North and Central Atlantic Information Resources: Data Search and Literature Synthesis Study Update

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Project Objectives

- Develop comprehensive information on the human and environmental aspects of the region
- Update the understanding of the ecological communities, the dominant oceanographic and other processes that drive the shelf and deep-sea ecosystems, and the potential sensitivities of the area

Project Parameters

- Leeward scope was extended to include state waters, but not estuarine
- Seaward scope limited to <100m bottom depth
- Literature search was conducted along the dimensions of:
  - Resource characterization
  - Impact characterization

Develop Comprehensive Information

- Annotated Reference Database
  - Commercial Reference Software (EndNote)
  - Stored copies of publicly available material
- Geospatial Database
  - Tied to MMS's TIMS database
  - Footprints of site-specific studies
  - Geospatial data files (limited number)

Updated Oceanographic Synthesis

- Consideration of data gaps in current literature
- Focused on resources and issues potentially impacted by alternative energy development
- Consideration of R&D Technology issues

Annotated Reference Database

- 1,264 total references
  - 40% biological oceanography
  - 11% chemical
  - 10% geological
  - 18% physical/air-sea interaction
  - 8% socioeconomics
  - 14% R&D
- Over 75% are either reports or journal articles

Biological Oceanography

- Database Stats
  - 531 total references
  - Key sources:
    - Best resource characterization data comes from government agencies (esp. federal): e.g.:
      - NOAA/NMFS:
      - Federally listed threatened or endangered, and species of concern
      - Managed species – Essential Fish Habitat (EFH) source documents
      - Fisheries surveys and fisheries independent surveys of commercially important species
      - Habitat identification and characterization
    - MMS:
      - Benthos characterization related to sand and gravel program
      - Worldwide synthesis & Programmatic EIS
    - ASMFC (Atlantic States Marine Fisheries Commission):
      - Reports on managed species
    - Peer reviewed scientific literature, state agency reports, and books.

Biological Oceanography

Project Scope

- Marine mammals
- Marine birds, coastal birds, and bats
- Sea turtles
- Fish resources and essential fish habitat
- Benthic resources and seafloor habitats
  - Soft-bottom benthic communities
  - Hard-bottom benthic communities
- Areas of special concern
  - Marine sanctuaries
  - Unique topographical features

Biological Oceanography

Research Questions

- How are important biological resources distributed over the study area in space and time (e.g., spawning areas, feeding areas, overwintering areas, and migration/movement patterns)?
- What are the distributions of endangered/threatened species?
- What are the important marine resources associated with unique topographical and hydrographic regions?
- What are the major living marine resource harvest areas (e.g., commercial and recreational)?
- Which habitats are currently protected (e.g., sanctuaries, seasonal closures)?

Biological Oceanography

Research Questions (continued)

- How do marine bioresources respond to impacts?
- What are the most important potential impacts of each type of alternative energy development?
- In what ways will the potential impacts be expressed?
- Are there new analysis approaches that can be applied to available observations?
- How might important biological processes be impacted by alternative energy development projects?

Biological Oceanography

Learnings / Data Gaps

- Site-specific information (for all taxonomic groups) is patchy and sometimes outdated
- Limited information on spatial and temporal distribution for specific life stages – e.g., seasonal distribution
  - Best information is for federally listed and commercially important or managed species
- Little information is available for
  - Effects of electromagnetic fields
  - Implications of the artificial reef effect
  - Impacts of offshore wind farms on bird and bat populations
  - Artificial lighting/shading

Physical Oceanography / Air-Sea Interaction

- Database Stats
  - 200 total references
    - 184 peer-reviewed journal articles
    - 16 conference proceedings
  - Key sources:
    - Continental Shelf Research
    - Deep Sea Research
    - Journal of Geophysical Research
    - Journal of Physical Oceanography
    - Journal of Marine Research

Physical Oceanography/ Air-Sea Interaction

Project Scope:

- Sea level, storm surge
- Temperature, salinity, density
- Water masses, stratification
- Currents, tides, waves
- Upwelling, downwelling
- Estuarine outflow, turbulence
- Water masses, stratification
- Air-sea exchanges
- Bathymetry, sediment transport

Physical Oceanography/ Air-Sea Interaction

Research Questions

- What are the spatial horizontal, vertical, and temporal characteristics of each resource?
- What are the main characteristics of those natural processes that can be considered potentially impacted resources?
- What are the most important potential impacts of each type of alternative energy development?
- What are the most important potential impacts on natural process resources?
- For each resource, which types of alternative energy development could cause the most important impacts?
- How would the potential impacts be expressed?

Physical Oceanography / Air-Sea Interaction

Learnings / Data Gaps

- Very few references include energy resource perspective, and
- Very few explore potential impacts of alternative energy to POASI
- Poorly known footprint of alternative energy technologies (water column, atmospheric boundary layer, seafloor environment) limits understanding of potential impacts on POASI
- Few observation programs sustained for more than a few months; long-term perspective lacking

Geological Oceanography

- Database Stats
  - 125 total references
  - Key sources:
    - USGS
    - NOAA
    - Journal of Marine Geology

Geological Oceanography

Project Scope

- Bathymetry
- Marine geology
- Sediment transport
- Geohazards

Geological Oceanography

Research Questions

- What is the bathymetry of the study area?
- What are the major geologic structures which could affect the siting of alternative energy facilities?
- What are the sediments types and their respective geotechnical properties within the study area?
- What is the spatial distribution of sediments?
- What is the depth to bedrock or other load-bearing strata (e.g. glacial till) for potential foundations?
- What is the hazard associated with slope instability and mass movements (e.g. slumps, slides, debris flows, turbidity currents)?

Geological Oceanography

Learnings / Data Gaps

- Almost complete lack of non-surficial sediment data
- Lack of seismic data (e.g. sub-bottom) in shallow water
- Lack of cooperation from some universities in sharing data

Chemical Oceanography

- Database Stats
  - 135 total references
  - Key sources:

Chemical Oceanography

Project Scope

- Water Properties (inorganic and organic, dissolved and particulate distributions)
  - Nutrients (nitrate, nitrite, ammonium, phosphate, silicate)
  - Dissolved oxygen
  - Carbonate system chemistry and pH
  - Trace metals (i.e. copper, iron)
  - Redox chemicals (i.e. sulfide)
  - Trace gases (i.e. methane)
  - Radionuclides
  - Organic chemicals (i.e. hydrocarbons)
  - Salinity, temperature, density
  - Turbidity and other optical characteristics
- Sediment Properties
- Interfacial Chemistry
  - Biota-Water Interface (i.e. nutrient uptake)
  - Sediment-Water Interface (i.e. pore waters, resuspension, benthic boundary layer)
  - Land-Water Interface (i.e. riverine inputs)
  - Air-Sea Interface (i.e. rain water inputs)

Chemical Oceanography

Research Questions

- What are the most important potential impacts of each type of alternative energy development on chemical concentrations, distributions and processes in the study area?
- How can existing and future environmental chemical data collected by the Regional Associations of the emergent Integrated Ocean Observing System (IOOS) be fully utilized to monitor and characterize the spatial and temporal changes in chemical distributions in the study area?

Chemical Oceanography

Learnings / Data Gaps

- Understanding of chemistry limited by lack of direct observation to establish baseline data.
- The Coastal Ocean Observatories are often equipped with fundamental instrumentation (CTDs for oxygen, salinity, pH etc.) but observations of nutrient, metals and gas exchange are hindered by technical availability and temporal and spatial resolution.
- Unknown short-term effects of resuspended contaminated, sediments from excavation for foundations
- Unknown long-term effects of chemicals (lubricants, cleansers, antifouling) modulated during the construction, maintenance and decommission of manmade structures

R&D Technology

- Database Stats
  - 215 total references
  - Key sources:
    - Offshore & Polar Engineering Conference Proceedings

R&D Technology

Project Scope

- Research and development activities
  - Exploration research
  - Anticipated development
- Engineering challenges
  - Geologic hazards (possibly including hydrates)
  - High winds and currents
  - High waves and water levels
- Spill Technologies
  - Spill avoidance
  - Spill control
- Storage technologies
  - Pumped storage
  - Hydrogen – storage and transmission

R&D Technology

Research Questions

- How will high currents, high winds, and high wave/water levels affect engineering design of structures and operations/maintenance of facilities?
- How will structure foundation siting and energy transmission routes be affected by geologic hazards (possibly including hydrates)?
- What methods and equipment would be available to minimize hazardous material spills, or maximize spilled material recovery?

R&D Technology

Learnings/Data Gaps

- No direct studies have been located that assess the environmental impact of hazardous material spills, including oil spills on the operation and construction of alternative energy facilities.

Socioeconomics

- Database Stats
  - 100 total references
  - Key sources:
    - European studies – COWRIE,
    - Cape Wind-generated
    - MMS
      - Worldwide Synthesis of Alternative Energy
      - Programmatic EIS on Alternative Energy

Socioeconomics

Project Scope

- Causal factors and/or impacts associated with the development of alternative energy projects
  - Economic Factors
  - Sociocultural Resources
- Relationship between causal factors/impacts and socioeconomic characteristics of the study area

Socioeconomics

Research Questions

- What significant socioeconomic impacts from alternative energy projects can be expected to occur in the study area?
- Are there geographic or demographic areas of particular concern in regard to these socioeconomic impacts in the study area?
- Socioeconomic resources to be considered include:
  - Visual resources
  - Recreation
  - Tourism
  - Commercial fishing and other maritime industries
  - Property values
  - Employment/Economic output
  - Cultural resources
  - At-risk populations
  - Land use patterns
  - Public acceptance

Socioeconomics

Learnings / Data Gaps

- Very little socioeconomic research done on *offshore* wind installations in U.S.
- UK, Denmark, Germany have done attitudinal research, some tourism research
- Very little empirical research done on economic impacts in Europe
- Opportunities exist for well-designed experimental studies on socioeconomic impacts

Remaining Project Schedule

- Synthesis Phase: January through May 2009
- Draft Synthesis Report & Technical Summary: June 2009
- Review Copy of Synthesis Report: August 2009
- Final Synthesis Report & Technical Summary: October 2009