BOEM ENVIRONMENTAL STUDIES PROGRAM: ONGOING STUDIES

BOEM OCS Region: Gulf of Mexico

Title: Sperm Whales and Bottlenose Dolphins in the Gulf of Mexico (GM-11-03)

Planning Area: Gulfwide

Total Cost: $2,700,000 **Period of Performance:** FY 2011-2015

Conducting Organization: NOAA, National Marine Fisheries Service

BOEM Contact: Dr. Deborah Epperson

Description:

Background: The Gulf of Mexico has a diverse marine mammal community. All marine mammal species are protected under the Marine Mammal Protection Act (MMPA) and the sperm whale, an endangered species, is also protected by the Endangered Species Act (ESA). The potential impacts of oil and gas activities are subject to thorough reviews by the National Marine Fisheries Service, Fish and Wildlife Service and Marine Mammal Commission.

Earlier work by BOEM was conducted in the northern GOM and provided information on sperm whale population structure, genetics, movements, and response of whales to anthropogenic industry activities. However, there were limitations to this study. The study area was primarily focused in the region between Mississippi Canyon and De Soto Canyon, although one cruise was conducted in the northwest Gulf. This region has extensive human activity in the form of marine transportation, recreational activities, commercial and recreational fishing, oil and gas activities, and other anthropogenic disturbances. Limited observations from areas outside the northern GOM may mean that previous results may not include variations, if any, in behaviors associated with other geographic regions in the Gulf, particularly sperm whale populations found off the south west coast of Florida, in the Dry Tortugas region.

Coastal bottlenose dolphin stocks are recognized as communities that exist as functioning units of the ecosystem and under the MMPA must be maintained as such. Genetic data supports separate identification of these stocks from other groups occurring in other GOM waters. The stable patterns of residency observed within these coastal dolphin communities suggest that long periods would be required to repopulate the home range of a community were it eradicated or severely depleted. The potential impacts from the DWH incident and the ongoing Unusual Mortality Event (UME) could result in depletion of some coastal bottlenose stocks. An effective management strategy for these stocks would be the protection of the long-term resident communities, with their multi-generational geographic, genetic, demographic and social stability. These localized units

would be at greatest risk from geographically-localized impacts (e.g. oil spills).

Objectives: *Sperm Whales in the Eastern GOM*. This study will focus on obtaining data about populations of sperm whales from less anthropogenically "impacted" areas in the eastern GOM. It will provide baseline information about a population of sperm whales prior to any industry activities and will provide valuable insights into potential effects of industry activities on a relatively "naïve" population. Sightings of sperm whales near the Dry Tortugas and off the southwestern coast of Florida have occurred consistently over many years of vessel based visual surveys of the region conducted by SEFSC. It is unknown whether these animals represent a distinct social or population unit from those occupying the north-central Gulf of Mexico or adjacent Atlantic populations. Animals occurring near the Dry Tortugas region have not been exposed to intensive seismic surveys or other oil and gas industrial activities and a study similar to the Sperm Whales Seismic Study (SWSS) in this region will provide information useful for comparison with the SWSS results from the northern GOM.

Study objectives are:

1. This study will focus on an area with little to no energy industry activity, offshore from southwestern Florida. Data collected in this study will be similar to those data collected in SWSS (see description of work below) and will include a detailed characterization of sperm whales in terms of sex and age distribution, genetic profiles, habitat use, and seasonal movement patterns.
2. Research vessels, moored acoustic monitoring units, and remote sensing tools will also be used to obtain ambient noise measurements and physical oceanographic data to allow a detailed habitat characterization – mapping of both physical oceanographic features and ambient underwater noise levels will be correlated to sightings and acoustic detections of sperm whales and other cetaceans.
3. A subset of whales will be tagged using location only satellite tags (S-tags), time-depth recording GPS tags (TDR-tags), or short duration D-tags to document seasonal movements, habitat use, foraging strategies and potential mixing with northern GOM and/or West Atlantic populations.

Bottlenose Dolphins in the Northern GOM. Bottlenose dolphins in the Gulf of Mexico consist of a complex suite of oceanic, continental shelf, coastal, and estuarine stocks. There are currently 37 defined stocks of bottlenose dolphins, and this includes 32 groups of resident animals within various Bays, Sounds, and Estuaries (BSE). Bottlenose dolphins are exposed to a wide variety of anthropogenic stressors including bycatch in commercial fisheries, exposure to pollution from industrial uses, military activities, and noise and other impacts from oil and gas operations. In addition, there are persistent and repeated Unusual Mortality Events (UME) of bottlenose dolphins in the northern Gulf, and these are most typically associated with Harmful Algal Blooms (HABs). There is an ongoing UME of bottlenose dolphins in the northern Gulf that began just prior to the DWH event and overlaps spatially and temporally with the potential impacts from DWH oil and response activities. Assessing the impacts of both anthropogenic and environmental stressors on these stocks is difficult due to a lack of adequate assessment information and limited understanding of the relatedness, seasonal movements, and population structure amongst these stocks. Therefore, this study will focus on collecting data that will support effective definition and delineation of stocks to improve the ability to quantify impacts.

Study objectives are to:

1. conduct field studies to collect skin and blubber samples from target estuarine and coastal stocks of bottlenose dolphins;
2. assess the population structure of bottlenose dolphins stocks using a combination of mitochondrial and nuclear DNA markers;
3. conduct stable isotope studies from skin samples to assess trophic status and relationships; and
4. analyze contaminants within blubber samples from targeted stocks to assess environmental exposure to pollutants.

Methods: *Sperm whales in the Eastern GOM*. Population size and seasonal occurrence will be assessed using a combination of moored passive acoustic monitoring units and vessel-based visual and passive acoustic survey. Sperm whales are an ideal species for assessment using passive acoustic tools because they predictably produce broad-band echolocation clicks at regular intervals during dives. As such, they are easily identifiable in acoustic records, and the consistent rate of sound production lends itself to estimation of local density of animals within the detection range of a unit, based upon counts of echolocation clicks received. High frequency acoustic recording packages (HARPs) developed by the Scripps Institution of Oceanography (SIO) are bottom-mounted acoustic units that sample wide band-widths (frequencies up to 100 kHz) for deployments of up to 6 months at a time. In addition to detections of sperm whale sounds, HARPs will also provide detections and recordings of beaked whales, pygmy and dwarf sperm whales, baleen whales, and small delphinids within a 3-5 mile detection range around the unit. With regard to sperm whales, in addition to echolocation clicks, "buzzes", that are associated with feeding behavior, can be detected and quantified as a measure of foraging, and "codas", which are thought to be identification calls, may also be detected.

As part of the NRDA effort associated with the DWH event, one HARP unit has been deployed near the Dry Tortugas since late July, 2010. This unit may remain in place through February 2012. In this project, we would augment that unit with the placement of two additional HARPs in the southwestern Florida/Dry Tortugas region. The units would be deployed as soon as possible (likely in late 2011) and would be maintained continuously through the duration of the project (18-month recording period). Analyses of the data collected from the units will provide a continuous record of the occurrence and density of sperm whales and other marine mammals within this region.

Visual and towed-array passive acoustic data on the occurrence and spatial distribution of sperm whales and other marine mammals will be conducted during summer 2012 aboard the NOAA ship *Gordon Gunter* in conjunction with a sperm whale tagging and biopsy effort (described below). Directed visual surveys will augment and confirm the detections from the HARP units as they will provide a broader spatial scale assessment of sperm whale and other marine mammal abundance and spatial distribution. In addition, visual confirmation of species identification along with simultaneous collection of recordings from a towed array improves the ability to confirm species identifications from the acoustic signals recorded on the HARPs. Visual surveys will be conducted following standard procedures used during marine mammal assessment cruises by the SEFSC.

Simultaneous with the visual effort, a towed hydrophone array will be used to collect broad-band acoustic data from encountered species.

Population genetics and demographics will be studied during the summer 2012 large vessel survey. When sperm whales are encountered during the survey, a 7-meter, rigid-hull, inflatable boat (RHIB) will be deployed to conduct close approaches. During these encounters, close approaches will be made to collect photographic data and biopsies of skin and blubber. Stereoscopic photographic methods or similar approaches will be used to collect measurements of the sizes of encountered animals. As opportunities allow, photo-identification images of whale flukes will also be collected that will allow for the development of a catalog of identified individuals using this region. Tissue samples will be collected from the small vessel using a specially designed dart and 0.22 caliber rifle. The dart is designed to penetrate a short distance into the animal and extract a sample containing skin and blubber. A portion of the skin will be stored for genetic analyses (i.e., sex and population structure), and a portion will be stored for stable isotope analyses (an indicator of trophic level status). Blubber will be stored at minus 80°C and may be used for a variety of analyses including contaminant loads, fatty acid signatures, and reproductive hormones. Finally, during close approaches sperm whale scat may be collected opportunistically which can provide information on prey through either genetic probes or identification of hard parts from squids and/or fish.

A subset of the sperm whales encountered during the summer 2012 vessel survey will be tagged with either location-only satellite tags (S-tags), time-depth recording GPS tags (TDR-tags), or short-duration, suction-cup, digital tags (D-tags). Used together, the different tags will provide information on long-term (~12 months), on-the-surface movements (S-tags), dive-surface behavior over 30-45 days (TDR tags), and intensive dive and feeding behavior over scales of hours (D-tags). Tagging operations will consist of first identifying animals through either visual sighting or passive acoustic arrays. Ancillary data (e.g., from aerial surveys) may also be used to locate whales during the tagging phase of the cruise. When whales are located, a rigid-hulled inflatable (RHIB) will be launched to approach and sample/tag whales. The tagging vessel crew of 3 persons will consist of a driver, a tagger/biopsy person, and a photo ID person. At a minimum, whales will be photographed and biopsy samples taken. Satellite tags will be deployed using an air-powered applicator at close range (<= 3 m). Animals to be tagged will be determined by selection criteria that exclude calves, small juveniles, and any signs of animals being compromised (such as emaciated whales). Tags will be deployed near the mid-dorsal line and within several meters anterior of the dorsal hump with a preferred vertical antenna orientation. The satellite tags will be scheduled to transmit based on optimum data collection and extended tag duration. TDR tags are deployed in a similar manner to S-tags; however, they record dive behavior over a 30- to 45-day cycle and transmit short summaries of dive activities over the Service ARGOS system. Detailed dive records are recorded on the TDR tags, which must be recovered after they detach to obtain their full data sets. Finally, as opportunity allows, suction-cup D-tags will be deployed to provide intensive, short-term information on whale swimming behavior, vocalization patterns, feeding attempts, and received sound.

Location data from the HARPs, visual surveys, and tags will be used to characterize sperm whale movements, density, and habitat use. The habitat will be characterized through a combination of remotely sensed surface physical data (e.g., chlorophyll concentration, sea surface height, geostrophic currents, and sea surface temperature) and continuous underway sampling of surface waters during the vessel survey. In addition, hydrographic profiles of salinity and temperature will be conducted during the survey to depths up to 1,000m using conductivity temperature depth (CTD) profilers and/or expendable bathythermographs (XBT). Furthermore, scientific echosounders operating at frequencies of 18, 38, and 120 kHz will be used throughout the survey to provide data on acoustic backscatter as an indicator of the biomass of plankton and micronekton within the surveyed area.

Bottlenose Dolphins in the Northern GOM. This study will provide information on the population structure, seasonal movements, and exposure to contaminants of selected coastal and estuarine bottlenose dolphins stocks. Stocks selected for study will not be those currently being evaluated as part of the Natural Resource Damage Assessment (NRDA) investigations. The planned NRDA studies focus on stocks in Mississippi and Louisiana, and there are complimentary studies currently planned for the panhandle and west coast of Florida. Therefore, it is most likely that the studies planned here will focus on the western Gulf of Mexico, including along the coasts of southern Louisiana and Texas. The continental shelf immediately offshore of these areas has high levels of oil and gas activity.

Bottlenose dolphin biopsy tissue samples will be collected from a small boat using techniques similar to those described above for sperm whales. Sampling efforts will be conducted during at least two seasons (summer and winter), at up to four sites. At each site, samples will be collected both within estuarine waters and in adjacent coastal waters during the same season. This allows a direct assessment of whether or not bottlenose dolphins within an estuary are genetically distinct from those immediately offshore. Seasonal comparisons will assess whether or not estuarine dolphins are year-round residents of estuarine habitats and evaluate potential seasonal movements of offshore stocks. Sampling will be conducted by a dedicated team of four staff operating from a small boat. Target sample sizes within each seasonal sampling effort will be 30 samples from each habitat (coastal and estuarine). Biopsy samples will be handled using clean techniques in the field and stored as appropriate for the genetic analysis of skin and the contaminant analysis of blubber.

Skin samples from biopsies will be analyzed genetically for gender determination and evaluation of population structure. Knowledge of the sex of each sample is integrated into the genetic analyses to test for evidence of sex-based dispersal rates among populations. Mitochondrial DNA (mtDNA) has proven an effective marker for stock discrimination in marine mammals. Analysis of mtDNA data provides an estimate of the degree of movement and genetic exchange of females, an important measurement for species such as bottlenose dolphins that exhibit a high degree of female site fidelity. To examine the contribution of both males and females to genetic exchange rates, we will also analyze 19 independent nuclear microsatellite loci tested and optimized for a wide range of common

bottlenose dolphin populations in the Gulf of Mexico and western North Atlantic. The microsatellite data can also be used for individual identification of dolphins, which will support the photo-identification and tagging work. Analysis of both mitochondrial and nuclear markers will provide a measure of the degree of interbreeding among these populations. Analysis of mitochondrial DNA and nuclear microsatellite markers will use standard methodologies and will utilize samples collected from up to four estuarine sites targeted during the biopsy efforts.

Blubber samples can be analyzed for a variety of contaminants and samples will be used for quantitative polymerase chain reaction (qPCR) analysis to determine cytochrome P4501A (CYP1A) protein expression as a biomarker for oil-related contaminant (polycyclic aromatic hydrocarbon) exposure. Remaining blubber will be used for the analysis of reproductive and stress hormones, as well as for the chemical analysis to determine the levels of other contaminants such as polychlorinated biphenyls which may cause increases in CYP1A.

Products: The primary objective of this IA is to collect and analyze data to provide BOEM with information on sperm whales in the eastern GOM and coastal bottlenose dolphins in the northern GOM. The NMFS will provide quarterly letter reports that address progress and problems for each of the study objectives noted in the goals and objectives above. Periodic updates will be provided as requested.

Importance to BOEM: The exploration and development of oil and gas resources in the Gulf of Mexico (GOM), as well as potential renewable energy and alternate use projects, will require BOEM to produce information for a variety of NEPA documents as well as Endangered Species Act (ESA) and Marine Mammal Protection Act (MMPA) compliance. Recent mandates to offer offshore leases within 125 miles of the west coast of Florida as well as the Deepwater Horizon (DWH) spill incident prompt the need for BOEM to investigate and better understand protected marine mammal resources.

Current Status: ongoing

Final Report Due:	December 2014
Publications:	None
Affiliated WWW Sites:	None
Revised date:	March 2012
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