G. Carowan. 1990. Distribution and movement patterns of manatees (*Trichechus manatus*) in northwestern peninsular Florida. FL Mar. Res. Publ. No. 48. 33 pp.

Ravitz, J. 2010. Vietnamese fishermen in Gulf fight to not get lost in translation. CNN. June 25, 2010. Internet website: http://www.flutrackers.com/forum/showthread.php?t=148708. Accessed November 10, 2011.

Regg, J. 2000. Deepwater development: A reference document for the deepwater environmental assessment, Gulf of Mexico OCS (1997 through 2000). U.S. Dept. of the Interior, Minerals Management Service, Gulf of Mexico OCS Region, New Orleans, LA. OCS Report MMS 99-0066.

Restrepo, C.E., F.C. Lamphear, C.A. Gunn, R.B. Ditton, J.P. Nichols, and L.S. Restrepo. 1982. IXTOC I oil spill economic impact study, executive summary. Report prepared by Restrepo and Associates for the U.S. Dept. of the Interior, Bureau of Land Management, New Orleans OCS Office, New Orleans, LA.

Rhodes, D.C. and J.D. Germano. 1982. Characterization of organism-sediment relations using sediment profile imaging: An efficient method of remote ecological monitoring of the seafloor (Remots™ System). Marine Ecology Progress Series 8:115-128.

Rice, S.A. and C.L. Hunter. 1992. Effects of suspended sediment and burial on Scleractinian corals from west central Florida patch reefs. Bulletin of Marine Science 51(3):429-442.

Rogers, C.S. 1990. Responses of coral reefs and reef organisms to sedimentation. Marine Ecology Progress Series 62:185-202.

Rogers, C.S. and V.H. Garrison. 2001. Ten years after the crime: Lasting effects of damage from a cruise ship anchor on a coral reef in St. John, U.S. Virgin Islands. Bulletin of Marine Science 69(2):793-803.

Russell, R.W. 2005. Interactions between migrating birds and offshore oil and gas platforms in the northern Gulf of Mexico: Final Report. U.S. Dept. of the Interior, Minerals Management Service, U.S. Dept. of the Interior, Minerals Management Service, Gulf of Mexico OCS Region, New Orleans, LA. OCS Study MMS 2005-009. 348 pp.

Sanders, H.L., J.F. Grassle, G.R. Hamson, L.S. Morse, S. Garner-Price, and C.C. Jones. 1980. Anatomy of an oil spill: Long-term effects from the grounding of the barge *Florida* off West Falmouth, Massachusetts. Journal of Marine Research 38:265-380.

Savitz, D.A. and L.S. Engel. 2010. Lessons for study of the health effects of oil spills. Annals of Internal Medicine. August 23, 2010. Internet website: http://www.annals.org/content/early/2010/08/23/0003-4819-153-8-201010190-00276.full. Accessed November 10, 2011.

Sathiakumar, N. 2010. Short-term physical effects of oil spills. Presentation, School of Public Health, University of Alabama at Birmingham. Internet website: http://www.iom.edu/~/media/Files/Activity%20Files/PublicHealth/OilSpillHealth/NaliniSathiakumar-6-22-1110am.pdf. Accessed November 10, 2011.

Scarlett, A., T.S. Galloway, M. Canty, E.L. Smith., J. Nilsson, and S.J. Rowland. 2005. Comparative toxicity of two oil dispersants, Superdispersant-25 and Corexit 9527, to a range of coastal species. Environmental Toxicology and Chemistry 24(5):1219-1227.

Schenkman, L. 2010. Gulf cruise raises questions on methane, but much data still to analyze. *Science Insider*. June 23, 2010. Internet website: http://news.sciencemag.org/scienceinsider/2010/06/gulf-cruise-raises-questions-on-.html. Accessed November 10, 2011.

Schiro, A.J., D. Fertl, L.P. May, G.T. Regan, and A. Amos. 1998. West Indian manatee (*Trichechus manatus*) occurrence in U.S. waters west of Florida. Presentation, World Marine Mammal Conference, 20-24 January, Monaco.

Schleifstein, M. 2010. Environmental justice concerns arising from Gulf of Mexico oil spill aired. *The Times-Picayune*. June 15, 2010. Internet website: http://www.nola.com/news/gulf-oil-spill/index.ssf/2010/06/environmental_justice_concerns.html. Accessed November 10, 2011.

Scholz, D.K., J.H. Kucklick, R.G. Pond, A.H. Walker, A. Bostrom, and P. Fischbeck. 1999. Fate of spilled oil in marine waters: Where does it go? What does it do? How do dispersants affect it? An information booklet for decision-makers. American Petroleum Institute Publication Number 4691.

ScienceDaily. 2010. Spawning habitat of bluefin tuna in Gulf of Mexico: Critical area intersects *Deepwater Horizon* oil spill. May 31, 2010. Internet website: http://www.sciencedaily.com/releases/2010/05/100528210726.htm. Accessed November 10, 2011.

Shah J.J. and H.B. Singh. 1988. Distribution of volatile organic chemicals in outdoor and indoor air. Environ. Sci. Technol. 22:1381-1388. In: U.S. Dept. of Health and Human, Services Public Health Service Agency for Toxic Substances and Disease Registry. Toxicological profile for benzene, August 2007.

Sheridan, P. and T.J. Minello. 2003. Nekton use of different habitat types in seagrass beds of lower Laguna Madre, Texas. Bulletin of Marine Science 72(1):37-61.

Shigenaka, G. 2001. Toxicity of oil to reef-building corals: A spill response perspective. U.S. Dept. of Commerce, National Oceanic and Atmospheric Administration, Office of Response and Restoration, Hazardous Materials Response Division, Seattle, WA. NOAA Technical Memorandum NOS OR&R 8. 95 pp. Internet website: http://response.restoration.noaa.gov/book_shelf/1_coral_tox.pdf. Accessed November 10, 2011.

Short, F.T. and R.G. Coles, eds. 2001. Global seagrass research methods. Amsterdam, The Netherlands: Elsevier Science B.V. 473 pp.

Short, F.T., R.G. Coles, and C. Pergent-Martini. 2001. Global seagrass distribution. In: Short, F.T. and R.G. Coles, eds. Global seagrass research methods. Amsterdam, The Netherlands: Elsevier Science B.V. Pp. 5-6, 20.

St. Aubin, D.J. and V. Lounsbury. 1990. Oil effects on manatees: Evaluating the risks. In: Geraci, J.R. and D.J. St. Aubin, eds. Sea mammals and oil: Confronting the risk. San Diego, CA: Academic Press. Pp. 241-251.

Stumpf, C.H., M.F. Piehler, S. Thompson, and R.T. Noble. 2010. Loading of fecal indicator bacteria in tidal creek headwaters: Hydrographic, meteorological, and terrestrial runoff relationships. Journal of Water Research 44(16):4704-15.

Szell, C.C. and M.S. Woodrey. 2003. Reproductive ecology of the least tern along the lower Mississippi River. Waterbirds 26:35-43.

Tacha, T.C., S.A. Nesbitt, and P.A. Vohs. 1992. Sandhill crane (*Grus canadensis*). In: Poole, A., ed. The birds of North America (online). Ithaca: Cornell Lab of Ornithology; retrieved from The Birds of North America online: http://bna.birds.cornell.edu/bna/species/031. Accessed November 10, 2011.

Tasker, M.L., P. Hope-Jones, B.F. Blake, T.J. Dixon, and A.W. Wallis. 1986. Seabirds associated with oil production platforms in the North Sea. Ringing and Migration 7:7-14.

Taylor, H.A., M.A. Rasheed, and R. Thomas. 2006. Port Curtis post oil spill seagrass assessment, Gladstone-2006. DPI&F Information Series QI06046 (DPI&F, Cairns). 19 pp. Internet website: http://www.seagrasswatch.org/Info_centre/Publications/pdf/meg/GladstonePostOilSpillReport2006_Final.pdf. Accessed November 10, 2011.

The Federal Interagency Solutions Group. 2010. Oil budget calculator: *Deepwater Horizon*. 217 pp. The Federal Interagency Solutions Group, Oil Budget Calculator Science and Engineering Team. Internet website: http://www.restorethegulf.gov/sites/default/files/documents/pdf/OilBudgetCalc_Full_HQ-Print_111110.pdf. Accessed November 10, 2011.

Thompson, J.H. 1980. Effects of drilling mud on seven species of reef-building coral as measured in field and laboratory. Report to the U.S. Dept. of Interior, Geological Survey by Texas A&M University, Department of Oceanography, College Station, TX.

Tokotch, B. 2010. Oil and coral fact sheet. 3 pp. Internet website: http://sero.nmfs.noaa.gov/sf/deepwater_horizon/Oil-CoralOnePage.pdf. Accessed November 10, 2011.

Tolbert, C.M. 1995. Oil and gas development and coastal income inequality: A comparative analysis. U.S. Dept. of the Interior, Minerals Management Service, Gulf of Mexico OCS Region, New Orleans, LA. OCS Study MMS 94-0052. 75 pp.

Trapido, E.J., Sc.D., F.A.C.E. 2010. Health and the *Deepwater Horizon* Gulf oil spill. (October 5-6, 2010). JSOST *Deepwater Horizon* Oil Spill Principal Investigator (PI) Conference, St. Petersburg, FL.

Unified Incident Command. 2010a. Vessel decontamination stations available around Louisiana. *Deepwater Horizon* Incident Joint Information Center. June 20, 2010.

Unified Incident Command. 2010b. Ask a responder: Q & A with Coast Guard Task Force leader for commercial vessel decontamination. September 29, 2010.

Unified Incident Command. 2010c. Media availability: Media invited to observe commercial-vessel decontamination operations. June 23, 2010.

Unified Incident Command. 2010d. Fish and Wildlife report, consolidated Fish and Wildlife collection report.

Unified Incident Command. 2010e. Unified Area Command continues to build a sea turtle observer program for on-water oil clean-up. *Deepwater Horizon* Incident Joint Information Center. July 2, 2010.

Unified Incident Command. 2010f. Unified Area Command daily report, August 25, 2010.

U.S. Department of Commerce. Economics and Statistics Administration. 2010. Estimating the economic effects of the deepwater drilling moratorium on the Gulf Coast economy: Inter-agency economic report. 25 pp. Internet website: http://www.esa.doc.gov/sites/default/files/reports/documents/drillingmoratorium.pdf. Accessed November 18, 2011.

U.S. Department of Commerce. National Oceanic and Atmospheric Administration (NOAA). 2010a. NOAA assists with multi-agency effort to decontaminate ships passing through oil spill. Internet website: http://www.noaanews.noaa.gov/stories2010/20100528_ships.html. Accessed November 10, 2011.

U.S. Department of Commerce. National Oceanic and Atmospheric Administration (NOAA). 2010b. Administration's Joint Analysis Group releases first scientific report on subsea monitoring data from Gulf spill. Internet website: http://www.noaanews.noaa.gov/stories2010/20100623_brooks.html. Accessed November 10, 2011.

U.S. Department of Commerce. National Oceanic and Atmospheric Administration (NOAA). 2010c. Second Federal analysis gives further clues about location and movement of subsurface oil. July 23, 2010. Internet website: http://www.noaanews.noaa.gov/stories2010/20100722_jag.html.

U.S. Department of Commerce. National Oceanic and Atmospheric Administration (NOAA). 2010d. No dead zones observed or expected as part of BP *Deepwater Horizon* oil spill. September 7, 2010. Internet website: http://www.noaanews.noaa.gov/stories2010/20100907_jag3.html.

U.S. Department of Commerce. National Oceanic and Atmospheric Administration (NOAA). 2010e. Using booms in response to oil spills. 4 pp. Internet website: http://sero.nmfs.noaa.gov/sf/deepwater_horizon/NOAA_boom_fact_sheet.pdf. Accessed November 10, 2011.

U.S. Department of Commerce. National Oceanic and Atmospheric Administration (NOAA). 2010f. What is an ecosystem? Internet website: http://ecosystems.noaa.gov/what_eco.htm. Accessed November 10, 2011.

U.S. Department of Commerce. National Oceanic and Atmospheric Administration (NOAA). 2010g. NOAA closes commercial and recreational fishing in oil-affected portion of Gulf of Mexico. May 2, 2010. Internet website: http://www.noaanews.noaa.gov/stories2010/20100502_fisheries.html. Accessed November 10, 2011.

U.S. Department of Commerce. National Oceanic and Atmospheric Administration (NOAA). Hazardous Materials Response and Assessment Division. 1992. Oil spill case histories, 1967-1991: Summaries of significant U.S. and international spills. HMRAD 92-11 to USCG Research and Development Center, Seattle, WA.

U.S. Department of Commerce. National Oceanic and Atmospheric Administration (NOAA). National Marine Fisheries Service (NMFS). 2010a. Sea turtles, dolphins, and whales and the Gulf of Mexico oil spill. Internet website: http://www.nmfs.noaa.gov/pr/health/oilspill.htm. Accessed November 10, 2011.

U.S. Department of Commerce. National Oceanic and Atmospheric Administration (NOAA). National Marine Fisheries Service (NMFS). 2010b. Fisheries economics of the United States, 2008. U.S. Dept. Commerce, NOAA Tech. Memo. NMFS-F/SPO-109. 177 pp. Internet website: http://www.st.nmfs.noaa.gov/st5/publication/index.html. Accessed November 10, 2011.

U.S. Department of Commerce. National Oceanic and Atmospheric Administration (NOAA). National Marine Fisheries Service (NMFS). 2010c Annual commercial landings by group. 2 pp. Internet website: http://www.st.nmfs.noaa.gov/st1/commercial/landings/gc_runc.html. Accessed November 10, 2011.

U.S. Department of Commerce. National Oceanic and Atmospheric Administration (NOAA). National Marine Fisheries Service (NMFS). 2010d. Impacts of oil on marine mammals and sea turtles. 2 pp. Internet website: http://www.nmfs.noaa.gov/pr/pdfs/health/oil_impacts.pdf. Accessed November 10, 2011.

U.S. Department of Commerce. National Oceanic and Atmospheric Administration (NOAA). National Ocean Service (NOS). 2008. Gulf of Mexico at a glance. Washington, DC: U.S. Dept. of Commerce, National Oceanic and Atmospheric Administration.

U.S. Department of Commerce. National Oceanic Atmospheric Administration (NOAA). National Weather Service. 2010a. Tropical cyclone climatology. Internet website: http://www.nhc.noaa.gov/pastprofile.shtml. Accessed November 10, 2011.

U.S. Department of Commerce. National Oceanic Atmospheric Administration (NOAA). National Weather Service. 2010b. NOAA's oil spill response: Hurricanes and the oil spill. Internet website: http://www.nhc.noaa.gov/pdf/hurricanes_oil_factsheet.pdf. Accessed November 10, 2011.

U.S. Department of Commerce. National Oceanic and Atmospheric Administration (NOAA). NOAA Fisheries Service. 2010a. Information about the Federal fishing closure in oil-affected portions of the Gulf of Mexico. U.S. Dept. of Commerce, National Oceanic and Atmospheric Administration, NOAA Fisheries Service, Southeast Regional Office, Saint Petersburg, FL. Southeast Fishery Bulletin, July 12, 2010. Internet website: http://sero.nmfs.noaa.gov/sf/deepwater_horizon/FB_Closure%20info_Eng.pdf Accessed November 10, 2011.

U.S. Department of Commerce. National Oceanic and Atmospheric Administration (NOAA). NOAA Fisheries Service. 2010b. *Deepwater Horizon*/BP oil spill: Size and percent coverage of fishing area closures due to BP oil spill. U.S. Dept. of Commerce, National Oceanic and Atmospheric Administration, NOAA Fisheries Service, Southeast Regional Office, Saint Petersburg, FL. Internet website: http://sero.nmfs.noaa.gov/ClosureSizeandPercentCoverage.htm. Updated April 29, 2011. Accessed November 10, 2011.

U.S. Department of Commerce. National Oceanic and Atmospheric Administration (NOAA). NOAA Fisheries Service. 2011. Dolphins and whales and the Gulf of Mexico oil spill. Internet website: http://www.nmfs.noaa.gov/pr/health/oilspill/mammals.htm. Last updated June 29, 2011. Accessed November 10, 2011.

U.S. Department of Commerce. National Oceanic and Atmospheric Administration (NOAA). Office of Response and Restoration. 2010a. IXTOC I. Internet website: http://www.incidentnews.gov/incident/6250. Accessed November 10, 2011.

U.S. Department of Commerce. National Oceanic and Atmospheric Administration (NOAA). Office of Response and Restoration. 2010b. Chevron Main Pass Block 41. Internet website: http://www.incidentnews.gov/incident/6209. Accessed November 10, 2011.

U.S. Department of Commerce. National Oceanic and Atmospheric Administration (NOAA). Office of Response and Restoration. 2010c. Shell Platform 26. Internet website: http://www.incidentnews.gov/incident/6211. Accessed November 10, 2011.

U.S. Department of Commerce. National Oceanic and Atmospheric Administration (NOAA). Office of Response and Restoration. 2010d. Shoreline threat update: Southern Florida, Florida Keys and East Coast *Deepwater Horizon*/BP oil spill, July 30, 2010. Internet website: http://response.restoration.noaa.gov/topic_subtopic_entry.php?RECORD_KEY%28entry_subtopic_topic%29=entry_id,subtopic_id,topic_id&entry_id(entry_subtopic_topic)=815&subtopic_id(entry_subtopic_topic)=2&topic_id(entry_subtopic_topic)=1#evolution. Accessed November 10, 2011.

U.S. Department of Health and Human Services (USDHHS). 2007. Toxicological profile for benzene. U.S. Dept. of Health and Human Services, Health Service Agency for Toxic Substances and Disease Registry. . August 2007.

U.S. Department of Labor. 2010a. Quarterly census of employment and wages. Internet website: http://www.bls.gov/cew/. Accessed November 17, 2011.

U.S. Department of Labor. 2010b. Quarterly Census of Employment and Wages, fact sheet. June 2010. Internet website: http://www.bls.gov/cew/gulf_coast_leisure_hospitality.htm. Accessed November 10, 2011.

U.S. Department of Labor. Bureau of Labor Statistics (BLS). 2010. Fact sheet: Employment in the oil and gas well drilling industry. Internet website: http://www.bls.gov/cew/oil_gas_drilling.htm. Accessed November 10, 2011.

U.S. Department of Labor. Occupational Safety and Health Administration (OSHA). 2010a. On-shore & off-shore PPE matrix for Gulf operations. Internet website: http://www.osha.gov/oilspills/gulf-operations-ppe-matrix.pdf. Accessed November 17, 2011.

U.S. Department of Labor. Occupational Safety and Health Administration (OSHA). 2010b. Keeping workers safe during oil spill response and cleanup operations: Gulf oil response and heat. Internet website: http://www.osha.gov/oilspills/heatstress.html. Accessed November 10, 2011.

U.S. Department of the Interior. Bureau of Ocean Energy Management, Regulation and Enforcement (BOEMRE). 2010a. Spills ≥50 barrels (2,100 gallons)—1967. Internet website: http://www.boemre.gov/incidents/SigPoll67.htm. Updated September 17, 2010.

U.S. Department of the Interior. Bureau of Ocean Energy Management, Regulation and Enforcement (BOEMRE). 2010b. Gulf of Mexico Region, Spills ≥ 50 barrels (2,100 gallons)—1970. Internet website: http://www.boemre.gov/incidents/SigPoll70.htm. Accessed November 10, 2011.

U.S. Department of the Interior. Bureau of Ocean Energy Management, Regulation and Enforcement (BOEMRE). 2010c. Technical Information Management System (TIMS). Accessed November 10, 2011.

U.S. Dept. of the Interior. Fish and Wildlife Service (FWS). 1973. Amendments to lists of endangered fish and wildlife. Title 50 Code of Federal Regulations Part 17, Federal Register Vol. 38, No. 106, June 4, 1973, page 14678.

U.S. Dept. of the Interior. Fish and Wildlife Service (FWS). 1991. Mississippi sandhill crane recovery plan, U.S. Fish and Wildlife Service, Atlanta, Georgia. 42 pp.

U.S. Department of the Interior. Fish and Wildlife Service (FWS). 2004. Effects of oil spills on wildlife and habitat. December 2004. Internet website: http://alaska.fws.gov/media/unalaska/Oil%20Spill%20Fact%20Sheet.pdf. Accessed November 10, 2011.

U.S. Department of the Interior. Fish and Wildlife Service (FWS). 2007. Alabama beach mouse—revision of critical habitat. January 2007. Daphne Ecological Services Field Office. Internet website: http://www.fws.gov/daphne/abm/pdf/ABM-FactSheet-finalCH-1-30-07.pdf. Accessed November 10, 2011.

U.S. Department of the Interior. Fish and Wildlife Service (FWS). 2009. Stock assessment report for the West Indian manatee Florida stock. U.S. Dept. of the Interior, Fish and Wildlife Service, Jacksonville, FL. December 20, 2009. Internet website: http://www.fws.gov/northflorida/Manatee/SARS/20091230_rpt_Final_Florida_Manatee_SAR.pdf. Accessed November 10, 2011.

U.S. Department of the Interior. Fish and Wildlife Service (FWS). 2010a. Wildlife threatened on the Gulf Coast. June 2010. Internet website: http://www.fws.gov/home/dhoilspill/pdfs/NewWildlifeOfGulf.pdf. Accessed November 10, 2011.

U.S. Department of the Interior. Fish and Wildlife Service (FWS). 2010b. Federally listed wildlife and plants threatened by Gulf oil spill. June 2010. Internet website: http://www.fws.gov/home/dhoilspill/pdfs/FedListedBirdsGulf.pdf. Accessed November 10, 2011.

U.S. Department of the Interior. Fish and Wildlife Service (FWS). 2010c. Beach-nesting birds of the Gulf. May 2010. Internet website: http://www.fws.gov/home/dhoilspill/pdfs/DHBirdsOfTheGulf.pdf. Accessed November 10, 2011.

U.S. Department of the Interior. Fish and Wildlife Service (FWS). 2010d. Bird impact data from DOI-ERDC database download 12 Oct. 2010. Internet website: http://www.fws.gov/home/dhoilspill/pdfs/Bird%20Data%20Species%20Spreadsheet%2010122010.pdf. Accessed November 10, 2011.

U.S. Department of the Interior. Fish and Wildlife Service (FWS). 2010e. State and Federal wildlife agencies, other partners, move to safeguard sea turtle nests; FedEx providing transportation to Florida's Space Coast. News Release, July 9, 2010. Internet website: http://www.fws.gov/southeast/news/2010/r10-048.html. Accessed November 10, 2011.

U.S. Department of the Interior. Fish and Wildlife Service (FWS). 2010f. Species report. Internet website: http://ecos.fws.gov/tess_public/SpeciesReport.do. Accessed November 10, 2011.

U.S. Department of the Interior. Fish and Wildlife Service (FWS). 2010g. Effects of oil on wildlife and habitat. Fact Sheet, June 2010. Internet website: http://www.fws.gov/home/dhoilspill/pdfs/DHJICFWSOilImpactsWildlifeFactSheet.pdf. Accessed November 10, 2011.

U.S. Department of the Interior. Minerals Management Service (MMS). 2000. Gulf of Mexico deepwater operations and activities: Environmental assessment. U.S. Dept. of the Interior, Minerals Management Service, Gulf of Mexico OCS Region, New Orleans, LA. OCS EIS/EA MMS 2000-001. Internet website: http://www.gomr.boemre.gov/PDFs/2000/2000-001.pdf. Accessed November 10, 2011.

U.S. Department of the Interior. Minerals Management Service (MMS). 2007. Gulf of Mexico OCS oil and gas lease sales: 2007-2012; Western Planning Area Sales 204, 207, 210, 215, and 218; Central Planning Area Sales 205, 206, 208, 213, 216, and 222—final environmental impact statement. 2 vols. U.S. Dept. the Interior, Minerals Management Service, Gulf of Mexico OCS Region, New Orleans, LA. OCS EIS/EA MMS 2007-018.

U.S. Department of the Interior. Minerals Management Service (MMS). 2008. Gulf of Mexico OCS oil and gas lease sales: 2009-2012; Central Planning Area Sales 208, 213, 216, and 222; Western Planning Area Sales 210, 215, and 218—final supplemental environmental impact statement. U.S. Dept. of the Interior, Minerals Management Service, Gulf of Mexico OCS Region, New Orleans, LA. OCS EIS/EA MMS 2008-041. Internet website: http://www.gomr.mms.gov/PDFs/2008/2008-041.pdf. Accessed November 10, 2011.

U.S. Department of the Interior. Minerals Management Service (MMS). 2010. Preliminary revised program Outer Continental Shelf Oil and Gas Leasing Program, 2007-2012. Internet website: http://www.boemre.gov/5-year/PDFs/PRP2007-2012.pdf. Accessed November 10, 2011.

U.S. Department of the Interior. National Park Service (NPS). 2010. Managing sea turtles during the oil spill response. 2 pp. Internet website: http://www.restorethegulf.gov/sites/default/files/imported_pdfs/external/content/document/2931/771879/1/NPS_Turtles_Web.pdf. Accessed November 18, 2011.

U.S. Department of Transportation (USDOT). 2010. Gulf Coast ports surrounding the *Deepwater Horizon* oil spill. Fact Sheet, June 2010. U.S. Dept. of Transportation, Research and Innovative Technology Administration. Internet website: http://www.bts.gov/publications/bts_fact_sheets/2010_001/pdf/entire.pdf. Accessed November 10, 2011.

U.S. Department of Transportation. Coast Guard (USCG). 2010. Dispersants/on-water oil removal capacity (CAPS). Internet website: https://homeport.uscg.mil/mycg/portal/ep/contentView.do?contentTypeId=2&channelId=-30095&contentId=125795&programId=114824&programPage=%2Fep%2Fprogram%2Feditorial.jsp&pageTypeId=13489. Accessed November 10, 2011.

U.S. Environmental Protection Agency (USEPA). 2008. Coastal condition report III. U.S. Environmental Protection Agency, Office of Research and Development/Office of Water, Washington, DC. EPA/842-R-08-002. Internet website: http://water.epa.gov/type/oceb/assessmonitor/downloads.cfm. Accessed November 10, 2011.

U.S. Environmental Protection Agency (USEPA). 2010a. Questions and answers about the BP oil spill in the Gulf Coast. Internet website: http://www.epa.gov/BPSpill/qanda.html#waste19. Accessed August 31, 2010.

U.S. Environmental Protection Agency (USEPA). 2010b. Odors from the BP oil spill. Internet website: http://www.epa.gov/BPSpill/odor.html. Accessed November 10, 2011.

U.S. Environmental Protection Agency (USEPA). 2010c. BP's analysis of subsurface dispersant use. Internet website: http://www.epa.gov/bpspill/dispersants-bp.html. Accessed November 10, 2011.

U.S. Environmental Protection Agency (USEPA). 2010d. Recovered oil, contaminated materials and liquid and solid wastes management directive, Louisiana, June 29, 2010. Internet website: http://www.epa.gov/bpspill/waste/wastemanagementdirective_la.pdf. Accessed November 10, 2011.

U.S. Environmental Protection Agency (USEPA). 2010e. Recovered oil, contaminated materials and liquid and solid wastes management directive, Mississippi, Alabama, Florida, June 29, 2010. Internet website: http://www.epa.gov/bpspill/waste/wastemanagementdirective_msalfl.pdf. Accessed November 10, 2011.

U.S. Environmental Protection Agency (USEPA). Office of Research and Development. 2010a. Comparative toxicity of Louisiana sweet crude oil (LSC) and chemically dispersed LSC to two Gulf of Mexico aquatic test species. 13 pp. Internet website: http://www.epa.gov/bpspill/reports/updated-phase2dispersant-toxtest.pdf. Accessed November 10, 2011.

U.S. Environmental Protection Agency (USEPA). Office of Research and Development. 2010b. Analysis of eight oil spill dispersants using *in vitro* tests for endocrine and other biological activity. 47 pp. Appendices 61 pp.

U.S. Travel Association. 2010. The power of travel. Internet website: http://www.poweroftravel.org/statistics. Accessed November 10, 2011.

Vandermeulen, J.H. 1982. Some conclusions regarding long-term biological effects of some major oil spills. Philosophical Transactions of the Royal Society of London. Series B, Biological Sciences 297(1087).

Velando, A., I. Munilla, M. Lopez-Alonso, J. Freire, and C. Perez. 2010. EROD activity and stable isotopes in seabirds to disentangle marine food web contamination after the *Prestige* oil spill. Environmental Pollution 158(2010):1275-1280. Internet website: http://webs.uvigo.es/cristobal/papers/8.EROD%20activity%20and%20stable%20isotopes%20in%20seabirds%20to%20disentangle%20marine%20food%20web%20contamination%20after%20the%20Prestige%20oil%20spill.pdf. Accessed November 10, 2011.

Ward, G.A., B. Baca, W. Cyriacks, R.E. Dodge, and A. Knap. 2003. Continuing long-term studies of the TROPICS Panama oil and dispersed oil spill sites. In: Proceedings 2003 International Oil Spill Conference, April 6-11, 2003, Vancouver, Canada. Washington, DC: American Petroleum Institute.

Webb, J.W. 1988. Establishment of vegetation on oil-contaminated dunes. Shore and Beach, October. Pp. 20-23.

Webb, J.W., G.T. Tanner, and B.H. Koerth. 1981. Oil spill effects on smooth cordgrass in Galveston Bay, Texas. Contributions in Marine Science 24:107-114.

Webb, J.W., S.K. Alexander, and J.K. Winters. 1985. Effects of autumn application of oil on *Spartina alterniflora* in a Texas salt marsh. Environ. Poll., Series A 38(4):321-337.

Wesseling, I., A.J. Uychiaoco, P.M. Aliño, T. Aurin, and J.E. Vermaat. 1999. Damage recovery of four Philippine corals from short-term sediment burial. Marine Ecology Progress Series 176:11-15.

Wetz, J.J., A.D. Blackwood, J.S. Fries, Z.F. Williams, and R.T. Noble. 2008. Trends in total *Vibrio* spp. and *Vibrio vulnificus* concentrations in the eutrophic Neuse River estuary, North Carolina, during storm events. Aquatic Microbial Ecology 53:141-149.

Widger, W.R., G. Golovko, A.F. Martinez, E.V. Ballesteros, J.J. Howard, Z. Xu, U. Pandya, V.Y. Fofanov, M. Rojas, C. Bradburne, T. Hadfield, N.A. Olson, J.L. Santarpia, and Y. Fofanov. 2011. Longitudinal metagenomic analysis of the water and soil from Gulf of Mexico beaches affected by the *Deepwater Horizon* oil spill. Nature Proceedings hdl:10101/npre.2011.5733.1.

Wiese, F.K., W.A. Montevecchi, G.K. Davoren, F. Huettman, A.W. Diamond and J. Linke. 2001. Seabirds at risk around offshore oil platforms in the Northwest Atlantic. Marine Pollution Bulletin 42:1285-1290.

Wiese, F.K. and G.J. Robertson. 2004. Assessing impacts of chronic oil discharges at sea on seabirds: a general oiled seabird mortality model applied to Eastern Canada. Journal of Wildlife Management 68:627–638.

Williams, R., S. Gero, L. Bejder, J. Calambokidis, S. Kraus, D. Lusseau, A. Read, and J. Robbins. 2011. Underestimating the damage: interpreting cetacean carcass recoveries in the context of the *Deepwater Horizon*/BP Incident. Conservation Letters, DOI: 10.1111/j.1755-263x2011.00168x.

Wright, S.D., B.B. Ackerman, R.K. Bonde, C.A. Beck, and D.J. Banowetz. 1995. Analysis of watercraft-related mortality of manatees in Florida, 1979-1991. In: O'Shea, T.J., B.B. Ackerman, and H.F. Percival, eds. Population biology of the Florida manatee. National Biological Service Information and Technology Report 1. Pp. 259-268.

Wyers, S.C., H.R. Frith, R.E. Dodge, S.R. Smith, A.H. Knap, and T.D. Sleeter. 1986. Behavioral effects of chemically dispersed oil and subsequent recovery in *Diploria strigosa*. Marine Ecology 7:23-42.

Zeller, T., Jr. 2010. Drill ban means hard times for rig workers. Internet website: http://www.nytimes.com/2010/06/18/business/18rig.html?_r=1. Accessed November 10, 2011.

Zieman, J.C., R. Orth, R.C. Phillips, G. Thayer, and A. Thorhaug. 1984. The effects of oil on seagrass ecosystems. In: Cairns, J., Jr. and A.L. Buikema, Jr., eds. Restoration of habitats impacted by oil spills. Boston, MA: Butterworth Publishers.

APPENDIX C

BOEM-OSRA CATASTROPHIC RUN

APPENDIX C. BOEM-OSRA CATASTROPHIC RUN

A special Oil-Spill Risk Analysis (OSRA) run was conducted in order to estimate the impacts of a possible future catastrophic or high-volume, long-duration oil spill. Thus, assuming a hypothetical high-volume, long-duration oil spill occurred, this analysis emphasized modeling a spill that continued for 90 consecutive days, with each trajectory tracked for up to 120 days. The OSRA for this analysis was conducted for only the trajectories of oil spills from five hypothetical spill locations to various land segments. The probability of an oil spill contacting a specific land segment within a given time of travel from a certain location or spill point is termed a *conditional probability*; the condition being that a spill is assumed to have occurred. Each trajectory was allowed to continue for as long as 120 days. However, if the hypothetical spill contacted shoreline sooner than 30 days after the start of the spill, the spill trajectory was terminated, and the contact was recorded. Although, overall OSRA is designed for use as a risk-based assessment, for this analysis, only the *conditional probability*, the probability of contact to the resource, was calculated. The probability of a catastrophic spill occurring was not calculated; thus, the combination of the probability of a spill and the probability of contact to the resources from the hypothetical spill locations were not performed. Results from this trajectory analysis provide input to the final product by estimating where spills might travel on the ocean's surface and what land segments might be contacted if and when another catastrophic spill occurs, but it does not provide input on the probability of another catastrophic spill occurring.

OSRA Overview

The OSRA model, originally developed by Smith et al. (1982) and enhanced by this Agency over the years (Ji et al., 2002, 2004a, 2004b), simulates oil-spill transport using model-simulated winds and ocean currents in the Gulf of Mexico. An oil spill on the ocean surface moves around by the complex surface ocean currents exerting a shear force on the spilled oil from below. In addition, the prevailing wind exerts an additional shear force on the spill from above, and the combination of the two forces causes the transportation of the oil spill away from its initial spill location. In the OSRA model, the velocity of a hypothetical oil spill is the linear superposition of the surface ocean current and the wind drift caused by the winds. The model calculates the movement of hypothetical spills by successively integrating time sequences of two spatially gridded input fields: the surface ocean currents and the sea-level winds. Thus, the OSRA model generates time sequences of hypothetical oil-spill locations—essentially, oil-spill trajectories.

At each successive time step, the OSRA model compares the location of the hypothetical spills against the geographic boundaries of shoreline. The frequencies of oil-spill contact are computed for designated oil-spill travel times (e.g., 3, 10, 30, or 120 days) by dividing the total number of oil-spill contacts by the total number of hypothetical spills initiated in the model from a given hypothetical spill location. The frequencies of oil-spill contact are the model-estimated probabilities of oil-spill contact. The OSRA model output provides the estimated probabilities of contact to segments of shoreline from the five launch points (LP) in the Gulf of Mexico, which are explained below.

There are factors not explicitly considered by the OSRA model that can affect the transport of spilled oil as well as the dimensions, volume, and nature of the oil spills contacting environmental resources or the shoreline. These include possible cleanup operations, chemical composition or biological weathering of oil spills, or the spreading and splitting of oil spills. The OSRA analysts have chosen to take a more environmentally conservative approach by presuming persistence of spilled oil over the selected time duration of the trajectories.

In the trajectory simulation portion of the OSRA model, many hypothetical oil-spill trajectories are produced by numerically integrating a temporally and spatially varying ocean current field, and superposing on that an empirical wind-induced drift of the hypothetical oil spills (Samuels et al., 1982). Collectively, the trajectories represent a statistical ensemble of simulated oil-spill displacements produced by a field of numerically derived winds and ocean currents. The winds and currents are assumed to be statistically similar to those that will occur in the Gulf during future offshore activities. In other words, the oil-spill risk analysts assume that the frequency of strong wind events in the wind field is the same as what will occur during future offshore activities. By inference, the frequencies of contact by the simulated oil spills are the same as what could occur from actual oil spills during future offshore activities.

Another portion of the OSRA model tabulates the contacts by the simulated oil spills. A contact to shore will stop the trajectory of an oil spill; no re-washing is assumed in this model. After specified periods of time, the OSRA model will divide the total number of contacts to the coastline segments by the total number of simulated oil spills from each of the five LP's. These ratios are the estimated probabilities of oil-spill contact from offshore activities at that geographic location, assuming spill occurrence.

Conducting an oil-spill risk analysis needs detailed information on ocean currents and wind fields (Ji, 2004). The ocean currents used are numerically computed from an ocean circulation model of the Gulf of Mexico driven by analyzed meteorological forces (the near-surface winds and the total heat fluxes) and observed river inflow into the Gulf of Mexico (Oey et al., 2004; Oey, 2005). The models used are versions of the Princeton Ocean Model, which is an enhanced version of the earlier constructed Mellor-Blumberg Model.

The ocean model calculation was performed by Princeton University (Oey et al., 2004). This simulation covered the 7-year period, 1993 through 1999, and the results were saved at 3-hour intervals. This run included the assimilation of sea-surface altimeter observations to improve the ocean model results. The surface currents were then computed for input into the OSRA model, along with the concurrent wind field. The OSRA model used the same wind field to calculate the empirical wind drift of the simulated spills. The statistics for the contacts by the trajectories forced by the currents and winds were combined for the average probabilities.

Catastrophic OSRA Run Overview

A special OSRA run was conducted in order to estimate the impacts of a possible future catastrophic spill. Thus, assuming a hypothetical catastrophic oil spill occurred, this analysis emphasized modeling a spill that continued for 90 consecutive days with each trajectory tracked for up to 120 days. The OSRA for this analysis was conducted for only the trajectories of oil spills from five hypothetical spill locations to various land segments (**Figure C-1 and C-2**). The probability that an oil spill will contact a specific land segment within a given time of travel from a certain location or spill point is termed a *conditional probability*; the condition being that a spill is assumed to have occurred. Each trajectory was allowed to continue for as long as 120 days. However, if the hypothetical spill contacted shoreline sooner than 30 days after the start of the spill, the spill trajectory was terminated, and the contact was recorded. Although, overall the OSRA is designed for use as a risk-based assessment, for this analysis, only the *conditional probability*, the probability of contact to the resource, was calculated. The probability of a catastrophic spill occurring was not calculated, thus the combination of the probability of a spill and the probability of contact to the resources from the hypothetical spill locations was not performed. Results from this trajectory analysis provide input to the final product by estimating where spills might travel on the ocean's surface and what land segments might be contacted if and when another catastrophic spill occurs, but it does not provide input on the probability of another catastrophic spill occurring.

Trajectories of hypothetical spills were initiated every 1.0 day from each of the launch points over the simulation period from January 1, 1993, to December 31, 1998 (**Figure C-1**). The chosen number of trajectories per site was small enough to be computationally practical and large enough to reduce the random sampling error to an insignificant level. Also, the weather-scale changes in the winds are at least minimally sampled, with simulated spills started every 1.0 day.

These launch point locations were developed within the Gulf of Mexico region for the purpose of this analysis. Five launch points were identified and encompassed the approximate areas with the possibility of finding the largest oil volume within the following regions:

- Central Gulf of Mexico shelf area west of the Mississippi River;
- Central Gulf of Mexico shelf area east of the Mississippi River;
- Central Gulf of Mexico slope area;

- Western Gulf of Mexico shelf area; and
- Western Gulf of Mexico slope area.

Longitude	Latitude	Launch Point (LP)
-92.17851	28.98660	1
-88.15338	29.91388	2
-90.22203	27.31998	3
-96.76627	27.55423	4
-94.51836	27.51367	5

The methodology used for launch point selection is not part of the OSRA model in the manner it has been typically run for this Agency's spill analyses. Gulf of Mexico OCS Region geologists and engineers used the following methodology to select the five points. For each geologic play currently recognized, the undiscovered technically recoverable resource volume was allocated throughout the play area based on the likelihood of future oil discovery potential. The probability factor used to allocate undiscovered oil volumes to areas within the geologic play was based on the density of existing discoveries, the density of undrilled prospects on leased acreage, and the results from recent exploration activity. In areas where the potential for undiscovered technically recoverable resource volume exists for more than one geologic play, the oil volumes were aggregated. Results from the aggregation were used to identify five geographic areas of high potential for future oil discoveries: three in the Central Planning Area and two in the Western Planning Area of the Gulf of Mexico. Although these areas may encompass hundreds of square miles, the coordinates for the five launch points were selected qualitatively to correspond with the centroid of these areas. After their selection, the five points were given to the OSRA analysts for use with the OSRA model.

Additionally, the total estimated oil-contacted area of water was also determined. The OSRA model integrates the spill velocities (a linear superposition of surface ocean currents and empirical wind drift) by integrating in time to produce the spill trajectories. The time step selected was 1 hour to fully utilize the spatial resolution of the ocean current field and to achieve a stable set of trajectories. The velocity field was bilinearly interpolated from the 3-hour grid to get velocities at 1-hour intervals.

The trajectories simulated by the model represent only hypothetical pathways of oil slicks; they do not involve any direct consideration of cleanup, dispersion, or weathering processes that could alter the quantity or properties of oil that might eventually contact the environmental resource locations. However, an implicit analysis of weathering and spill degradation can be considered by choosing a travel time for the simulated oil spills when they contact environmental resource locations that represent the likely persistence of the oil slick on the water surface. Therefore, OSRA model trajectories were analyzed up to 120 days. Any spill contacts occurring during this elapsed time are reported in the probability tables. Conditional probabilities of contact with land segments within 120 days of travel time were calculated for each of the hypothetical spill sites.

The probability estimates were tabulated as 90-day groupings of the 120-day trajectories, as averages for the 6 years of the analysis from 1993 to 1998. These groupings were treated as seasonal probabilities that corresponded with quarters of the year: Winter, Q1 (January, February, and March); Spring, Q2 (April, May, and June); Summer, Q3 (July, August, and September); and Fall, Q4 (October, November, and December). These 3-month probabilities can be used to estimate the average number of land segments (counties/parishes) contacted during a spill, treated as one spill occurring each day for 90 days, within the quarter. The seasonal quarterly groupings take account of the differing meteorological and oceanographic conditions (wind and current patterns) during the year. The latest meteorological and oceanographic information in the Gulf of Mexico available to BOEM were for the years 1993-1998.

The area of ocean surface contacted by oil from the hypothetical spills was estimated by creating a grid of 1/6 degree longitude by 1/6 degree latitude. As the trajectories were computed, contact to the grid cells was tabulated. To estimate the area, the number of grid cells was multiplied by the approximate area of 342 square kilometers per grid cell. The number of grid cells and the approximate area of the ocean contacted by the spills were summarized at the same time intervals that were used for the land segment (county/parish boundary) tables (3, 10, 30, and 120 days).

Catastrophic OSRA Results and Discussion

It should be noted that the study area only extends somewhat into the Atlantic Ocean, where oil spills in the Gulf might be transported via the exiting Loop Current. However, on average, less than 0.5 percent of the simulated spills made it across the northern or southern Florida Straits boundary within 30 days, and only 1-2 percent within 120 days. The hypothetical spill trajectories from launch points in the western Gulf of Mexico (e.g., LP1, LP4, and LP5) have a much less chance of being transported through the Florida Straits than those in the central Gulf of Mexico (LP2 and LP3).

As one might expect, land segments closest to the spill sites had the greatest risk of contact. As the model run duration increases, more of the shoreline segments could have meaningful probabilities of contact (≥0.5%) (See **Tables C-1 through C-5** for the probabilities expressed as percent chance of one or more offshore spills ≥1,000 bbl contacting the areas noted in **Figure C-2**.). It should be reiterated that these are *conditional probabilities*; the condition being that a spill is assumed to have occurred. The longer transit times up to 120 days allowed by the model enable hypothetical spills to reach the environmental resources and the shoreline from more distant spill locations. With increased travel time, the complex patterns of wind and ocean currents produce eddy-like motions of the oil spills and multiple opportunities for a spill to make contact with shoreline segments. For some launch points and for the travel times greater than 30 days, the probability of contact to land decreases very slowly or remains constant because the early contacts to land have occurred within 30 days, and the trajectories that have not contacted land within 30 days will remain at sea for 120 days or more.

To summarize the differences between the LP's, a chart showing the estimated square area of each launch point for the 6-day intervals is shown (see **Figures C-3 through C-7** corresponding to LP's 1-5, respectively). The differences between the estimated spill areas from each LP can be explained by meteorological and oceanographic conditions.

- LP1—CPA, shelf area, west of the Mississippi River Delta, offshore south-central Louisiana, deepwater. Launch Point 1 is located near the Louisiana coast, and the fall circulation results in persistent and recurring coastal current from Louisiana waters toward Texas waters.

- LP2—CPA, shelf edge area, east of the Mississippi River Delta, south of the Alabama-Mississippi border, ultra-deepwater. Launch Point 2 is located near the Mississippi River Delta on the eastern side. The trajectories contact the coastline of Louisiana, Mississippi, Alabama, and Florida. Many of the trajectories are forced offshore by the wind drift and interact with the Loop Current and Loop Current eddies.

- LP3—CPA, shelf area, west of the Mississippi River delta, due south of New Orleans, deepwater. Launch Point 3 is located relatively far offshore and west of the Mississippi River Delta. The estimated area contacted by the spill is the largest of all the selected points, and the trajectories are influenced by the deepwater Loop Current eddies and offshore currents.

- LP4—WPA, shelf area, deepwater. Launch Point 4 is near the Texas coast in the western Gulf of Mexico. The trajectories from this launch point frequently contact land. The coastal flow near Texas, but to the south of the U.S./Mexico border, has a high fraction of northward currents, the wind is relatively persistent with a westward component, and the trajectories remain in a relatively smaller area.

- LP5—WPA, slope area, ultra-deepwater. Launch Point 5 is in the western Gulf of Mexico between the coast (LP4) and the central Gulf (LP3). The trajectories are forced by the Loop Current eddies that are somewhat weaker in this part of the Gulf of Mexico because these eddies dissipate kinetic energy as they drift to the west from their original separation zone.

REFERENCES CITED

Ji, Z.-G. 2004. Use of physical sciences in support of environmental management. Environmental Management 34(2). Pp. 159-169.

Ji, Z.-G., W.R. Johnson, C.F. Marshall, G.B. Rainey, and E.M. Lear. 2002. Oil-spill risk analysis: Gulf of Mexico outer continental shelf (OCS) lease sales, Central Planning Area and Western Planning Area, 2003-2007, and Gulfwide OCS program, 2003-2042. U.S. Dept. of the Interior, Minerals Management Service, Herndon, VA. OCS Report MMS 2002-032. 61 pp.

Ji, Z.-G., W.R. Johnson, and C.F. Marshall. 2004a. Deepwater oil-spill modeling for assessing environmental impacts. Coastal Environment V. Southampton, MA: WIT Press. Pp. 349-358.

Ji, Z.-G., W.R. Johnson, C.F. Marshall, and E.M. Lear. 2004b. Oil-spill risk analysis: Contingency planning statistics for Gulf of Mexico OCS activities. U.S. Dept. of the Interior, Minerals Management Service, Herndon, VA. OCS Report MMS 2004-026. 62 pp.

Oey, L.-Y. 2005. Circulation model of the Gulf of Mexico and the Caribbean Sea: Development of the Princeton Regional Ocean Forecast (& Hindcast) System—PROFS and Hindcast experiment for 1992-1999: Final report. U.S. Dept. of the Interior, Minerals Management Service, Environmental Division, Herndon, VA. OCS Study MMS 2005-049. 174 pp.

Oey, L.-Y., P. Hamilton, and H. C.-Lee. 2004. Modeling and data analyses of circulation processes in the Gulf of Mexico: Final report. U.S. Dept. of the Interior, Minerals Management Service, Gulf of Mexico OCS Region, New Orleans, LA. OCS Study MMS 2003-074. 129 pp.

Samuels, W. B., N. E. Huang, and D.E. Amstutz. 1982. An oil spill trajectory analysis model with a variable wind deflection angle. Ocean Engineering 9:347-360.

Smith, R.A., J.R. Slack, T. Wyant, and K.J. Lanfear. 1982. The oil spill risk analysis model of the U.S. Geological Survey. U.S. Dept. of the Interior, Geological Survey Professional Paper 1227.

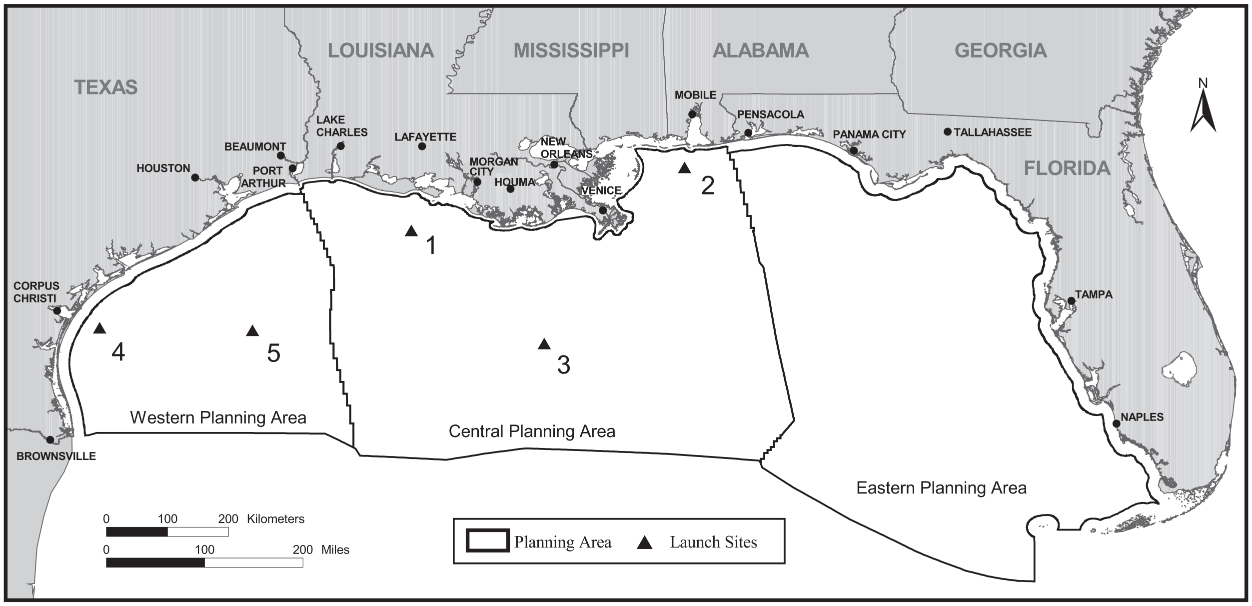

Figure C-1. Location of Five Hypothetical Oil-Spill Launch Points for OSRA within the Study Area.

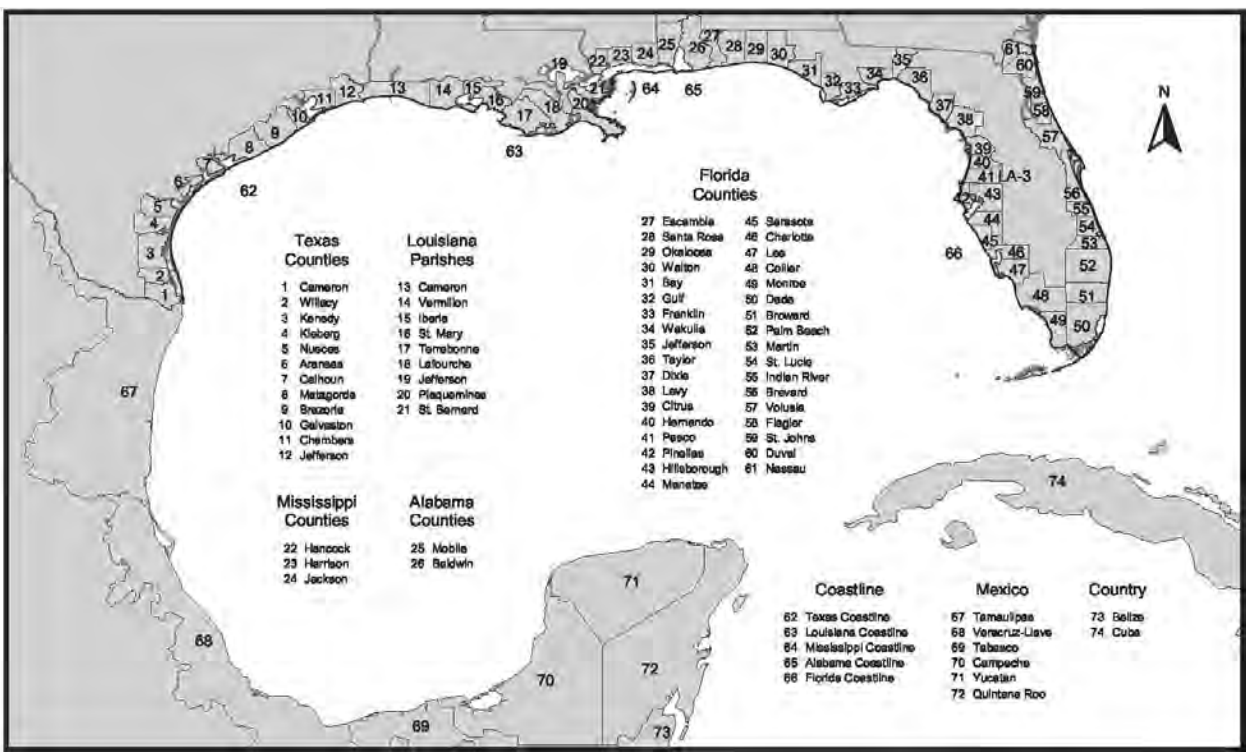

Figure C-2. Locations of Parishes, Counties, and Coastlines Examined in the Special OSRA Run Conducted in Order to Estimate the Impacts of a Possible Future Catastrophic Spill.

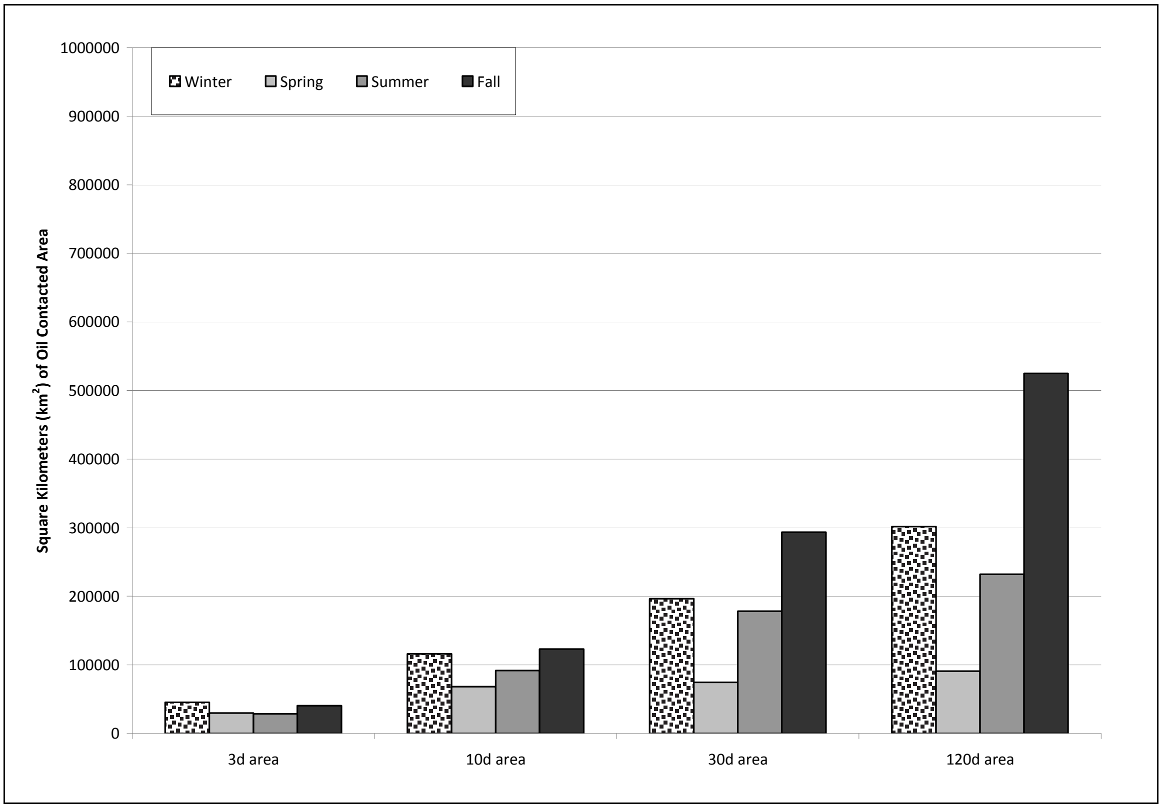

Figure C-3. Estimated Square Area of Launch Point One (LP 1) for 3, 10, 30, and 120 Days in Winter, Spring, Summer, and Fall.

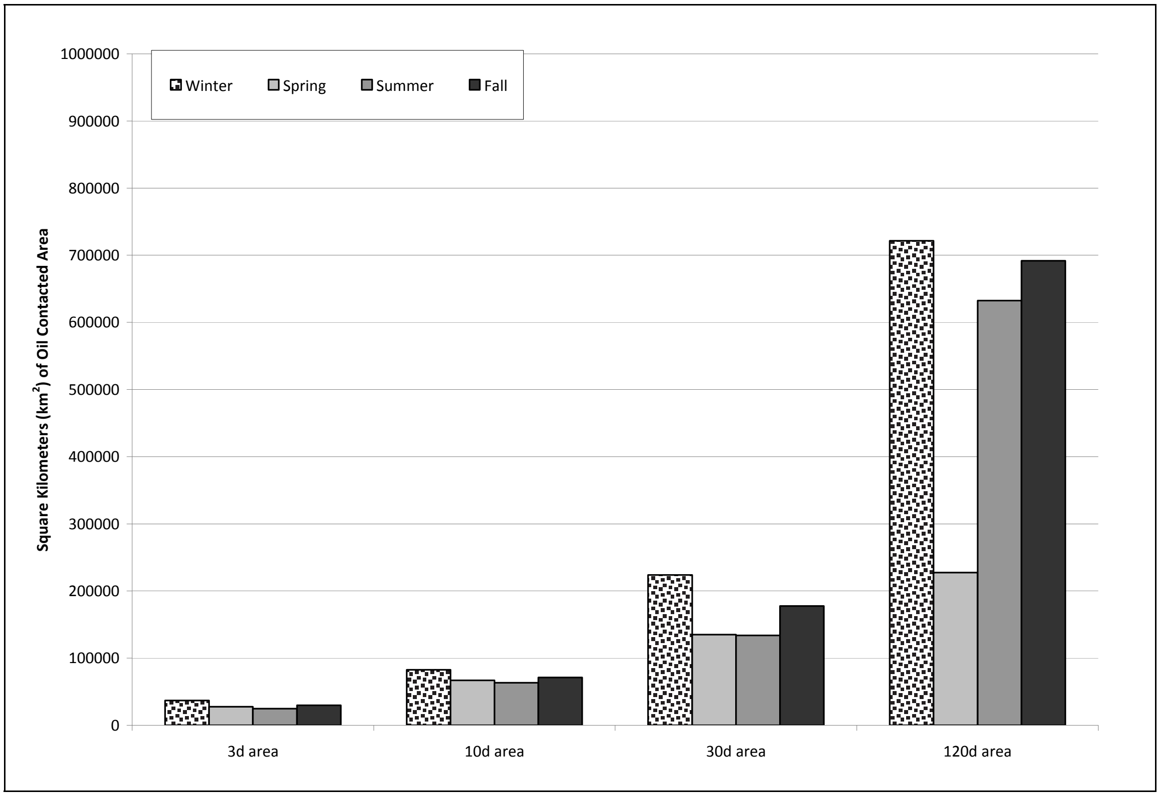

Figure C-4. Estimated Square Area of Launch Point Two (LP 2) for 3, 10, 30, and 120 Days in Winter, Spring, Summer, and Fall.

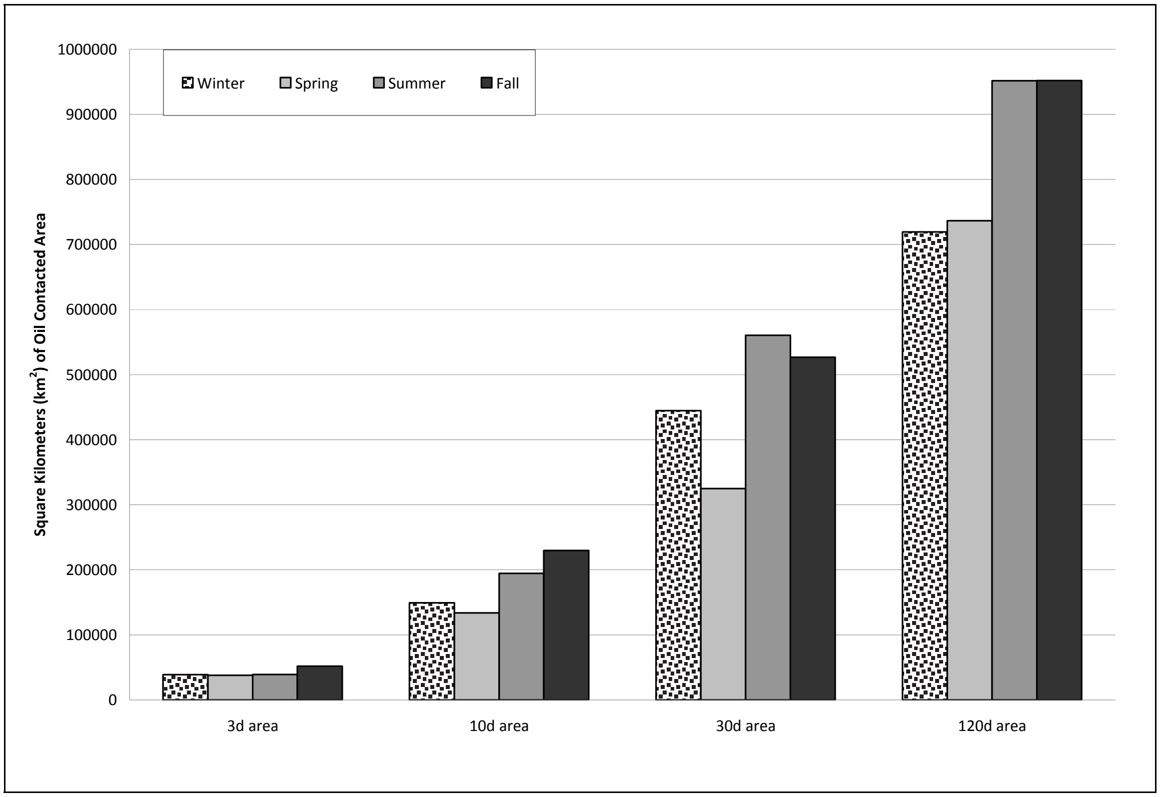

Figure C-5. Estimated Square Area of Launch Point Three (LP 3) for 3, 10, 30, and 120 Days in Winter, Spring, Summer, and Fall.

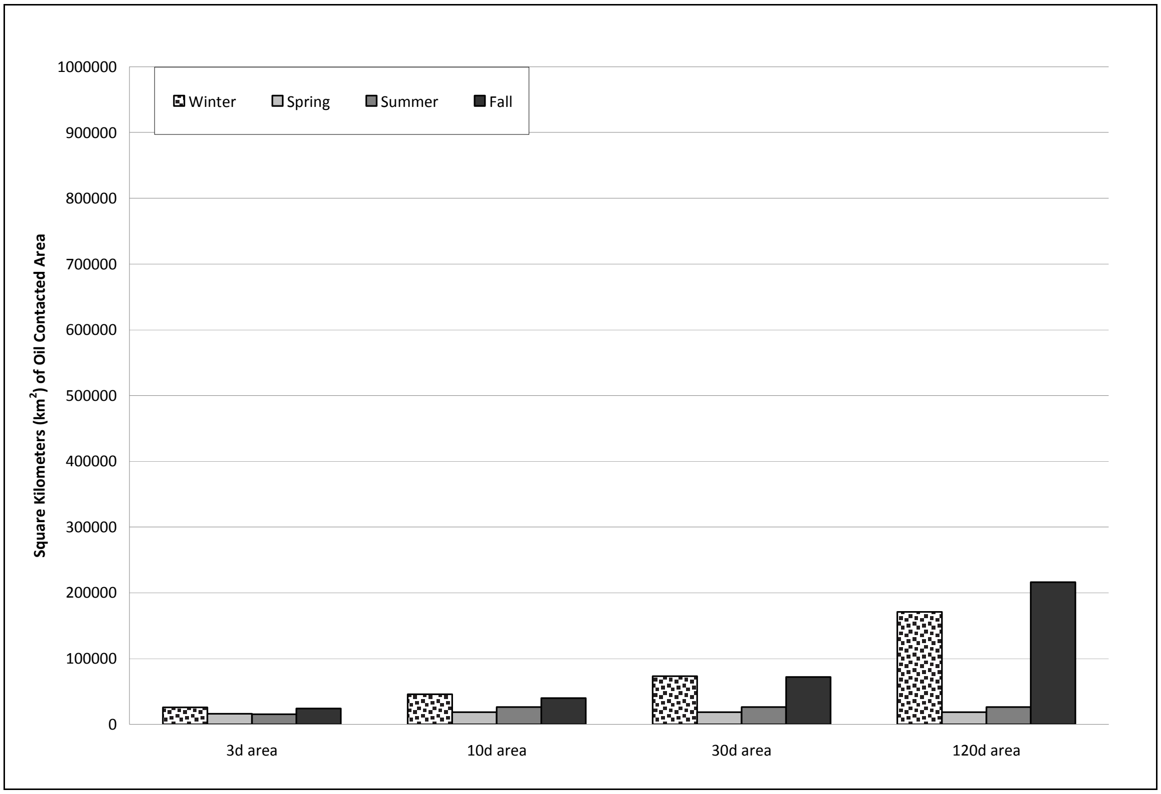

Figure C-6. Estimated Square Area of Launch Point Four (LP 4) for 3, 10, 30, and 120 Days in Winter, Spring, Summer, and Fall.

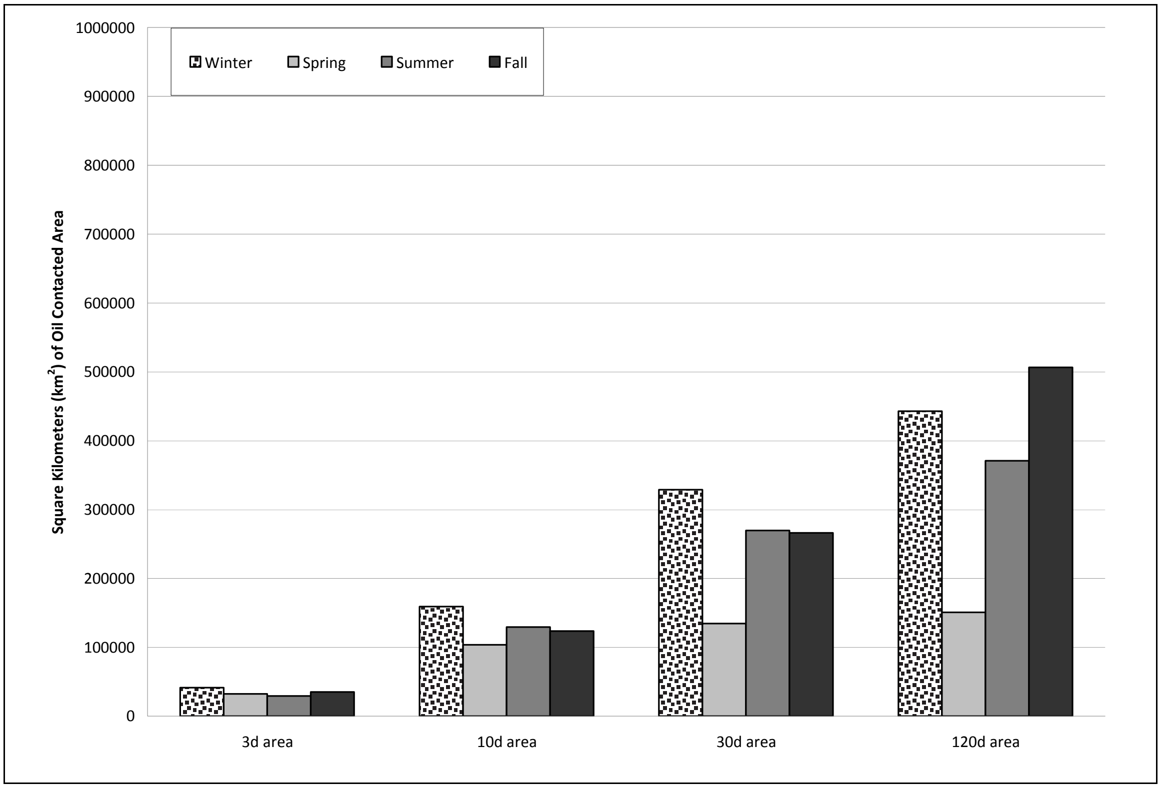

Figure C-7. Estimated Square Area of Launch Point Five (LP 5) for 3, 10, 30, and 120 Days in Winter, Spring, Summer, and Fall.

Table C-1

Conditional Probabilities Expressed as Percent Chance that an Oil Spill Starting at Launch Point One Will Contact a Certain Parish, County, or Coastline within 120 Days

	Season	Winter				Spring				Summer				Fall			
	Day	3	10	30	120	3	10	30	120	3	10	30	120	3	10	30	120
ID	Name	Percent Chance															
1	Cameron, TX	-	-	1	2	-	-	-	-	-	-	-	1	-	-	-	2
2	Willacy, TX	-	-	1	1	-	-	-	-	-	-	-	-	-	-	-	-
3	Kenedy, TX	-	-	1	3	-	-	-	-	-	-	1	1	-	-	2	4
4	Kleberg, TX	-	-	-	1	-	-	-	1	-	-	1	1	-	-	1	3
5	Nueces, TX	-	-	1	4	-	-	-	-	-	-	1	2	-	-	1	3
6	Aransas, TX	-	-	2	4	-	-	-	-	-	-	2	2	-	-	2	4
7	Calhoun, TX	-	-	5	10	-	-	-	-	-	-	4	4	-	-	2	3
8	Matagorda, TX	-	1	13	17	-	-	1	1	-	-	3	4	-	1	9	11
9	Brazoria, TX	-	1	9	10	-	1	3	3	-	-	4	6	-	-	6	6
10	Galveston, TX	-	2	9	11	-	2	8	9	-	2	12	15	-	1	9	9
11	Chambers, TX	-	-	-	-	-	-	-	-	-	-	1	1	-	-	-	-
12	Jefferson, TX	-	2	5	6	-	5	9	9	-	2	9	10	-	3	6	6
13	Cameron, LA	2	10	13	15	5	35	41	41	-	7	18	20	2	13	16	19
14	Vermilion, LA	4	9	10	10	8	22	24	24	1	9	12	12	4	8	9	9
15	Iberia, LA	1	2	3	3	1	5	6	6	-	5	7	7	1	2	3	3
16	St. Mary, LA	-	1	1	1	-	1	1	1	-	-	-	-	-	-	-	-
17	Terrebonne, LA	-	1	1	1	-	2	2	2	-	-	5	6	-	1	1	1
18	Lafourche, LA	-	-	-	-	-	-	-	-	-	-	1	1	-	-	-	-
19	Jefferson, LA	-	-	1	1	-	-	-	-	-	-	-	-	-	-	-	-
21	St. Bernard, LA	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-
62	Texas Coastline	-	6	45	68	-	8	23	24	-	5	37	47	-	6	38	52
63	Louisiana Coastline	8	23	28	30	14	64	75	76	2	21	43	49	6	23	30	32
64	Mississippi Coastline	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-
67	Tamaulipas, Mexico	-	-	-	1	-	-	-	-	-	-	2	2	-	-	1	3

Note: Values of <0.5% are indicated by "-". Any areas where the percent chance within 120 days of all seasons are all <0.5% are not shown. See Figure C-1 for the location of Launch Point One. See Figure C-2 for the location of the named land areas.

Table C-2

Conditional Probabilities Expressed as Percent Chance that an Oil Spill Starting at Launch Point Two Will Contact a Certain Parish, County, or Coastline within 120 Days

	Season	Winter				Spring				Summer				Fall			
	Day	3	10	30	120	3	10	30	120	3	10	30	120	3	10	30	120
ID	Name	Percent Chance															
1	Cameron, TX	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-
2	Willacy, TX	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-
3	Kenedy, TX	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	1
4	Kleberg, TX	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-
7	Calhoun, TX	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	1
8	Matagorda, TX	-	-	-	2	-	-	-	-	-	-	-	1	-	-	-	2
9	Brazoria, TX	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	1
10	Galveston, TX	-	-	-	1	-	-	-	-	-	-	-	1	-	-	-	-
12	Jefferson, TX	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-
13	Cameron, LA	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-
14	Vermilion, LA	-	-	-	2	-	-	-	-	-	-	-	-	-	-	-	-
17	Terrebonne, LA	-	-	3	4	-	-	-	-	-	-	-	1	-	-	-	1
18	Lafourche, LA	-	-	-	1	-	-	-	-	-	-	-	-	-	-	1	1
19	Jefferson, LA	-	-	-	-	-	-	-	-	-	-	-	1	-	-	1	1
20	Plaquemines, LA	1	14	21	23	-	3	4	6	1	8	20	25	2	21	27	28
21	St. Bernard, LA	-	4	5	5	-	1	2	3	1	7	14	16	-	8	9	10
22	Hancock, MS	-	1	2	4	-	2	2	2	-	2	3	3	1	3	5	5
23	Harrison, MS	2	3	4	5	-	4	4	4	1	3	4	4	1	2	3	3
24	Jackson, MS	7	11	11	13	5	11	12	12	1	3	4	4	6	12	13	14
25	Mobile, AL	11	14	14	15	11	16	17	17	4	8	9	10	8	11	12	13
26	Baldwin, AL	4	7	7	9	6	14	16	17	1	8	10	10	1	2	2	3
27	Escambia, FL	-	1	1	2	1	5	11	13	1	3	5	6	-	-	1	1
29	Okaloosa, FL	-	-	-	1	-	1	2	3	-	-	1	1	-	-	-	-
30	Walton, FL	-	-	-	-	-	1	1	1	-	-	-	-	-	-	-	1
31	Bay, FL	-	-	-	1	-	2	3	5	-	-	1	2	-	-	-	-
32	Gulf, FL	-	-	-	-	-	1	3	5	-	-	1	1	-	-	-	-
33	Franklin, FL	-	-	-	-	-	-	-	3	-	-	1	2	-	-	-	-
34	Wakulla, FL	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-
36	Taylor, FL	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-
38	Levy, FL	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-
49	Monroe, FL	-	-	-	1	-	-	-	1	-	-	-	-	-	-	-	-
50	Dade, FL	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-
62	Texas Coastline	-	-	-	7	-	-	-	-	-	-	-	5	-	-	1	6
63	Louisiana Coastline	2	18	29	37	-	4	6	9	1	15	34	43	2	29	39	41
64	Mississippi Coastline	9	15	17	22	5	16	18	19	3	7	11	12	7	16	21	22
65	Alabama Coastline	15	21	21	24	18	30	34	34	5	16	19	20	9	13	14	15
66	Florida Coastline	-	2	2	6	1	10	20	36	1	3	10	14	-	-	1	2
67	Tamaulipas, Mexico	-	-	-	1	-	-	-	-	-	-	-	1	-	-	-	1

Note: Values of <0.5% are indicated by "-". Any areas where the percent chance within 120 days of all seasons are all <0.5% are not shown. See Figure C-1 for the location of Launch Point Two. See Figure C-2 for the location of the named land areas.

Table C-3

Conditional Probabilities Expressed as Percent Chance that an Oil Spill Starting at Launch Point Three Will Contact a Certain Parish, County, or Coastline within 120 Days

	Season	Winter				Spring				Summer				Fall			
	Day	3	10	30	120	3	10	30	120	3	10	30	120	3	10	30	120
ID	Name	Percent Chance															
1	Cameron, TX	-	-	-	2	-	-	-	-	-	-	-	2	-	-	-	2
2	Willacy, TX	-	-	-	3	-	-	-	-	-	-	-	2	-	-	-	3
3	Kenedy, TX	-	-	-	8	-	-	-	1	-	-	-	9	-	-	-	5
4	Kleberg, TX	-	-	1	6	-	-	-	-	-	-	-	4	-	-	1	6
5	Nueces, TX	-	-	1	6	-	-	-	-	-	-	-	2	-	-	1	2
6	Aransas, TX	-	-	-	5	-	-	-	1	-	-	-	3	-	-	-	2
7	Calhoun, TX	-	-	1	6	-	-	-	-	-	-	-	6	-	-	1	4
8	Matagorda, TX	-	-	2	17	-	-	3	4	-	-	-	11	-	-	1	6
9	Brazoria, TX	-	-	3	12	-	-	1	3	-	-	2	8	-	-	1	5
10	Galveston, TX	-	-	3	10	-	-	3	6	-	-	2	5	-	-	1	4
12	Jefferson, TX	-	-	1	4	-	-	7	9	-	-	1	1	-	-	-	2
13	Cameron, LA	-	-	1	4	-	-	11	12	-	1	1	4	-	-	-	4
14	Vermilion, LA	-	-	1	2	-	-	5	6	-	1	1	2	-	-	-	-
15	Iberia, LA	-	-	-	1	-	-	4	4	-	-	-	-	-	-	-	-
17	Terrebonne, LA	-	1	2	3	-	4	12	14	-	-	-	2	-	-	-	-
18	Lafourche, LA	-	-	1	1	-	2	8	10	-	-	1	2	-	-	-	-
19	Jefferson, LA	-	-	-	1	-	-	2	2	-	-	1	1	-	-	-	-
20	Plaquemines, LA	-	-	-	1	-	2	10	12	-	-	1	2	-	-	-	-
24	Jackson, MS	-	-	-	-	-	-	1	1	-	-	-	-	-	-	-	-
26	Baldwin, AL	-	-	-	-	-	-	1	1	-	-	-	-	-	-	-	-
31	Bay, FL	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-
33	Franklin, FL	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-
49	Monroe, FL	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	1
50	Dade, FL	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-
62	Texas Coastline	-	-	12	78	-	-	14	24	-	-	6	54	-	-	4	41
63	Louisiana Coastline	-	1	6	14	-	9	52	60	-	1	4	13	-	-	-	6
64	Mississippi Coastline	-	-	-	-	-	-	1	1	-	-	-	-	-	-	-	-
65	Alabama Coastline	-	-	-	-	-	-	1	1	-	-	-	-	-	-	-	-
66	Florida Coastline	-	-	-	1	-	-	1	4	-	-	-	2	-	-	-	2
67	Tamaulipas, Mexico	-	-	-	4	-	-	-	1	-	-	-	10	-	-	-	10
68	Veracruz-Llave, Mexico	-	-	-	-	-	-	-	-	-	-	1	7	-	-	-	1
69	Tabasco, Mexico	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-

Note: Values of <0.5% are indicated by "-". Any areas where the percent chance within 120 days of all seasons are all <0.5% are not shown. See Figure C-1 for the location of Launch Point Three. See Figure C-2 for the location of the named land areas.

Table C-4

Conditional Probabilities Expressed as Percent Chance that an Oil Spill Starting at Launch Point Four Will Contact a Certain Parish, County, or Coastline within 120 Days

	Season	Winter				Spring				Summer				Fall			
	Day	3	10	30	120	3	10	30	120	3	10	30	120	3	10	30	120
ID	Name	Percent Chance															
1	Cameron, TX	1	3	3	3	-	-	-	-	-	-	-	-	-	2	3	3
2	Willacy, TX	3	4	4	4	1	1	1	1	-	1	1	1	3	7	8	8
3	Kenedy, TX	10	22	23	23	7	9	9	9	3	9	9	9	10	21	22	23
4	Kleberg, TX	9	14	15	16	12	14	14	14	9	17	17	17	7	13	14	14
5	Nueces, TX	10	16	17	18	21	26	26	26	8	17	18	18	11	16	17	17
6	Aransas, TX	11	15	16	16	28	33	33	33	17	26	26	26	9	12	13	13
7	Calhoun, TX	7	12	13	14	12	15	15	15	18	25	26	26	7	11	12	12
8	Matagorda, TX	1	3	3	4	1	2	2	2	-	2	2	2	-	1	2	3
9	Brazoria, TX	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	1
62	Texas Coastline	51	90	94	98	82	99	**	**	56	98	**	**	48	84	91	93
67	Tamaulipas, Mexico	-	1	2	2	-	-	-	-	-	-	-	-	-	-	1	1

Note: Values of <0.5%.are indicated by “-”. Any areas where the percent chance within 120 days of all seasons are all <0.5% are not shown. Values of >99.5% are indicated by “**”. See Figure C-1 for the location of Launch Point Four. See Figure C-2 for the location of the named land areas.

Table C-5

Conditional Probabilities Expressed as Percent Chance that an Oil Spill Starting at Launch Point Five Will Contact a Certain Parish, County, or Coastline within 120 Days

	Season	Winter				Spring				Summer				Fall			
	Day	3	10	30	120	3	10	30	120	3	10	30	120	3	10	30	120
ID	Name	Percent Chance															
1	Cameron, TX	-	-	2	4	-	-	-	-	-	-	2	3	-	-	3	5
2	Willacy, TX	-	-	1	4	-	-	-	-	-	-	2	3	-	-	2	3
3	Kenedy, TX	-	1	8	14	-	-	1	1	-	-	4	7	-	-	6	9
4	Kleberg, TX	-	-	5	7	-	1	2	2	-	-	1	3	-	-	4	5
5	Nueces, TX	-	1	5	9	-	1	2	2	-	-	1	1	-	-	3	5
6	Aransas, TX	-	1	5	10	-	-	3	3	-	-	2	3	-	-	4	6
7	Calhoun, TX	-	2	10	20	-	3	11	12	-	-	7	9	-	1	5	7
8	Matagorda, TX	-	1	8	14	-	18	29	30	-	2	12	21	-	2	9	15
9	Brazoria, TX	-	-	3	4	-	9	13	13	-	-	7	12	-	1	4	6
10	Galveston, TX	-	1	2	4	-	3	11	13	-	-	5	12	-	1	2	3
12	Jefferson, TX	-	-	-	1	-	-	12	15	-	-	1	4	-	-	-	1
13	Cameron, LA	-	-	-	1	-	1	5	6	-	-	6	8	-	-	-	-
14	Vermilion, LA	-	-	-	-	-	-	2	3	-	-	1	2	-	-	-	-
20	Plaquemines, LA	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-
62	Texas Coastline	-	7	50	91	-	35	85	90	-	2	43	79	-	5	43	65
63	Louisiana Coastline	-	-	-	1	-	1	8	9	-	-	8	11	-	-	-	-
67	Tamaulipas, Mexico	-	-	1	6	-	-	-	-	-	-	3	7	-	-	2	11
68	Veracruz-Llave, Mexico	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-

Note: Values of <0.5% are indicated by "-". Any areas where the percent chance within 120 days of all seasons are all <0.5% are not shown. See Figure C-1 for the location of Launch Point Five. See Figure C-2 for the location of the named land areas.

APPENDIX D

RECENT PUBLICATIONS OF THE ENVIRONMENTAL STUDIES PROGRAM, GULF OF MEXICO OCS REGION, 2006—PRESENT

APPENDIX D. RECENT PUBLICATIONS OF THE ENVIRONMENTAL STUDIES PROGRAM, GULF OF MEXICO OCS REGION, 2006—PRESENT

Published in 2011	
BOEMRE 2011-001 (in press)	*Analysis of the Oil Services Contract Industry in the Gulf of Mexico Region*
BOEMRE 2011-002	*Status and Applications of Acoustic Mitigation and Monitoring Systems for Marine Mammals: Workshop Proceedings, November 17-19, 2009, Boston, Massachusetts*
BOEMRE 2011-003 (in press)	*Impact of Recent Hurricane Activity on Historic Shipwrecks in the Gulf of Mexico Outer Continental Shelf*
BOEMRE 2011-004 (in press)	*Archival Investigations for Potential Colonial-Era Shipwrecks in Ultra-Deepwater within the Gulf of Mexico*
BOEMRE 2011-011	*User's Guide for the 2011 Gulfwide Offshore Activities Data System (GOADS-2011)*
BOEMRE 2011-012	*Literature Synthesis for the North and Central Atlantic Ocean*
BOEMRE 2011-028	*Assessment of Opportunities for Alternative Uses of Hydrocarbon Infrastructure in the Gulf of Mexico*
Published in 2010	
Study Number	Title
MMS 2010-001	*Proceedings: USA-Mexico Workshop on the Deepwater Physical Oceanography of the Gulf of Mexico, June 2007*
MMS 2010-002	*Proof of Concept for Platform Recruited Reef Fish, Phase 1: Do Platforms Provide Habitat for Subadult Red Snapper?*
MMS 2010-007	*Assessment of Marginal Production in the Gulf of Mexico and Lost Production from Early Decommissioning*
MMS 2010-015	*Low-Frequency Variability of Currents in the Deepwater Eastern Gulf of Mexico*
MMS 2010-016	*Trophic Aspects of Sperm Whales (*Physeter macrocephalus*) in the Northern Gulf of Mexico Using Stable Isotopes of Carbon and Nitrogen*
BOEMRE 2010-039	*Bank Erosion of Navigation Canals in the Western and Central Gulf of Mexico*
BOEMRE 2010-041 (in press)	*Study of Deepwater Currents in the Eastern Gulf of Mexico*
BOEMRE 2010-042 (in press)	*Fact Book: Offshore Oil and Gas Industry Support Sectors*
BOEMRE 2010-044 (in press)	*Full-Water Column Current Observations in the Western Gulf of Mexico*

BOEMRE 2010-045	*Year 2008 Gulfwide Emission Inventory Study*
BOEMRE 2010-046	*Multicomponent and Multifrequency Seismic for Assessment of Fluid-Gas Expulsion Geology and Gas-Hydrate Deposits: Gulf of Mexico Hydrates*
BOEMRE 2010-050 (in press)	*Satellite Data Assimilation into Meteorological/Air Quality Models*
BOEMRE 2010-051 (in press)	*Evaluation of NASA Aura's Data Products for Use in Air Quality Studies over the Gulf of Mexico*
BOEMRE 2010-052 BOEMRE 2010-053 (in press)	*Long-Term Monitoring at the East and West Flower Garden Banks: 2004-2008* *Volume 1: Technical Report* *Volume 2: Appendices*
Published in 2009	
Study Number	Title
MMS 2009-010	*Quality Control and Analysis of Acoustic Doppler Current Profiler Data Collected on Offshore Platforms of the Gulf of Mexico*
MMS 2009-013	*Foraminiferal Communities of Bathyal Hydrocarbon Seeps, Northern Gulf of Mexico: A Taxonomic, Ecologic, and Geologic Study*
MMS 2009-023	*Loop Current Frontal Eddies Based on Satellite Remote Sensing and Drifter Data*
MMS 2009-032	*Post-Hurricane Assessment of Sensitive Habitats of the Flower Garden Banks Vicinity*
MMS 2009-039	*Northern Gulf of Mexico Continental Slope Habitats and Benthic Ecology Study: Final Report*
MMS 2009-043	*Blue Crab (*Callinectes sapidus*) Use of the Ship/Trinity/Tiger Shoal Complex as a Nationally Important Spawning/Hatching/Foraging Ground: Discovery, Evaluation, and Sand Mining Recommendations Based on Blue Crab, Shrimp, and Spotted Seatrout Findings*
MMS 2009-046	*Investigations of Chemosynthetic Communities on the Lower Continental Slope of the Gulf of Mexico, Interim Report 2*
MMS 2009-048	*Outer Continental Shelf (OCS)-Related Pipelines and Navigation Canals in the Western and Central Gulf of Mexico: Relative Impacts on Wetlands Habitats and Effectiveness of Mitigation*
MMS 2009-050	*Observation of the Deepwater Manifestation of the Loop Current and Loop Current Rings in the Eastern Gulf of Mexico*
MMS 2009-051	*Proceedings: Twenty-fifth Gulf of Mexico Information Transfer Meeting, January 2009*

 MMS 2009-055 MMS 2009-056 MMS 2009-057 MMS 2009-058	*Synthesis, Analysis, and Integration of Meteorological and Air Quality Data for the Gulf of Mexico Region* *Volume I: User's Manual for the Gulf of Mexico Air Quality Database (Version 1.0)* *Volume II: Technical Reference Manual for the Gulf of Mexico Air Quality Database* *Volume III: Data Analysis* *Volume IV: Cart Analysis of Modeling Episode Days*
MMS 2009-059	*Evaluation of Oil and Gas Platforms on the Louisiana Continental Shelf for Organisms with Biotechnology Potential*
MMS 2009-060	*Modeling Waves and Currents Produced by Hurricanes Katrina, Rita, and Wilma*
Published in 2008	
Study Number	Title
MMS 2008-001	*Deepwater Currents in the Eastern Gulf of Mexico: Observations at 25.5°N and 87°W*
MMS 2008-006	*Sperm Whale Seismic Study in the Gulf of Mexico: Synthesis Report*
MMS 2008-009	*Investigations of Chemosynthetic Communities on the Lower Continental Slope of the Gulf of Mexico: Interim Report 1*
MMS 2008-012	*Proceedings: Twenty-Fourth Gulf of Mexico Information Transfer Meeting, January 2007*
MMS 2008-015	Lophelia *Reef Megafaunal Community Structure, Biotopes, Genetics, Microbial Ecology, and Geology (2004-2006)* NOTE: This study was conducted by the U.S. Geological Survey (USGS) for the Agency's Headquarters' Office, and it was funded by USGS.
MMS 2008-017	*Examination of the Development of Liquefied Natural Gas on the Gulf of Mexico*
MMS 2008-018	*Viosca Knoll Wreck: Discovery and Investigation of an Early Nineteenth-Century Wooden Sailing Vessel in 2,000 Feet of Water*
MMS 2008-019	*Post-Hurricane Assessment at the East Flower Garden Bank Long-Term Monitoring Site: November 2005*
MMS 2008-022	*Effects of Subsea Processing on Deepwater Environments in the Gulf of Mexico*
MMS 2008-024	*Executive Summary: 3rd International Deep-Sea Coral Symposium in Miami*
 MMS 2008-027 MMS 2008-028	*Long-Term Monitoring at the East and West Flower Garden Banks, 2004-2005—Interim Report* *Volume I: Technical Report* *Volume II: Appendices*
MMS 2008-029	*Five-Year Meteorological Datasets for CALMET/CALPUFF and OCD5 Modeling of the Gulf of Mexico Region*
 MMS 2008-030 MMS 2008-031	*Study of Deepwater Currents in the Northwestern Gulf of Mexico* *Volume I: Executive Summary* *Volume II: Technical Report*

 MMS 2008-042 MMS 2008-043 MMS 2008-044 MMS 2008-045 MMS 2008-046 MMS 2008-047	*History of the Offshore Oil and Gas Industry in Southern Louisiana* *Volume I: Papers on the Evolving Offshore Industry* *Volume II: Bayou Lafourche—Oral Histories of the Oil and Gas Industry* *Volume III: Morgan City's History in the Era of Oil and Gas—Perspectives of Those Who Were There* *Volume IV: Terrebonne Parish* *Volume V: Guide to the Interviews* *Volume VI: A Collection of Photographs*
MMS 2008-048	*Platform Debris Fields Associated with the Blue Dolphin (Buccaneer) Gas and Oil Field Artificial Reef Sites Offshore Freeport, Texas: Extent, Composition, and Biological Utilization*
 MMS 2008-050 MMS 2008-051	*Labor Needs Survey* *Volume I: Technical Report* *Volume II: Survey Instruments*
MMS 2008-052	*Benefits and Burdens of OCS Activities on States, Labor Market Areas, Coastal Counties, and Selected Communities*
MMS 2008-058	*Cumulative Increment Analysis for the Breton National Wilderness Area*
Published in 2007	
Study Number	Title
MMS 2007-015	*Archaeological and Biological Analysis of World War II Shipwrecks in the Gulf of Mexico; Artificial Reef Effect in Deepwater*
MMS 2007-019	*Mixtures of Metals and Polynuclear Aromatic Hydrocarbons May Elicit Complex, Nonadditive Toxicological Interactions*
MMS 2007-022	*Full-Water Column Current Observations in the Central Gulf of Mexico: Final Report*
MMS 2007-030	*Incorporation of Gulf of Mexico Benthic Survey Data into the Ocean Biogeographic Information System*
MMS 2007-031	*Idle Iron in the Gulf of Mexico*
MMS 2007-033	*Cooperative Research to Study Dive Patterns of Sperm Whales in the Atlantic Ocean*
MMS 2007-034	*Competition and Performance in Oil and Gas Lease Sales and Development in the U.S. Gulf of Mexico OCS Region, 1983-1999*
MMS 2007-035	*Seafloor Characteristics and Distribution Patterns of* Lophelia pertusa *and Other Sessile Megafauna at Two Upper-Slope Sites in the Northeastern Gulf of Mexico*
MMS 2007-044	*Characterization of Northern Gulf of Mexico Deepwater Hard-Bottom Communities with Emphasis on* Lophelia *Coral*
MMS 2007-056	*Full-Water Column Currents Near the Sigsbee Escarpment (91-92º W. Longitude) and Relationships with the Loop Current and Associated Warm- and Cold-Core Eddies*
MMS 2007-061	*Study of Barite Solubility and the Release of Trace Components to the Marine Environment*
MMS 2007-067	*Year 2005 Gulfwide Emission Inventory Study*

MMS 2007-068	*User's Guide for the 2008 Gulfwide Offshore Activities Data System (GOADS-2008)*
Published in 2006	
Study Number	Title
MMS 2006-005	*Fidelity of Red Snapper to Petroleum Platforms and Artificial Reefs in the Northern Gulf of Mexico*
MMS 2006-011	*Sustainable Community in Oil and Gas Country: Final Report*
MMS 2006-028	*Degradation of Synthetic-Based Drilling Mud Base Fluids by Gulf of Mexico Sediments, Final Report*
MMS 2006-030	*Accounting for Socioeconomic Change from Offshore Oil and Gas: Cumulative Effects on Louisiana's Coastal Parishes, 1969-2000*
MMS 2006-034	*Sperm Whale Seismic Study in the Gulf of Mexico, Summary Report: 2002-2004*
MMS 2006-035	*Long-Term Monitoring at the East and West Flower Garden Banks National Marine Sanctuary, 2002-2003*
MMS 2006-036	*Study to Conduct National Register of Historic Places Evaluations of Submerged Sites on the Gulf of Mexico Outer Continental Shelf*
MMS 2006-037	*Effect of Depth, Location, and Habitat Type, on Relative Abundance and Species Composition of Fishes Associated with Petroleum Platforms and Sonnier Bank in the Northern Gulf of Mexico*
MMS 2006-044 MMS 2006-045 MMS 2006-046	*Effects of Oil and Gas Exploration and Development at Selected Continental Slope Sites in the Gulf of Mexico;* *Volume I: Executive Summary* *Volume II: Technical Report* *Volume III: Appendices*
MMS 2006-063	*Economic Effects of Petroleum Prices and Production in the Gulf of Mexico OCS on the U.S. Gulf Coast Economy*
MMS 2006-064	*Capital Investment Decisionmaking and Trends in Petroleum Resource Development in the U.S. Gulf of Mexico*
MMS 2006-067	*Sperm Whale Seismic Study in the Gulf of Mexico, Annual Report: Years 3 and 4*
MMS 2006-071	*Annotated Bibliography of the Potential Environmental Impacts of Chlorination and Disinfection Byproducts Relevant to Offshore Liquefied Natural Gas Port Facilities*
MMS 2006-072	*Mica Shipwreck Project Report: Deepwater Archaeological Investigation of a 19th Century Shipwreck in the Gulf of Mexico*
MMS 2006-073 MMS 2006-074	*Exploratory Study of Deepwater Currents in the Gulf of Mexico* *Volume I: Executive Summary* *Volume II: Technical Report*

APPENDIX E

AGENCY-FUNDED HURRICANE RESEARCH AND STUDIES

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Project/Study Number	Title
Hurricanes Katrina and Rita	
BOEMRE 2011-003 (in press)	*Impacts of Recent Hurricane Activity on Historic Shipwrecks in the Gulf of Mexico Outer Continental Shelf*
MMS 2009-060	*Modeling Waves and Currents Produced by Hurricanes Katrina, Rita, and Wilma*
MMS 2009-032	*Post-Hurricane Assessment of Sensitive Habitats of the Flower Garden Banks Vicinity*
MMS 2008-019	*Post-Hurricane Assessment at the East Flower Garden Bank Long-Term Monitoring Site: November 2005*
GM-07-x12	Assessing Impact of OCS Activities on Public Infrastructure, Service, and Population in Coastal Communities Following Hurricanes Rita and Katrina
GM-92-42-124	Post-Hurricane Assessment of OCS-Related Infrastructure and Communities in the Gulf of Mexico Region
GM-92-42-125	Spatial Restructuring and Fiscal Impacts in the Wake of Disaster: The Case of the Oil and Gas Industry Following Hurricanes Katrina and Rita
GM-92-42-131	Gulf Coast Subsidence and Wetland Loss: A Synthesis of Recent Research
GM-92-42-137	Socioeconomic Responses to Coastal Landloss and Hurricanes: Measuring Resilience Among OCS-Related Coastal Communities in Louisiana
Project No. 578	Assessment of Fixed Offshore Platform Performance in Hurricanes Katrina and Rita
Project No. 580	Hindcast Data on Winds, Waves and Currents in Northern Gulf of Mexico in Hurricanes Katrina and Rita
Project No. 581	Pipeline Damage Assessments from Hurricanes Katrina and Rita
Project No. 591 (completed December 5, 2007)	Evaluate Accuracy of Polyester Subrope Damage Detection Performed by Remotely-Operated Vehicles (ROV's) Following Hurricanes and Other Events
Project No. 593	Evaluate and Assess the Performance of Jackup Rigs That Were Subject to Hurricanes Katrina or Rita
Project No. 599	JIP to Quantify Risks in Deepwater Production Facilities and Flowlines in the GOM
Project No. 603	Stability of Tension-Leg Platforms (TLP's) with Damaged Tendons
Project No. 604	Evaluation of Fatigue Life Models and Assessment Practice for Tension-Leg Platforms (Phase 1: Tendon System Fatigue)

Project No. 605	Cooperative Research on Extreme Seas and Their Impact to Floating Structures
Project No. 609	Reliability vs. Consequence of Failure for API RP 2A Platforms Using RP2MET
Hurricane Ivan	
GM-05-x12	Ocean Currents under Hurricane Ivan on the Mississippi/Alabama Shelf
Project No. 548	Examination and Review of Mobile Offshore Drilling Unit (MODU) Loss of Station-keeping Ability during Hurricane Ivan and Assessment of Current Mooring Standards and Criteria to Prevent Similar Failures
Project No. 549	Assessment of Fixed Offshore Platforms in Hurricane Ivan, Andrew
Project No. 550	A Pilot Study for Regionally-Consistent Hazard Susceptibility Mapping of Submarine Mudslides, Offshore Gulf of Mexico
Project No. 551	Assessment of Drilling and Workover Rig Storm Sea Fastenings on Offshore Floating Platforms during Hurricane Ivan
Project No. 552	Mudslides during Hurricane Ivan and an Assessment of the Potential for Future Mudslides in the GOM
Project No. 553	Pipeline Damage Assessment from Hurricane Ivan
Project No. 559	Offshore Hurricane Readiness and Recovery Conference
Hurricane Lili	
MMS 2009-039	*Oil Spill during Hurricane Lili: Ship Shoal Block 119; Response, Fate, and Effects*
Project No. 466	Validation and Calibration of API RP2A Using Hurricane Lili to Update the Hurricane Andrew JIP Results that Provided the Basis for API Section 17
Project No. 467	Hindcast Study of Winds, Waves, and Currents in Northern GOM in Hurricane Lili (2002)
Project No. 469	Post-Mortem Failure Assessment of Drilling Rigs during Hurricane Lili
Project No. 471	Assessment of Performance of Deepwater Floating Production Facilities
Project No. 503	Evaluate and Compare Hurricane-Induced Damage to Offshore Pipelines for Hurricane Lili—Rev. A
Hurricane Andrew	
Project No. 193	Study and Hindcast of Wind and Wave Fields for Hurricane Andrew
Project No. 199	Hurricane Andrew Calibration Study
Project No. 201	Evaluation of Hurricane Pipeline Damage
Project No. 203	Performance of Safety and Pollution Control Devices in the Aftermath of Hurricane Andrew (Part of the Hurricane Andrew OCS Damage Assessment Program)

Project No. 204	Post-Mortem Platform Failure Evaluation Study
Project No. 206	Shallow-Water Wave and Current Field Study
Project No. 207	API/Hurricane Foundation Study
Project No. 209	Development of Acceptance Criteria for Caisson Structures Damaged during Hurricane Andrew
Project No. 210	Hurricane Andrew Effects on Offshore Platforms
Project No. 224	Dynamic Nonlinear Loading Effects on Offshore Platforms
Project No. 229	Hurricane Andrew Effects on Offshore Platforms (Phase II – JIP)

KEYWORD INDEX

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The Department of the Interior Mission

As the Nation's principal conservation agency, the Department of the Interior has responsibility for most of our nationally owned public lands and natural resources. This includes fostering the sound use of our land and water resources, protecting our fish, wildlife and biological diversity; preserving the environmental and cultural values of our national parks and historical places; and providing for the enjoyment of life through outdoor recreation. The Department assesses our energy and mineral resources and works to ensure that their development is in the best interests of all our people by encouraging stewardship and citizen participation in their care. The Department also has a major responsibility for American Indian reservation communities and for people who live in island communities.

The Bureau of Ocean Energy Management

The Bureau of Ocean Energy Management (BOEM) works to manage the exploration and development of the nation's offshore resources in a way that appropriately balances economic development, energy independence, and environmental protection through oil and gas leases, renewable energy development and environmental reviews and studies.