ATLANTIC WIND ENERGY WORKSHOP
Summary Report

FINAL
28 September 2011

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Prepared for:
U.S. Department of the Interior
Bureau of Ocean Energy Management,
Regulation and Enforcement

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1.0 INTRODUCTION

On November 23, 2010, Secretary of the Interior Ken Salazar launched a “Smart from the Start” wind energy initiative for the Atlantic OCS to facilitate siting, leasing and construction of new projects, spurring the rapid and responsible development of this abundant renewable resource. In January 2011, the Department of the Interior’s (DOI) Bureau of Ocean Energy Management, Regulation and Enforcement (BOEMRE) initiated the National Environmental Policy Act (NEPA) environmental assessment (EA) to evaluate the potential impacts associated with site assessment activities on the Atlantic OCS. BOEMRE published the draft EA in July 2011 for review and public comment (to be submitted by August 11, 2011). All comments on the draft EA will be considered in the preparation of the final EA and determination of whether a Finding of No Significant Impact (FONSI) would be appropriate, or whether an Environmental Impact Statement (EIS) would need to be prepared. The draft EA can be accessed online at: Uhttp://www.boemre.gov/offshore/RenewableEnergy/SmartFromTheStart.htm.

On October 1, 2011, BOEMRE was reorganized into the Bureau of Ocean Energy Management (BOEM) and Bureau of Safety and Environmental Enforcement (BSEE). For more information on the reorganization: http://www.boemre.gov/reorganization.htm

As part of the Secretary of the Interior’s “Smart from the Start” wind energy initiative to spur renewable energy development on the Outer Continental Shelf (OCS), this workshop will assist BOEMRE and its federal partners in environmental and technical reviews of wind energy areas and in the evaluation of new projects. Additionally, this workshop was part of the DOI-Department of Energy (DOE), Memorandum of Understanding (MOU) process to coordinate environmental monitoring and baseline studies in support of environmental assessment and consultations for siting and leasing in the mid-Atlantic wind energy areas. The Atlantic Wind Energy Workshop was held 12 through 14 July 2011 at the Hyatt Dulles Hotel in Herndon, Virginia. The three day workshop had 180 participants, representing Federal, State, tribal, NGO, academia, developers and public interest.

Director Bromwich opened the Workshop with a speech that touched on the role of offshore renewable energy development in the Administration’s Blueprint for a Secure Energy Future, and explained how the bureau’s Offshore Renewable Energy Program is being elevated through the overall reorganization of the former Minerals Management Service. The Director also highlighted steps the bureau is taking internally and with other federal agencies and state partners to streamline the leasing process while ensuring environmental protection as projects move forward. He concluded his opening speech, “We all have a role to play in building a secure energy future for America. Here today, we are moving forward collectively in support of the Administration’s ambitious clean energy goals. Success is achievable. How and when we attain that success is, in part, dependent upon the active communication and coordination among our respective agencies and organizations. I encourage you to fully engage in discussions over the next three days to help define and advance our collective scientific knowledge, identify critical data gaps, and outline strategies for enhancing collaboration in future environmental studies and research. As BOEMRE continues with its comprehensive regulatory reforms and reorganization, I assure you that we will remain focused and dedicated to leading the nation toward a renewable energy future.” The full address may be found at: http://www.boemre.gov/ooc/press/2011/press0714.htm
1.1 WORKSHOP GOALS

Goals for the workshop included 1) providing a summary and synthesis of recent and ongoing technical, environmental and social sciences research; 2) identifying key data needs and prioritize research gaps; and 3) developing partnerships and identifying potential synergies for future studies. In addition, the Workshop provided a technical document updating the research conducted since the Worldwide Synthesis and Analysis of Existing Information Regarding Environmental Effects of Alternative Energy Uses on the Outer Continental Shelf workshop in 2007, related to offshore wind development in the Atlantic Wind Energy Areas (Map 1).

1.2 WORKSHOP FORMAT

The Workshop was structured so that the specific goals could be achieved and information sharing could occur within small breakout groups. This was accomplished by beginning the workshop with a Plenary Session with all attendees present to set the stage for subsequent breakout sessions. The presentations provided updated information relevant to the regulatory program, market barriers, maritime infrastructure, energy infrastructure, and some aspects of energy markets as they relate to offshore wind power on the Atlantic Outer Continental Shelf (OCS).

Map 1. Areas under Consideration for Wind Energy Areas
### AGENDA

**Day One (July 12, 2011)**  
**Plenary Session**

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<tr>
<td>8:00-8:45</td>
<td>CIRRUS FOYER A</td>
<td>Registration and continental breakfast</td>
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<td>8:45-12:15</td>
<td>CIRRUS BALLROOM</td>
<td>All groups until 12:15 PM</td>
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**Session Objective:** The workshop focus is on the available data and information needs for site assessment and operational planning in the mid-Atlantic Wind Energy Areas. The plenary session is designed to set the stage for the breakout sessions (page 5).

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<td>8:45-9:15</td>
<td>Welcome &amp; Keynote Address – Introduction and Scope of Workshop including DOI-DOE MOU, &quot;Smart from the Start&quot; research initiatives, goals of workshop including an update of knowledge; priority data gap identification, and developing partnerships and collaboration – Michael R. Bromwich, Director</td>
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<td>9:15-9:40</td>
<td>BOEMRE Renewable Energy Research and Regulatory Program Update – An overview of the planning, leasing and environmental review processes for wind energy on the Atlantic OCS. This will include a brief overview of existing and expected survey guidelines for potential lessees. A state-by-state status will be given, including identification of current and future wind energy areas – Maureen Bornholdt, Program Manager, Office of Offshore Alternative Energy Programs</td>
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<td>9:40-10:05</td>
<td>Department of Energy – An overview of market barriers for future wind energy projects, and how these barriers are being address under DOE funding opportunities –Christopher G. Hart, Ph.D., Offshore Wind Manager, DOE</td>
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<td>10:25-10:35</td>
<td>Break</td>
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<td>10:35-12:15</td>
<td>Federal Agency Panel – In addition to BOEMRE and DOE, many other federal agencies have roles in offshore renewable energy, either as a regulator or resource agency. Panel participants will discuss each of their legal mandates and how the agencies are coordinating with each other to reduce duplication and increase efficiency.</td>
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<td>Moderator – Joel Whitman, CEO, Global Marine Energy, Inc.</td>
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<td>BOEMRE – Maureen Bornholdt, Program Manager, Office of Offshore Alternative Energy</td>
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<td>FERC – Tim Konnert, Fish Biologist, Office of Energy Projects</td>
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<td>FWS – David Cottingham, Senior Advisor to the Director</td>
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<td>USGS – Walter Barnhardt, Director, Woods Hole Coastal &amp; Marine Science Center</td>
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<td>NPS – Sarah A. Quinn, J.D., External Renewable Energy Specialist</td>
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<td>NOAA – Emily Lindow, Senior Policy Advisor</td>
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<td>USCG – George Detwiler, Marine Transportation Specialist</td>
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<td>DOD – Frederick Engle, Office of the Secretary of Defense</td>
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<td>EPA – Susan E. Bromm, Director, Office of Federal Activities</td>
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<td>ACHP – Tom McCulloch, Senior Program Analyst</td>
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Facilitated Q & A session
12:15-1:00 Lunch – Bag lunches provided

1:00-5:00 ROCKBRIDGE ROOM Technology Assessment & Research (TA&R) Program: Renewable Energy Studies session – Page 7-9

CIRRUS BALLROOM

Day One facilitator for environmental sessions will be Brian Balcom, CSA International, Inc.

1:00-3:00 Information Management and Data Sharing Products Panel – Cross-discipline look at mapping and data issues in support of the science needed for planning, decision making and stewardship. Panel participants will discuss existing and future efforts, including Coastal Marine Spatial Planning (CMSP), geo-spatial databases, mapping products, and data portals. (10 minute briefs with Q & A at the end).

- Moderator – Mary Boatman, Ph.D., (BOEMRE)
- EcoSpatial Information Database (ESID) – Keld Madsen, Geospatial Services Manager, AMEC
- Habitat Mapping – Chris Caldow, Branch Chief, NOAA Biogeography Branch
- Sonar Mapping for Multipurpose Use and an Integrated Ocean and Coastal Mapping Standard – Brian Calder, Ph.D., NOAA/University of New Hampshire Joint Hydrographic Center
- Space Use Conflicts – Developing a geospatial database compatible with the BOEMRE mapping system to assist in determining multiple uses offshore – John Weiss, Industrial Economics, Inc.
- Mid-Atlantic Regional Council on the Ocean – MARCO Data Portal – Laura McKay, Program Manager, Virginia CZM Program, Dept of Environmental Quality
- Northeast Regional Council on the Ocean – NROC Data Portal – Nicholas Napoli, Director of Marine Planning Programs, Massachusetts Ocean Partnership
- OBIS-SEAMAP – Patrick N. Halpin, Associate Professor of Marine Geospatial Ecology, Duke University
- MMC – The future of data sharing – Update on Multipurpose Marine Cadastre – Christine Taylor (BOEMRE) and Brian Smith (NOAA)

Facilitated Q & A session

3:00-3:15 Break

3:15-5:00 LAYTON ROOM Social-Economics Afternoon Session: Overview of Assessment Focus (Environmental Assessment and NEPA) and the Cultural and Historic Resources Session – Page 9

CIRRUS BALLROOM

3:15-5:00 Developers Panel – Monitoring from meteorological towers, buoys and survey plans, capabilities, limitations and lessons from the field.

- Moderator – Jim Lanard, President, Offshore Wind Development Coalition
- Fishermen’s Energy of NJ, LLC – Stephen O’Malley, Engineering Coordinator
- Deepwater Wind, LLC – Aileen Kenney, Director of Permitting
- Bluewater Wind NJ Energy, LLC & Bluewater Wind Delaware, LLC – Laurie Jodziewicz, Director of Permitting
- Atlantic Wind Connection – Kris Ohleth, Director of Permitting, Atlantic Wind Connection

Facilitated Q & A session

5:00-5:30 Day one summary and direction for day two
Day Two (July 13, 2011)
Breakout Sessions

1) Environmental Breakout Sessions: Monitoring and Baseline Studies, CIRRUS AB ROOM – Pages 5-6

2) Technology Assessment & Research Program: Renewable Energy Studies, ROCKBRIDGE ROOM – Page 8

3) Social-Economic Breakout: Assessment Driven Issues, CIRRUS CD ROOM – Page 10

4) Birds, Bats and Offshore Wind Development: Remaining Information Gaps, LAYTON ROOM – Page 11

Environmental Breakout Sessions: Focus on Biological and Habitat Concerns Related to Environmental Monitoring and Baseline Studies Breakout Sessions Day Two (July 13, 2011)

8:00-9:00 CIRRUS FOYER A Registration and continental breakfast
9:00-5:15 CIRRUS AB ROOM

Day Two facilitator for all environmental breakout sessions will be Brian Balcom, CSA International, Inc.

<table>
<thead>
<tr>
<th>Time</th>
<th>Session</th>
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</thead>
<tbody>
<tr>
<td>9:00-10:45</td>
<td>State Planning and Information</td>
</tr>
<tr>
<td>9:00-9:15</td>
<td>New Jersey Ecological Baseline Study – Gary A. Buchanan, Ph.D.,</td>
</tr>
<tr>
<td>9:15-9:30</td>
<td>Massachusetts Ocean Plan – Bill White</td>
</tr>
<tr>
<td>9:30-9:45</td>
<td>Maine State Planning Office, Maine Coastal Program – Matt Nixon</td>
</tr>
<tr>
<td>9:45-10:00</td>
<td>Rhode Island Ocean Special Area Management Plan – Grover Fugate</td>
</tr>
<tr>
<td>10:00-10:15</td>
<td>Developing Environmental Protocols – Michelle Carnevale and John King, Ph.D.</td>
</tr>
<tr>
<td>10:15-10:45</td>
<td>Facilitated Q &amp; A session</td>
</tr>
<tr>
<td>10:45-11:00</td>
<td>Break</td>
</tr>
</tbody>
</table>
### Broad Scale Habitat, Abundance and Distribution – Consultation Process

**Session Objective:** To provide an overview of the applicable environmental laws and regulations enforced by the other environmental agencies, namely NOAA and FWS, that govern offshore renewable energy activities. Provide the attendees with an overview of the Acts, the information, data, and applications to comply with the Acts, and the timing for these compliance documents.

- **Moderator** – Kim Skrupky, BOEMRE

<table>
<thead>
<tr>
<th>Time</th>
<th>Session</th>
<th>Details</th>
</tr>
</thead>
<tbody>
<tr>
<td>11:00-11:15</td>
<td>Marine Mammal Permits</td>
<td>NOAA, Michelle Magliocca</td>
</tr>
<tr>
<td>11:15-11:30</td>
<td>ESA Consultations</td>
<td>NOAA, Kellie Foster (invited)</td>
</tr>
<tr>
<td>11:30-11:45</td>
<td>ESA Consultations</td>
<td>FWS, Julie Thompson</td>
</tr>
<tr>
<td>11:45-12:00</td>
<td>Facilitated Q &amp; A session</td>
<td></td>
</tr>
</tbody>
</table>

**12:00-1:00**  
Lunch – bag lunches provided

### Broad Scale Habitat, Abundance & Distribution – Baseline Data

**Session Objective:** To identify what species are being studied in what locations, during which seasons, using which technologies, and if there is any data (or preliminary data).

- **Moderator** – Kim Skrupky, BOEMRE

<table>
<thead>
<tr>
<th>Time</th>
<th>Session</th>
<th>Details</th>
</tr>
</thead>
<tbody>
<tr>
<td>1:00-3:00</td>
<td>Fisheries Management Council Perspective: Spatial Aspects of Fishery Management Plans</td>
<td>Tom Hoff, MAFMC &amp; Michelle Bachman, NEFMC &amp; Roger Pugliese SAFMC</td>
</tr>
<tr>
<td>1:35-1:50</td>
<td>NMFS Surveys</td>
<td>Sofie Van Parijs, Ph.D., NMFS</td>
</tr>
<tr>
<td>1:50-2:05</td>
<td>AMAPPs</td>
<td>Update on this multi-agency project – Kim Skrupky, BOEMRE</td>
</tr>
<tr>
<td>2:05-2:20</td>
<td>Navy Baseline Studies</td>
<td>Robin Fitch, U.S. Navy</td>
</tr>
<tr>
<td>2:20-3:00</td>
<td>Facilitated Q &amp; A session</td>
<td>How these data may be incorporated in environmental analyses, which data gaps exist, and which data gaps can be closed soon.</td>
</tr>
</tbody>
</table>

**3:00-3:15**  
Break

**3:15-5:15**  
**Acoustic Monitoring Technology and Impacts**

**Session Objective:** To identify which monitoring methods and technologies are currently being used, both unsuccessfully and successfully, on various species, locations, and seasons. And what impacts have been identified

- **Moderator** – Michael Rasser, Ph.D., BOEMRE

<table>
<thead>
<tr>
<th>Time</th>
<th>Session</th>
<th>Details</th>
</tr>
</thead>
<tbody>
<tr>
<td>3:00-3:15</td>
<td>OSC Acoustic Monitoring</td>
<td>David Zeddies, JASCO</td>
</tr>
<tr>
<td>3:15-3:30</td>
<td>Monitoring Technologies and Acoustics PNNL</td>
<td>Tom Carlson, PNNL</td>
</tr>
<tr>
<td>3:45-4:00</td>
<td>Acoustic Monitoring, Impacts and Sound Characterization</td>
<td>Peter Dugan, Cornell</td>
</tr>
<tr>
<td>4:00-4:15</td>
<td>Electromagnetic Fields</td>
<td>Ann Pembroke, Normandeau Associates</td>
</tr>
<tr>
<td>4:15-4:45</td>
<td>NMFS Large Whales and Acoustics</td>
<td>Sofie Van Parijs, Ph.D.,</td>
</tr>
<tr>
<td>4:45-5:15</td>
<td>Facilitated Q &amp; A session</td>
<td>How these data may be incorporated in environmental analyses, which data gaps exist, and which data gaps can be closed soon.</td>
</tr>
</tbody>
</table>

**5:15–5:30**  
Day two summary and direction for day three
# Technology Assessment and Research (TA&R) Program: Renewable Energy Studies
## Breakout Sessions Day One (July 12, 2011)

### 1:00-5:00 ROCKBRIDGE ROOM

Day One facilitator for all TA&R sessions will be Dan White, Continental Shelf Associates, Inc.

Moderator:  Lori Medley, BOEMRE

<table>
<thead>
<tr>
<th>Time</th>
<th>Session Details</th>
</tr>
</thead>
<tbody>
<tr>
<td>1:00-1:30</td>
<td>Overview of TA&amp;R Program and Summary Review of Renewable Energy Studies Conducted to Date – Lori Medley, BOEMRE</td>
</tr>
<tr>
<td>1:30-2:00</td>
<td>TA&amp;R 634 “Mitigation of Underwater Pile Driving Noise During Offshore Construction” and TA&amp;R 651 “Evaluate the Effect of Turbine Period of Vibration Requirements on Structural Design Parameters” – Dwight Davis, Applied Physical Sciences Corp.</td>
</tr>
<tr>
<td>2:45-3:00</td>
<td>Break</td>
</tr>
<tr>
<td>3:00-3:25</td>
<td>TA&amp;R 656 “Seabed Scour Considerations” – Tom McNeilan, Fugro Atlantic</td>
</tr>
<tr>
<td>4:15-4:30</td>
<td>TA&amp;R 672 “Development of an Integrated Extreme Wind, Wave, Current, and Water Level Climatology to Support Standards-Based Design of Offshore Wind Projects” – George Hagerman, Virginia Tech Advanced Research Institute</td>
</tr>
<tr>
<td>4:30-4:40</td>
<td>IEC TC 88 status update – James Manwell, Univ. of Mass.</td>
</tr>
<tr>
<td>4:40-4:50</td>
<td>TRB “Structural Integrity of Offshore Wind Turbines” report – Walt Musial, NREL</td>
</tr>
<tr>
<td>4:50-5:00</td>
<td>Closing remarks and instructions for tomorrow’s sessions</td>
</tr>
</tbody>
</table>
## Technology Assessment and Research (TA&R) Program: Renewable Energy Studies
### Breakout Sessions Day Two (July 13, 2011)

<table>
<thead>
<tr>
<th>Time</th>
<th>Location</th>
<th>Activity</th>
</tr>
</thead>
<tbody>
<tr>
<td>8:00-9:00</td>
<td>CIRRUS FOYER A</td>
<td>Registration and continental breakfast</td>
</tr>
<tr>
<td>9:00-5:15</td>
<td>ROCKBRIDGE ROOM</td>
<td>Day Two facilitator for all TA&amp;R sessions will be Dan White, Continental Shelf Associates, Inc.</td>
</tr>
<tr>
<td>9:00-9:30</td>
<td></td>
<td>Moderator: Lori Medley, BOEMRE</td>
</tr>
<tr>
<td>9:00-9:30</td>
<td></td>
<td>Open Mic – An opportunity for participants to present any other relevant efforts that have been recently completed, or that are on-going that may have an impact on TA&amp;R research efforts.</td>
</tr>
<tr>
<td>9:30-9:50</td>
<td></td>
<td>“Proven Technology” in New Operating Environments – Several differences in the operating environment of the Atlantic seaboard, and the areas where offshore wind turbines currently are sited have been identified, e.g. hurricanes and open-ocean breaking waves. What other issues present unique concerns for the U.S. OCS? What can we adapt from oil and gas experience?</td>
</tr>
<tr>
<td>9:50-10:10</td>
<td></td>
<td>Marine Hydrokinetic (MHK) Devices (with special emphasis on current devices in the Gulf Stream) – FERC will be the regulatory agency for construction and operations of some MHK devices on BOEMRE leases, but if the device is not grid connected, BOEMRE will regulate its construction and operations. Design standards have not been developed for these devices. What are the key operational safety/protection of the environment concerns? Are API standards, such as those for the design of mooring systems, appropriate for this industry?</td>
</tr>
<tr>
<td>10:10-10:30</td>
<td></td>
<td>Design and Safety Standards Gaps – Several preliminary studies and on-going standards maintenance efforts have been initiated. What gaps have been identified? Are they appropriate for consideration for research under the TA&amp;R program funding?</td>
</tr>
<tr>
<td>10:30-10:45</td>
<td></td>
<td>Break</td>
</tr>
<tr>
<td>10:45-11:05</td>
<td></td>
<td>Regulating Worker Safety – The risks to offshore oil and gas workers and terrestrial wind farm workers will be discussed with the goal of determining the key issues of regulating worker safety on the U.S. OCS.</td>
</tr>
<tr>
<td>11:05-11:25</td>
<td></td>
<td>Working with Intellectual Property in Technology and Safety Assessments – Recent documents submitted to BOEMRE have revealed that offshore wind turbines may contain substances that present hazards that are not obvious, e.g. ethylene glycol contained in a dampering system. What other unknown hazards are there? How do we work around IP issues?</td>
</tr>
<tr>
<td>11:25-12:00</td>
<td></td>
<td>Participants’ Concerns – Participants will be encouraged to introduce additional topics.</td>
</tr>
<tr>
<td>12:00-1:00</td>
<td></td>
<td>Lunch – bag lunch provided</td>
</tr>
<tr>
<td>1:00-4:00</td>
<td></td>
<td>Development of potential research topics – Based on topics identified in the morning session, those deemed most appropriate for potential funding under the TA&amp;R program will be further defined. Most critical topics will be identified and research requirements including data sources and other challenges will be discussed.</td>
</tr>
<tr>
<td>4:00-5:00</td>
<td></td>
<td>Wrap Up</td>
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</table>
3:15-5:30 LAYTON ROOM

Day One facilitator for socioeconomic session will be David Blaha, ERM

<table>
<thead>
<tr>
<th>Time</th>
<th>Event</th>
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<tbody>
<tr>
<td>3:15-3:35</td>
<td>Discussion on the Assessment Driven Focus of This Workshop (Environmental Assessments/NEPA)</td>
</tr>
<tr>
<td>3:35-5:30</td>
<td>Cultural and Historic Resources</td>
</tr>
</tbody>
</table>

Session Topics: Historic/Cultural resources, tribal issues, archaeological resources, submerged cultural sites and landscapes.

- **Moderator** – Brian Jordan, BOEMRE
- **Fathom Research, LLC** – Mr. David Robinson
- **Wampanoag Tribe of Gay Head** – Ms. Bettina Washington
- **Narragansett Indian Tribe** – Mr. Doug Harris
- **BOEMRE** – Mr. David Ball
- **Sea Education Association** – John Jensen, Ph.D.

Conclusion for Day 1
## Social-Economic Breakout: Assessment Driven Issues
### Breakout Sessions Day Two (July 13, 2011)

8:00-9:00  **CIRRUS FOYER A**  Registration and Continental Breakfast

9:00-5:40  **CIRRUS CD ROOM**

Day Two facilitator for all socioeconomic sessions will be David Blaha, ERM

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<thead>
<tr>
<th>Time</th>
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<th>Location</th>
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<tbody>
<tr>
<td>9:00-9:10</td>
<td>Recap: Assessment Driven Focus of This Workshop</td>
<td>CIRRUS CD ROOM</td>
</tr>
<tr>
<td>9:10-11:10</td>
<td>Multi-Use Issues/Space-Use Conflicts</td>
<td>CIRRUS CD ROOM</td>
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</table>

Session Topics: OCS renewable energy and space-use conflicts and related mitigation, recreational fishing, commercial fishing, DOD, shipping, human geography/spatial analysis.

- **Moderator** – John Primo, BOEMRE
- Independent Contractor and University of Maryland, Adjunct Faculty – Susan Abbott-Jamieson, Ph.D.
- University of Delaware – Jeremy Firestone, Ph.D.
- Woods Hole Oceanographic Institute – Porter Hoagland, Ph.D.
- Rutgers University – Kevin St. Martin, Ph.D.

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<th>Location</th>
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<tbody>
<tr>
<td>11:10-12:10</td>
<td>Lunch – bag lunches provided</td>
<td>CIRRUS CD ROOM</td>
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</tbody>
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<th>Event</th>
<th>Location</th>
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<tbody>
<tr>
<td>12:10-2:10</td>
<td>Public Perception, Legal Studies, Visual Impacts, Tourism</td>
<td>CIRRUS CD ROOM</td>
</tr>
</tbody>
</table>

Session Topics: Marine policy, impact on tourism, public perception, legal issues, visual Impacts on historic properties.

- **Moderator** – Amardeep Dhanju, BOEMRE
- University of Delaware – Jeremy Firestone, Ph.D.
- Wampanoag Tribe of Gay Head – Ms. Bettina Washington
- Lawrence Berkeley National Laboratory – Mr. Ben Hoen
- Clean Power Now – Ms. Barbara Hill

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<th>Location</th>
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<tbody>
<tr>
<td>2:10-2:40</td>
<td>Break</td>
<td>CIRRUS CD ROOM</td>
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<th>Event</th>
<th>Location</th>
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<tbody>
<tr>
<td>2:40-4:40</td>
<td>Economic Impact, Regulatory, Policy, Stakeholder Issues and Infrastructure</td>
<td>CIRRUS CD ROOM</td>
</tr>
</tbody>
</table>

Session Topics: Land-based resources (jobs, facilities, infrastructure), property values, navigational access and safety, staging areas, ports and harbors, vessels, grid infrastructure.

- **Moderator** – Gary Norton, DOE
- Virginia Polytechnic Institute & State University – Mr. Matt Unger
- Eastern Research Group, Inc. – Maureen Kaplan, Ph.D.,
- Woods Hole Oceanographic Institute – Porter Hoagland, Ph.D.

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<th>Location</th>
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</thead>
<tbody>
<tr>
<td>4:40-5:40</td>
<td>Create Social Science Report – Facilitator/Support Staff, Panel Members, Moderators, and BOEMRE/DOE Personnel</td>
<td>CIRRUS CD ROOM</td>
</tr>
</tbody>
</table>
## Birds, Bats and Offshore Wind Development: Remaining Information Gaps
### Breakout Sessions Day Two (July 13, 2011)

<table>
<thead>
<tr>
<th>Time</th>
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</thead>
<tbody>
<tr>
<td>8:00-9:00</td>
<td><strong>CIRRUS FOYER A</strong></td>
<td>Registration and Continental Breakfast</td>
</tr>
<tr>
<td>9:00-4:00</td>
<td><strong>LAYTON Room</strong></td>
<td>Day Two facilitator for all birds and bats sessions will be Julia Tims, ERM</td>
</tr>
</tbody>
</table>

### Session Objective:
To present information on immediate information needs and on current and planned research efforts. Following the presentations, there will be a facilitated discussion aimed at identifying and prioritizing the remaining information gaps.

- **Moderator** – James Woehr, Ph.D., BOEMRE

#### 9:00-12:00
**Birds, Bats and Offshore Wind Development: Remaining Information Gaps**

- 9:00-9:15 **BOEMRE Immediate Information Needs** – David Bigger, Ph.D., BOEMRE
- 9:15-9:45 “Marine Bird and Offshore Wind Workshop- Summary” – Melanie Steinkamp, FWS
- 9:45-11:00 Current research efforts & expected startups – Panel
  - James Woehr, Ph.D., BOEMRE
  - Caleb Gordon, Ph.D., Normandeau
  - Allan O’Connell, Ph.D., USGS
  - Richard Veit, Ph.D., CSI/CUNY
- 11:00-11:15 Break
- 11:15-12:00 **Ongoing Offshore Bat Studies in the Gulf of Maine**, Steve Pelletier, CWB Stantec
- 12:00-1:00 Lunch – bag lunch provided
- 1:00-2:30 List of research needs – Report from FWS workshop & Bat Studies – Melanie Steinkamp, FWS & David Bigger, BOEMRE
- 2:30-2:45 Break
- 2:45-4:15 Prioritize research needs – Follow up from FWS workshop & Bat Studies – Melanie Steinkamp, FWS & David Bigger, BOEMRE
- 4:15-5:00 Create Bird & Bat Research prioritized research needs report
Workshop Breakout Overview Data Gaps and Partnerships
Day Three (July 14, 2011)

8:00-9:00  **CIRRUS FOYER A**  Registration and continental breakfast

9:00-12:15 **CIRRUS BALLROOM**  Breakout groups present overview of findings, identify priority data gaps and overlaps and identify partnerships and collaboration

9:00-9:30  Environmental: Monitoring and Baseline Studies

9:30-10:00  Social – Economics

10:00-10:15  Break

10:15-10:45  Birds & Bats

10:45-11:15  TA&R

11:15-12:15  Open Discussion & Public Comment

12:15-1:15  Lunch – on your own

1:15-4:00  Development of future study topics with Federal Partners or Collaborators
2.0 PRESENTATION ABSTRACTS

2.1 PLENARY SESSION

The Plenary Session was attended by all workshop attendees to provide direction and an overview of the objectives of the Atlantic Wind Energy Workshop and ultimately, set the stage for content to be included in the breakout sessions.

2.1.1 Welcome & Keynote Address

Michael R. Bromwich, Director of the Bureau of Ocean Energy Management, Regulation and Enforcement (BOEMRE) — The opening remarks delivered by the Director touched on the role of offshore renewable energy development in the Administration’s Blueprint for a Secure Energy Future, and explained how the bureau’s Offshore Renewable Energy Program is being elevated through the overall reorganization of the former Minerals Management Service. The Director also highlighted steps the bureau is taking internally and with other Federal agencies and State partners to streamline the leasing process while ensuring environmental protection as projects move forward.


2.1.1.1 BOEMRE Renewable Energy Research and Regulatory Program Update

Maureen Bornholdt, Program Manager, Office of Offshore Alternative Energy Programs — This presentation provided an overview of renewable energy activities, guiding laws and mandates, philosophy of the Program, ongoing consultation and coordination between regulatory agencies (taskforces), regulatory framework, and research efforts (see links below). The key stages of the Renewable Energy Program, emphasizing the importance of engaging intergovernmental task forces, stakeholders, and the public throughout the process were outlined and described. These stages include Planning and Analysis, Lease or Grant Issuance, Site Assessment (see links below), and Commercial development. Ms. Bornholdt explained that future guidance documents will be required and that workshops and interagency coordination can aid in their development. The recent publication of the Draft Environmental Assessment for Wind Energy Areas offshore Delaware, Maryland, New Jersey, and Virginia was outlined, and updates were provided on current progress/projects within each State or region. Continued focus areas and future steps were outlined and discussed. The presentation was concluded with listing the objectives of this Workshop: 1) identify key data needs; 2) prioritize data collection and research initiatives; 3) develop potential synergies for future studies; and 4) cultivate partnerships. The slides for this presentation are provided in Appendix A, Pages A-2 to A-6.

Research and Studies Efforts Links
www.boemre.gov/tarprojectcategories/RenewableEnergy.htm
http://www.boemre.gov/offshore/RenewableEnergy/PDFs/MidAtlanticWEAs_DraftEA.pdf

Guidance Documents Links
2.1.1.2 Department of Energy – Offshore Wind Market Barriers

Christopher G. Hart, Ph.D., Offshore Wind Manager, Department of Energy (DOE) — The National Offshore Wind Strategy (see link below) published on February 7, 2011 was outlined, and key points listed: 1) benefits to the nation; 2) challenges facing offshore wind development; 3) realizing the benefits in spite of the challenges; and 4) understanding and reducing market barriers are critical to the Strategy. The critical objectives that will be required to reduce market barriers, including the costs, siting, deployment, and infrastructure required to support associated with the development of offshore wind energy were discussed. The DOE has established a strategy to address the barriers that incorporates research activities with stakeholder collaboration to identify information needs and the utilization of information from European projects. The wind research solicitations currently published and the topics covered, funded in part by the DOE to aid in filling some data gaps were outlined. Specific challenges to siting and permitting and to infrastructure development were outlined and included ongoing involvement of DOE and interagency collaboration, solutions and the partners involved to overcome the challenges. The presentation concluded with a discussion of each key takeaway point: 1) the environmental and economic benefits of ocean renewable energy are significant, and the resources are abundant; 2) The DOE is leading the nation’s efforts to develop and deploy ocean renewable energy technologies; and 3) the DOE’s efforts will reduce costs and timelines for projects and enable growth of robust industry. The slides for this presentation are provided in Appendix A, Pages A-7 to A-9.

A National Offshore Wind Strategy: Creating an Offshore Wind Energy Industry in the U.S.  

2.1.1.3 Energy Market and Infrastructure Information for Evaluating Alternative Energy Projects for OCS Atlantic

Maureen Kaplan, Ph.D., Eastern Research Group, Inc. — A summary of the BOEMRE study focusing on the maritime and industry infrastructure, started in 2008, was presented. The maritime infrastructure research focused on existing ports and the vessels utilizing them, including fishing communities along the east coast of the Atlantic. The assessment was conducted to determine if the existing maritime infrastructure would be sufficient to support offshore wind energy development, including: port sizes, vessel sizes, capabilities, and the associated applicability for use in offshore wind energy development and whether the existing resources could be retrofitted or if purpose-built assets would be required (see link below). The presentation provided information regarding the components of an offshore wind project, including transmission cables, turbine manufacturing, and connection to existing energy infrastructure onshore. The results of this analysis, which included regional maps generated from Platts data, (see link below) showing the existing onshore energy infrastructure was presented. Observations from the study were outlined and indicated that getting the power onshore might be the weakest link and that the consistent theme throughout the study was to identify the point where demand is sufficient to support a domestic supply chain. The slides for this presentation are provided in Appendix A, Pages A-10 to A-13. Additional information regarding this project can be found in Section 4.6.

Shipyard construction records  
http://www.shipbuildinghistory.com/

World Electric Power Plants Database  
http://www.platts.com/Products/worldelectricpowerplantsdatabase
2.1.2 Federal Agency Panel

Maureen Bornholdt, Program Manager, Office of Offshore Alternative Energy, BOEMRE; Tim Konnert, Fish Biologist, Office of Energy Projects, FERC; David Cottingham, Senior Advisor to the Director, FWS; Walter Barnhardt, Director, Woods Hole Coastal & Marine Science Center, USGS; Sarah A. Quinn, J.D., External Renewable Energy Specialist, NPS; Emily Lindow, Senior Policy Advisor, NOAA; John Page, Obstruction Evaluation Group, FAA; James Haggerty, NAD Program Manager, USACE; George Detweiler, Marine Transportation Specialist, USCG; Frederick Engle, Office of the Secretary of Defense, DOD; Susan E. Bromm, Director, Office of Federal Activities, EPA; Tom McCulloch, Senior Program Analyst, ACH — The Federal agency panel included agencies that have roles in offshore renewable energy, whether as a regulator or resource agency. The purpose of this panel was to provide the mandates of each agency and discuss how the agencies are coordinating with each other to reduce duplication and increase efficiency. Each panel member presented their agency and respective legal mandate, existing Memorandums of Understanding/Agreement, and programs and research (ongoing and completed) specific to offshore energy development. Information presented during this panel is provided in the supplemental Handout (Synopsis of Federal and State Regulatory and Research Activities); any additional information that was discussed during this panel was incorporated into the updated Synopsis. The slides for this presentation are provided in Appendix A, Pages A-14 to A-20.

Studies discussed in this panel:

EPA Cape Wind Fact Sheet

USCG Atlantic Coast Port Access Route Study (ACPARS)

2.2 ENVIRONMENTAL BREAKOUT SESSIONS: MONITORING AND BASELINE STUDIES

2.2.1 Information Management and Data Sharing Products Panel

Moderator – Mary Boatman, Ph.D., BOEMRE — This panel provided a cross-discipline look at mapping and data issues in support of the science needed for planning, decision making and stewardship. Panel participants discussed existing and future efforts, including Coastal Marine Spatial Planning (CMSP), geo-spatial databases, mapping products, and data portals.

2.2.1.1 EcoSpatial Information Database

Keld Madsen, Geospatial Services Manager, AMEC — The EcoSpatial Information Database (ESID) is a BOEMRE project with the purpose to support ecosystem-based management decisions and this project approach addressed four major elements: 1) to acquire relevant ecological resources for the project area; 2) create a robust geospatial database structure that would allow the documents to be accessed; 3) create a GIS mapping application that would allow for spatial query of the resources; and 4) provide the ability to query the resources. A rigorous process was implemented through which the information was compiled, categorized, verified, and the geographical extent identified. Together the geodatabase and applications will offer a decision support system to assist in identifying environmental impacts from proposed offshore energy projects by providing geographically relevant scientific information that is easily

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accessible through a cloud configuration. The slides for this presentation are provided in Appendix A, Pages A-21 to A-22. Additional information is provided in Section 4.5.

2.2.1.2 Mapping Habitats and Species to Meet Local and Regional Needs

Chris Caldow, Branch Chief, NOAA Biogeography Branch — The purpose of the Biogeography Branch is to develop information and analytical capabilities through research, monitoring, and assessment on the distribution and ecology of living marine resources and their associated habitats for improved ecosystem-based management. Geospatial analysis is conducted to aid in siting of energy projects inclusive of human uses and natural resources from existing and actively collected data. The assessment approach, for both habitat types and for species, begins by selecting an area of interest, followed by selection of the technology type to acquire the data and how it will be analyzed, and lastly, determining how it will be presented and disseminated. The importance of the resources versus the confidence in the data was emphasized. The slides for this presentation are provided in Appendix A, Pages A-23 to A-25.

2.2.1.3 Sonar Mapping for Multipurpose Use and an Integrated Ocean and Coastal Mapping Standard

Brian Calder, Ph.D., NOAA/University of New Hampshire Joint Hydrographic Center — This presentation focused on a consistent theme based on the fact that data collected for a specific project or purpose is not transferred in its original form for use in other areas. The importance of integrating existing data so that an area can be mapped once and used many times was emphasized. A set of data collection recommendations and a list of needs were discussed to ensure that data can be transferred for other uses. An agreement on the type of data to collect, the accuracy of the data, the calibration of the equipment, data format, and distribution processes will be required to facilitate the idea of mapping once and using many times. The slides for this presentation are provided in Appendix A, Pages A-26 to A-28.

2.2.1.4 Outer Continental Shelf Space Use Conflicts and Analysis of Potential Mitigation Measures: Geodatabase Development

John Weiss, Industrial Economics, Inc. — The objectives of this project were to identify and characterize potential space and use conflicts that could result from OCS renewable energy activities in the Atlantic and Pacific regions and to describe strategies and specific measures for avoiding or mitigating these conflicts, including mechanisms for improved communication and cooperation among stakeholders. The elements of the project included literature review, development of geospatial database, stakeholder engagement, and a report. The specific steps taken to develop the database and navigation within the database to ultimately provide GIS layers of use areas under 13 primary categories or data types was discussed. The slides for this presentation are provided in Appendix A, Pages A-29 to A-30.

2.2.1.5 Mid-Atlantic Regional Council on the Ocean – MARCO Data Portal

Laura McKay, Program Manager, Virginia CZM Program, Dept of Environmental Quality — The MARCO Mapping and Planning Portal was developed under an agreement between the Governors of New York, New Jersey, Delaware, Maryland, and Virginia to protect ocean habitats and promote renewable offshore energy. Key offshore habitats were identified and the knowledge of the best locations for wind energies was combined to determine where space use conflicts may arise. Additionally, the MARCO Portal incorporates water quality data and potential risks from climate change. The structure of the MARCO Portal and the steps taken into account during creation of the Portal was discussed. The guiding principles of the project include staying focused on immediate planning needs; trusting that the Portal will grow, evolve,
and adapt over time; and making data needs known over a wide audience and seek traditional knowledge from tribes and ocean users. Some aspects of the MARCO Data Portal were demonstrated while describing some of the categories and data layers, and features. The next steps of the project, including finding a host server, developing a maintenance plan, seeking missing data layers, and securing funding to develop decision support tools was also discussed. The slides for this presentation are provided in Appendix A, Pages A-31 to A-33.

MARCO Mapping & Planning Portal
www.midatlanticocean.org

2.2.1.6 Northeast Regional Council on the Ocean – Northeast Ocean Data Portal

Nicholas Napoli, Director of Marine Planning Programs, Massachusetts Ocean Partnership — The Northeast Ocean Data Portal has been developed through a collaborative working group that is entirely self-funded with volunteer effort and coordination with the Northeast Regional Ocean Council (NROC). The goal of the Portal is to integrate data from many providers and provide regionally consistent data products and tools. The progress of data integration and organization within six categories with a total of 29 data layers available was described. Examples of the website and data viewer were presented and it was explained that the data catalog could be downloaded and external datasets could be incorporated. The next steps and ongoing efforts include receiving feedback from stakeholders, coordinating with other working groups, continued data product development, and collaboration with data providers to fill data gaps. The slides for this presentation are provided in Appendix A, Pages A-34 to A-36.

2.2.1.7 OBIS-SEAMAP – Protected Species Information & Analysis System

Patrick N. Halpin, Associate Professor of Marine Geospatial Ecology, Duke University — The OBIS-SEAMAP is a spatially referenced online database, aggregating protected marine mammal, seabird and sea turtle observation data, focusing on the activity of the species rather than occurrence only. Raw observation data is used to fully document habitat and density models. This information can be useful for siting of offshore energy development and to understand the potential interaction of migratory species and wind energy development to support environmental impact analysis and forecasting models. The OBIS-SEAMAP database supports multiple data types and because data can be collected and interpreted in many different ways, the data must include extent and effort. The approach to include various data types was outlined, by data type, and examples of the database were presented for various data types. The data needs specific to data resolution for incorporation into the modeling process was described; noting that the OBIS-SEAMAP is a node of the larger OBIS network; the OBIS-SEAMAP specializes in the synthesis and analysis of data and that they would be interested in formally coordinating with the DOI/BOEMRE initiatives on the Atlantic OCS. The slides for this presentation are provided in Appendix A, Pages A-37 to A-40.

2.2.1.8 MMC – The Future of Data Sharing – Update on Multipurpose Marine Cadastre

Christine Taylor (BOEMRE) and Brian Smith (NOAA) — The Multipurpose Marine Cadastre data viewer is an integrated marine information system that provides legal, physical, ecological, and cultural information in a common geographic information system (GIS) framework, developed through a partnership between BOEMRE and NOAA. An overview of the website and viewer was provided, and it was emphasized that the data sets comprise federal authoritative data with the purpose of supporting renewable energy siting; however, the project is looking to accept data from other sources and that the data can be used for numerous other ocean planning projects. The eight major categories contained in the MMC include, jurisdictional boundaries, Federal agency regions, Federal georegulations, navigation and
marine infrastructure, marine habitat and biodiversity, human uses, physical and oceanographic, and basemaps. It was noted that data gaps exist in the categories of marine habitat and biodiversity and human uses. Additional data that is currently being worked on includes marine mammal, turtle, avian, Navy/NGA areas, nautical charts, selected State planning areas, AIS tracks and hot/cold maps, and hurricane and extra-tropical storms. In addition the planned improvements for the future include enhanced and new datasets, improved tools, links to additional data and similar portals, special applications provided by ESRI, and developing an on-line decision support tool for assessing site suitability in the marine environment. The slides for this presentation are provided in Appendix A, Pages A-41 to A-43.

The Multipurpose Marine Cadastre
http://www.marinecadastre.gov

2.2.2 Developers Panel

Moderator – Jim Lanard, President, Offshore Wind Development Coalition — This panel provided information from developers who have firsthand experience and can provide insight from lessons learned. Developers require an efficient and known timeline for permitting from the agencies.

2.2.2.1 Fishermen’s Energy of NJ, LLC

Aviv Goldsmith, Engineering Coordinator — Fisherman’s Energy is a community-based offshore wind developer formed by principals of the New Jersey fishing companies to enable the fishing industry to participate in and invest in offshore wind energy, and extends participation from Maine to South Carolina. Fisherman’s Energy is working on two projects off the coast of New Jersey: 1) A 350 megawatt project in Federal waters and 2) a 25 megawatt project in State waters located 2.8 mi east of Atlantic City. The State waters project proposes to install six turbines parallel to shore in 12 m of water; construction is set to begin in the fall of 2011 and commissioned in the fall of 2012. The process implemented by Fisherman’s Energy to collected data, perform site assessments, and conduct impact studies was detailed. The project utilized historical data, publicly available real-time data, conducted site-specific surveys, and deployed monitoring equipment. Site-specific survey types included biological, geophysical, and geotechnical. Monitoring buoys were deployed to record wind, current, wave and wildlife data transmitted to shore for compilation throughout the year-long deployment. An innovative approach is being used to collect additional wind data using a floating vertical LIDAR unit and a horizontal scanning LIDAR. The next phases of the project with the continued collaboration between all stakeholders include collecting additional data and completing the State waters windfarm project. The slides for this presentation are provided in Appendix A, Pages A-44 to A-48.

2.2.2.2 Deepwater Wind, LLC

Aileen Kenney, Director of Permitting — Deepwater Wind is led by a management team comprising developers, marine construction firms, investors with oversight from an advisory board. Deepwater Wind was selected through state solicitations to become the preferred offshore wind developer for both Rhode Island and New Jersey. The company has several regional projects, in New England, New York, and southern New Jersey. These projects required meteorological, biological, oceanographic, geophysical, geotechnical, and cultural studies and utilized both traditional and innovative technologies to collect pertinent data. The data collection and analysis methods had both challenges and limitations. Other studies
required include visual, navigational safety, air emissions, and commercial fishing conflicts. The slides for this presentation are provided in Appendix A, Pages A-49 to A-50.

2.2.2.3 Bluewater Wind NJ Energy, LLC & Bluewater Wind Delaware, LLC

Laurie Jodziewicz, Director of Permitting — Bluewater Wind was acquired by NRG Energy, Inc. and is referred to as NRG Bluewater Wind. NRG Bluewater Wind is developing the Mid-Atlantic Wind Park offshore Delaware and has executed leases for OCS Blocks 6325 and 6936 offshore Delaware and New Jersey. Installation of meteorological data collection towers within the lease blocks are in the planning stages. Five permits were required to install the necessary meteorological towers. The survey work completed included geological and geophysical surveys, archaeological reports, and biological resource reports. The lessons learned thus far in the project including mobilization of geophysical surveys, timing of survey work, agencies’ unfamiliarity with offshore wind activities, and lack of metocean information. An observation highlighted was that although the technology of installing wind turbines is new, the activities that support these activities are similar to other regulated projects that are not new. The slides for this presentation are provided in Appendix A, Pages A-51 to A-52.

2.2.2.4 Atlantic Wind Connection

Kris Ohleth, Director of Permitting, Atlantic Wind Connection — The Atlantic Wind Connection (AWC) project is a proposed transmission backbone extending from New Jersey to Virginia that aims at addressing the challenge of juggling variable load and variable production of wind energy that cannot be stored. The project is divided into five phases or segments that will ultimately provide the required infrastructure for offshore wind development with two independent circuits. The network will comprise a multi-terminal high voltage direct current (HVDC) network with a buried transmission cable linking to terrestrial converter stations from offshore converter platforms. Some of the conflicts that have arisen during siting the location of the components include use conflict and air space designation. The system must be installed in areas where wind energy development is likely to occur, and also must avoid conflict with existing uses of the seafloor (e.g., shipping lanes, submarine communication cables, dumping grounds, fish havens). A two-tiered approach was utilized to determined location for the cables and the associated platform or hub sites. AWC has filed with BOEMRE to obtain a Right of Way (ROW) grant for cable and hub sites, and are in the process of developing a general activities plan (GAP) for submittal to BOEMRE in early 2012, and are planning surveys for late summer 2011. The project anticipates that a Phase A notice to proceed would be issued in 2013 and operations would commence in 2016. The continued coordination with wind developers is very important to ensure that the AWC fits the needs of future projects and to ensure project compliance. The slides for this presentation are provided in Appendix A, Pages A-53 to A-55.

2.2.2.5 Panel Open Discussion

At the end of the panel and open question and answers session was conducted, attendees were able to ask questions to each panelist or provide information. Key questions and the associated discussions included:

- Why do developers collected their own data rather than using historical and existing data? The reason that developers collect their own data is to gain the specific data needed for their project at the fine scale necessary for the permitting process. The developers need data at their specific project height because a small change in wind speed results in a large change in power output, which is required for investors and required for designers to engineer the system to function.
• For impacts to birds at project sites in New Jersey, is mitigation required? There is a low occurrence of T&E species, monitoring will occur during construction and operations, and curtailment of impacts is a permit condition.

• What funding sources or credits are available for the efforts offshore New Jersey? Federal tax credits, renewable energy certificates, and state portfolios were used to provide funding to conduct baseline studies, and allocated money to the developer for the meteorological buoy.

2.2.3 State Planning and Information

Moderator – Jennifer Ewald, BOEMRE — The objective of the State Planning Panel was to provide information on state ocean management plans and baseline study efforts, including obstacles encountered and remaining gaps and how this information is useful to the OCS development.

2.2.3.1 New Jersey Ecological Baseline Study

Gary A. Buchanan, Ph.D. — New Jersey Department of Environmental Protection conducted the Ocean/Wind Power Ecological Baseline Study to conduct baseline studies to determine the current distribution and usage of this area by ecological resources and to fill data gaps in the areas offshore New Jersey in order to facilitate offshore renewable energy. Field studies and data compilation were conducted within a predetermined study area and included primarily avian, marine mammal, and sea turtle distribution, abundance, and utilization data collection. Additional studies conducted include oceanographic, fisheries, benthic mapping, and GIS and modeling. GIS data layers are available on the website for download (see link below). The survey effort was conducted over a 2 year period along 18,183 km of survey lines. A suite of survey methods were used to collect the data. The data were then interpreted to create sensitivity maps, where the portions of the study area that are more or less suitable for wind/alternative energy power facilities were determined based on potential ecological impact using predictive modeling, mapping, and environmental assessment methodologies. While this information provides broad scale data, site specific data for a project would also be required. Some of the hurdles faced throughout the project included a lack of standard methods for U.S., obtaining NOAA Marine Mammal authorizations, weather challenges, availability of vessels for surveys, and budget. This project is significant in that the data will aid in the development of renewable energy projects, help to assess potential impacts, provide a template for other states, and provide information relevant to the National Environmental Policy Act (NEPA) process and Federal consultation process. Existing data gaps/future plans include the development of a CMSP work plan in coordination with regional working groups and Federal agencies. The slides for this presentation are provided in Appendix A, Pages A-108 to A-112.

The New Jersey Department of Environmental Protection (NJDEP), Office of Science

http://www.nj.gov/dep/dsr/ocean-wind/index.htm

2.2.3.2 Massachusetts Ocean Plan

Bill White, Assistant Secretary for Federal Affairs, Executive Office of Energy and Environmental Affairs — The Massachusetts Ocean Management Plan was created under the Oceans Act instated by Governor Patrick in 2008 and is the first Ocean Plan in the nation, presenting the most ambitious energy efficiency programs. The need for a comprehensive energy plan was needed in Massachusetts since they do not have any other known indigenous energy sources, and identifying prohibited areas to avoid use conflicts was a priority. The Ocean Plan for
Massachusetts State waters developed a management plan; established prohibited areas; identified renewable energy areas; created buffers from high activity areas, environmentally sensitive areas, water-dependent marine uses, and regulated airspace. A task force has been established to continue coordination with BOEMRE to provide input into an RFI issued by BOEMRE for OCS leasing in Federal waters offshore. The data, information and outreach from the Ocean Plan are useful in the continued coordination and meetings with topic specific working groups, stakeholders, and Federal agencies. Recommendations on the RFI included the review of whale, turtle, avian, fish, fisheries, and navigation data. To reduce potential impacts to these resources, it was recommended that half of the area presented in the RFI be excluded. The next steps include BOEMRE issuing a Call for Interest and Nominations and issue a draft NEPA planning notice. Task forces, working groups, and stakeholder meetings will continue throughout this process. The slides for this presentation are provided in Appendix A, Pages A-113 to A-116.

2.2.3.3 Maine State Planning Office, Maine Coastal Program

Matt Nixon, Maine State Planning Office, Maine Coastal Program — Maine has an Ocean Energy Demonstration Siting Initiative that initiated an Ocean Energy Task Force lead by The Department of Conservation (DOC) and State Planning Office (SPO). The Task Force was tasked with siting up to five Demonstration Sites within State waters. This task required analysis of spatial data, coordination with stakeholders, and public meetings. Through process of elimination an original seven sites was narrowed down to three that were selected as demonstration sites. Deep C Wind is a University-led consortium that collected data and identified gaps to facilitate the siting of the testing facilities. Close coordination with academia, NGOs, and state resources was the networking approach used to gather information and identify gaps. The list of needs and obstacles facing the program include reliable funding sources, standards for siting, inter-agency communication, and coordinated data collection efforts. Areas where coordination with federal agencies, academia, and/or private companies could be beneficial include human use mapping, bathymetric mapping, and avian work. The slides for this presentation are provided in Appendix A, Pages A-117 to A-118.

2.2.3.4 Rhode Island Ocean Special Area Management Plan

Grover Fugate — The Rhode Island Ocean Special Area Management Plan (SAMP) is a marine spatial planning tool for renewable energy siting started in 2008. The project began by mapping potential wind areas and identifying areas to be avoided. A technology based assessment was conducted to develop a metric based on technical challenge to power production potential to screen for sites. Marine user data and natural resource data were incorporated in the database. Marine resource research included analysis of wind resources, marine mammals and birds, fisheries uses, physical oceanography, ecosystem interactions, sediment and benthic habitat, cultural resources, acoustics and electromagnetic effects, meteorology, engineering, and marine transportation uses. Data were collected utilizing various technologies, and it was suggested that a minimum of 3 years of preconstruction surveys would be required for avian data. Other considerations incorporated into the Ocean SAMP document included socioeconomic issues such as fisheries, sailing events, diving, whale watching tours, recreation and tourism, and cultural and historical resources. The slides for this presentation are provided in Appendix A, Pages A-119 to A-125.

Ocean SAMP document
http://seagrant.gso.uri.edu/oceansamp/
2.2.3.5 Developing Environmental Protocols

Michelle Carnevale and John King, Ph.D., University of Rhode Island — This project is a study in progress under NOPP to develop standardized protocols for baseline assessment and monitoring for offshore wind, wave and current energy development and develop a conceptual framework and approach for cumulative environmental impact evaluation. European standards and the lessons learned during development of the industry were evaluated and applied as applicable. The approach to achieve the study goals included collaboration with researchers, regulators, and industry professionals to create a project advisory committee to review information and examine the information from a topic-specific reviewer’s point. Identification and comparison of techniques currently being used followed to develop a common language. The CEQ Task force and the proposed national priority objectives include ecosystem-based management, coastal and marine spatial planning, informed decisions and understanding, and coordination and support. Tier one screening was conducted to develop criteria, look at other mapping strategies, and recommend scale for surveys and data products from different survey methods. Tier two screening was conducted to look at the ecological components, categories, indices, and models to recommend standard classification schemes, like the U.S. Coastal and Marine Ecological Classification Standard (CMECS). Obstacles encountered and the remaining data gaps to achieve the goals of this project include establishing between agencies and developers effective approaches for baseline studies, development of indices to evaluate impacts, and developing cost-effective and valid monitoring programs. The slides for this presentation are provided in Appendix A, Pages A-126 to A-129.

2.2.4 Broad Scale Habitat, Abundance and Distribution – Consultation Process

Moderator – Kim Skrupky, BOEMRE — The objective of this panel is to provide an overview of the applicable environmental laws and regulations enforced by the other environmental agencies, namely NOAA and FWS, that govern offshore renewable energy activities. This panel also provided the attendees with an overview of the regulatory Acts, the information, data, and applications to comply with the Acts, and the timing for these compliance documents.

2.2.4.1 Marine Mammal Permits

Michelle Magliocca, NOAA — The Marine Mammal Protection Act Prohibits the taking of marine mammals unless exempted or authorized under a permit. There are two types of permits that can be issued, a letter of authorization (LOA) or an incidental harassment authorization (IHA), by the Secretary of the Department of Commerce for the incidental take of small numbers of mammals from a specified activity within a specific geographic area. There are two types of harassment levels with different thresholds, Level A: injury, and Level B: behavioral disruption. An LOA includes harassment or mortality, requires regulations, is valid for 5 years, and requires rulemaking with two public comment periods. An IHA includes harassment only, is only valid for 1 year, and does not require rulemaking, but still has one public comment period. Specific considerations relevant to wind include possible permits required for pre-construction surveys, acoustic impacts during construction possibility of entanglement, acoustic impacts during operation, and modifications to avoid impact. The acoustic criteria used to evaluate permit applications include the proposed activity, species impacted, quantity and type of take, and the impact to the species. Requirements for the permit application include mitigation, monitoring and compliance. The slides for this presentation are provided in Appendix A, Pages A-130 to A-131.
2.2.4.2 ESA Consultations

Kellie Foster, NOAA and Julie Thompson-Slacum, FWS — The Endangered Species Act and Section 7 Consultation process was outlined in this join presentation by NOAA and FWS. FWS has jurisdiction for terrestrial species and NOAA handles marine protected species, and the consultation process between the two agencies is similar. The goal is to facilitate interagency cooperation. There are four types of Section 7 consultations, 7(a)(1), 7(a)(2), 7(a)(3), and 7(a)(4) and formal and informal consultations. Informal consultation takes place when the proposed action is not likely to affect any listed species in the project area. Formal consultation takes place when the proposed action is likely to adversely affect a listed species. It was noted that applicants underutilize 7(a)(3) (Early Consultation), which would begin before the proposal stage of an action including any permit or license process. Although 7(a)(3), requires a prospective applicant’s Certification as an “applicant for the purposes of Section 7 consultation, it allows any applicant to sit at the table during the consultation process from beginning to end, from submitting information for the consultation to reviewing draft biological opinions. This will expedite the process and a preliminary Biological Opinion will be developed. Flow charts depicting the process and actions required by the applicant and the role of the applicant throughout the process are included. The slides for this presentation are provided in Appendix A, Pages A-132 to A-136.

2.2.5 Broad Scale Habitat, Abundance and Distribution – Baseline Data

Moderator – Kim Skrupky, BOEMRE — The objective of this panel was to identify what species are being studied and in what locations, during which seasons, using which technologies, and if there is any data (or preliminary data).

2.2.5.1 Fisheries Management Council Perspective: Spatial Aspects of Fishery Management Plans

Tom Hoff, MAFMC, Michelle Bachman, NEFMC, and Roger Pugliese SAFMC — The Fishery Management Councils (New England, Mid-Atlantic, and South-Atlantic) collaborate with NMFS to develop Fishery Management Plans (FMPs) based on analysis of existing fishery data within each respective region. The FMCs recommend regulations and essential fish habitat (EFH) designations to NMFS based on analysis of data and consultation with stakeholders, state resource managers, and academic partners. The FMCs are looking into emerging relationships and partnerships for future collaboration. The topics that should be considered during wind energy siting and development include closed areas, gear restricted areas, marine protected areas, special management zones, EFH, habitat areas of particular concern (HAPC), and the distribution of fishery resources, activities, and revenues. The panel described the differences in fishery independent data and fishery dependent data incorporated into the FMPs. FMC Programs, areas, and activities that would be useful to BOEMRE include the Swept Area Seabed Impact Approach (SASI) utilized by the NEFMC to estimate the magnitude, location, and duration of adverse effects of fishing on EFH across gears types and FMPs, and to evaluate the cumulative impacts of management alternatives to minimize those effects; the tilefish HAPCs and gear restricted areas within the MAFMC areas; and. all managed areas within the SAFMC area including fishery areas, marine protected areas, coral HAPCs, and the internet mapping server that is available to display the information. The benefits of ecosystem models were outlined, and it was stated that these types of models will begin to be the precedence as the FMCs move forward with ecosystem-based approaches. The panel FMCs expressing their continued support of renewable energy and continued coordination to include fisheries into spatial planning. The slides for this presentation are provided in Appendix A, Pages A-137 to A-139.
2.2.5.2 NMFS Surveys

Sofie Van Parijs, Ph.D., NMFS — An overview of NOAA/NMFS surveys was provided and included NOAA CetMap (cetacean density and distribution mapping working group), AMAPPS – Atlantic multi-year multi agency effort, and NMFS standard surveys. The CetMap project aims to create a comprehensive GIS-based visualization tool that will identify the single most appropriate indicator of density or distribution, based on the best available science, for a given area, time, and species. Challenges faced during this project include variation in data quality, identification of data gaps, and the variation in density models throughout regions. The AMAPPS and NMFS standard survey results were presented, pointing out the variation in broad scale versus detailed mapping. Passive acoustic surveys are now providing more detailed information than visual surveys. All of NOAA/NMFS data can be found in the OBIS-SEAMAP database (as discussed in Section 2.2.1.7). The slides for this presentation are provided in Appendix A, Pages A-140 to A-143.

2.2.5.3 AMAPPS

Kim Skrupky, BOEMRE — The Atlantic Marine Assessment Program for Protected Species (AMAPPS) is a program aimed at collecting broad-scale data on the seasonal distribution and abundance of marine mammals, sea turtles, and sea birds. The program is a collaborated effort that includes BOEMRE, NOAA, FWS, and the U.S. Navy. Additional objectives include collecting similar data at finer scales at sites of particular interest; conducting tag telemetry studies of sea turtles, pinnipeds, and seabirds; exploring alternative platforms and technologies; assessing the population size at regional scales; and developing models and tools to translate the data into seasonal, spatially-explicit density estimates with habitat characteristics. The five-year study plan includes aerial, vessel, and satellite telemetry surveys and continued investigation of advanced data collection technologies such as LIDAR and UAV gliders. Additionally, the program aims to improve existing capabilities for spatial modeling of the collected data. The data will be integrated into a common database that will allow users to query data and view model products to support environmental assessments. The activities completed during the Year 1 include aerial surveys for marine mammals and turtles and sea turtle telemetry tagging. Year 2 activities planned include seal tagging and aerial surveys, additional turtle telemetry surveys, and aerial surveys for waterfowl. The slides for this presentation are provided in Appendix A, Pages A-144 to A-146.

2.2.5.4 Navy Baseline Studies

Robin Fitch, U.S. Navy — Navy-Funded data collection includes visual surveys, passive acoustic monitoring, behavioral response studies, and photo identification. Many Navy activities require coordination and permitting with NOAA-NMFS which requires the best available habitat, distribution and abundance data. The Navy-NMFS adaptive management process for annual survey planning was developed to comply with the requirement for monitoring workshops required under the Final Rules for the unintentional taking of marine mammals incidental to Navy activities on Navy training ranges and operating areas. There is ongoing coordination with the National Ocean Council to make the Navy’s data available in a portal for use by coastal planners. The slides for this presentation are provided in Appendix A, Pages A-147 to A-148.

2.2.6 Acoustic Monitoring Technology and Impacts

Moderator – Michael Rasser, Ph.D., BOEMRE — This panel aimed to identify which monitoring methods and technologies are currently being used, both successfully and unsuccessfully, on various species, locations, and seasons, and to determine what impacts have been identified.
2.2.6.1 OSC Acoustic Monitoring

David Zeddies, JASCO — Acoustic monitoring is being conducted to characterize ambient sound in areas of the OCS that are to be developed for renewable energy using subsurface acoustic monitoring stations (AMARs) to record sounds. The first phase involves characterization of the ambient sound at two sites, selected by BOEMRE, by deploying the ‘float on a rope’ AMARs and recording ocean sounds for 3 continuous months. The resultant data is output to a Wenz curve and spectral analysis is conducted. Data are presented in quartile-distribution plots for the entire duration of recording. The results from data collected at the two sites, Nantucket Sound and Delaware Bay was presented. In Nantucket Sound the spectrogram was compared to wind and wave data from a nearby meteorological buoy and the quartile distributions were presented. In Delaware Bay the same analysis was provided showing the tracks of two hurricanes in the region and the associated increase in sound levels. A summary of the project, is that the ambient sound levels at the two sites can be used for future comparisons and identified the sound sources of most ambient noise as shipping traffic and biological sources. These data are useful for monitoring / assessing protected and endangered species at the development sites. The slides for this presentation are provided in Appendix A, Pages A-149 to A-155.

2.2.6.2 Monitoring Technologies and Acoustics PNNL

Tom Carlson, Pacific Northwest National Laboratory (PNNL) — The application of acoustic technologies to ocean energy development includes reconnaissance, site characterization, impact assessment, compliance monitoring, and evaluation. Compliance monitoring required to assure that no ‘takes’ of endangered whales occur utilized passive acoustic detection using tetrahedral arrays and also active acoustic detection using multi-bean or fixed aspect array. The active acoustic system had to use a frequency of operation based on the hearing of the mammal and the pulse duration had to relate to the frequency. Field measurements were taken with an echosounder at multiple frequencies and different pulse durations. The sonar operating at 200 kHz generates sound within the hearing range of killer whales, but evidence is showing that there may be a behavioral response to the sonar pulses. A potential advantage of this behavior response may be that sonar pulses could actually alert marine mammals to the presence of a turbine. The slides for this presentation are provided in Appendix A, Pages A-156 to A-158.

2.2.6.3 Acoustic Monitoring, Impacts and Sound Characterization

Peter Dugan Ph.D., Cornell — The processing of collected acoustic data faces many challenges. Data can be processed for multiple reasons, including for species detection, ambient noise, and location of anthropogenic noises. This data can then be analyzed and modeled both spatially and temporally. The archived data is analyzed through various software types and resultant models are produced. Examples of data results from Massachusetts Bay were presented and the models for temporal, spatial, and ambient noise analysis were shown. The sizes of the data sets over a long term project were compared to the effort required to process the data. Data processing has become more efficient due to new technology associated with high performance computing. Some of the challenges with data processing were discussed, including the non-homogenous nature of data formats and the large quantities of data. Moving forward, modeling of noise impacts and tools will be required to disseminate the information to resource managers. The slides for this presentation are provided in Appendix A, Pages A-159 to A-160.
2.2.6.4 Electromagnetic Fields

*Ann Pembroke, Normandeau Associates* — Studies are on-going to examine the effects to marine organisms as a result of electromagnetic fields (EMFs) associated with transmission cables. Concerns arise from electrosensitivity and magnetosensitivity of marine organisms to shielded and unshielded cables for both DC and AC power. Influence from geomagnetic fields was analyzed for buried cables separated by varying distances. A case study on sand bar sharks determined that they are sensitive to DC magnetic field if it is greater than the geomagnetic field, but could not determine if it impacted the species adversely. Sockeye salmon react to geomagnetic cues and their life cycle is dependent on rivers; therefore, it was suggested that DC cables near the mouth of an estuary could impact sockeye salmon migration. A case study on bottlenose dolphin found that they are sensitive to small changes in the geomagnetic field and that they could be exposed to DC fields up to 50 m above the cable; however, their speed and agility would likely limit the exposure duration. A Loggerhead turtle case study found that adults, juveniles, and hatchlings use geomagnetic fields for orientation and may rely on geomagnetic fields for locating nesting beaches. A spiny lobster case study was conducted and found that they are magnetosensitive and could potentially be sensitive to a field up to 20 m on either side of a DC cable. Data gaps include: research has been conducted using only natural electric or magnetic stimuli; the behavioral responses of individuals have not been studied; speculative to extrapolate to population level; and lack of species data throughout life stages. The slides for this presentation are provided in Appendix A, Pages A-161 to A-162.

2.2.6.5 NMFS Large Whales and Acoustics

*Sofie Van Parijs, Ph.D., NMFS* — There are four main research areas that NMFS is working in, including the Ocean Noise Project, long term monitoring and behavior, acoustic abundance, and autonomous acoustic technology. The Ocean Noise project began in 2007 and is ongoing to map and characterize ocean noise within Stellwagen Bank National Marine Sanctuary. The project aims to characterize contributing sound sources (biological and anthropogenic) and evaluate the acoustic impact. Long term monitoring has been ongoing since 2007 and aims to understand the basic acoustic occurrence, distribution, and behavior of different species. Additionally, this will validate passive acoustic results against other monitoring methods. The monitoring data has shown the variation of call types based on locations and time of year and throughout life stages. New tracking methods are being developed to assess behavioral changes. Acoustic abundance estimates can be determined from the AMAPPS data (Section 2.2.5.3). Autonomous acoustic technology can record low and mid frequency marine mammal vocalizations and allows detection, classification, and reporting in real time, while simultaneously collecting oceanographic data. There are currently 28 Passive Acoustic Monitoring Field projects on-going within the U.S. The next steps for passive acoustic monitoring include finalization of emerging technologies (e.g., gliders), make processing tools more widely available, develop better integrative tools, and establishing a portal for archived data. The slides for this presentation are provided in Appendix A, Pages A-163 to A-166.

2.3 TECHNOLOGY ASSESSMENT & RESEARCH PROGRAM: RENEWABLE ENERGY STUDIES

2.3.1 Overview of TA&R Program and Summary Review of Renewable Energy Studies Conducted to Date

*Lori Medley, BOEMRE* — The TA&R Program was established in the 1970’s to ensure use of Best Available and Safest Technologies (BAST) required through the OSC Lands Act.
Amendments of 1978. The TA&R Program focuses on operational safety and protection of the environment. A number of renewable energy studies have been completed or are currently being conducted. The presentation provided a list of the studies (see link below), showed an example of a study abstract from the TA&R web site and how to review the completed final reports, and provided a brief summary of the studies previously conducted that were not covered by other presenters in this session. The slides for this presentation are provided in Appendix A, Pages A-56 to A-59.

Studies Efforts Link  

2.3.2 TA&R 634 “Mitigation of Underwater Pile Driving Noise During Offshore Construction” and TA&R 651 “Evaluate the Effect of Turbine Period of Vibration Requirements on Structural Design Parameters”

Dwight Davis, Applied Physical Sciences Corp. — The efforts in this project are focused specifically on analyzing the pertinent noise transmission and radiation mechanisms associated with driving large monopile foundations. Further, the project will identify specific mitigation concepts appropriate to those mechanisms and assess the potential performance of those approaches with the context of achievable engineering design. The goals of the study are to identify risk of sound contributions, to assess mitigation measures, and develop recommendations. Pile driving is the highest noise level/issue of construction or operation and there are no significant current mitigation measures (European practice of starting slow/low impact to startle sea life away before building the drive frequency is not proven effective in protecting marine animals). Current mitigation options include bubble screens, compliant surface, and dewatered cofferdams and early determination is that dewatered cofferdam is effective and practical. The study also focused on particular frequencies audible to marine mammals and they are identified in the report. The slides for this presentation are provided in Appendix A, Pages A-60 to A-70.

2.3.3 TA&R 633 “Wind Farm/Turbine Accidents and the Applicability to Risks to Personnel and Property on the OCS, and Design Standards to Ensure Structural Safety/Reliability/Survivability of Offshore Wind Farms on the OCS” and TA&R 671 “Offshore Electrical Cable Burial for Wind Farms: State of the Art; Standards and Guidance; Acceptable Burial Depths and Separation Distances; and Sand Wave Effects”

Malcolm Sharples, Ph.D., Offshore Risk and Technology Consulting Inc. — Safety is a key issue for development of the offshore wind energy industry. Most companies in the oil and gas and chemical industries recognize the importance of formal documentation of safety requirements for design, installation, and operations; however, similar documentation is lacking for the emerging offshore wind energy industry. The existing standards that are in place for other industries are not directly applicable to this new industry. One mission of BOEMRE is to “encourage orderly, safe and environmentally responsible development” and when that mission is fulfilled needs to be determined and outlined. There is a need for development of suitable standards for a wide variety of areas including primary structures; control and protection systems; fire detection and protection; lightening protection; installation, construction, and commissioning procedures; access to and within the structures, and emergency equipment. There was a recommendation to cooperate more with other countries (Europe) that have longer experience with offshore wind facilities and potential structural problems. There was agreement that more research needs to follow up on issues identified in TA&R 633. TA&R 671 focuses on
the issues associated with the burial of the offshore electrical cables. It is anticipated that this study will be completed by the end of 2011. The slides for this presentation are provided in Appendix A, Pages A-71 to A-82.

2.3.4 TA&R 656 “Seabed Scour Considerations”

Tom McNeilan, Fugro Atlantic — The objective of this study was to review oceanographic and seabed data from the Atlantic OCS, review European Offshore Wind Farm (OWF) project experience, and describe how OWF structure and cable installation may affect scour susceptibility of the seabed. Scour is common and should be considered inevitable in most seabed substrates. A number of side scan sonar images from existing structures were presented showing scour around the monopile structure as well as cable trenches. A decrease in water depth can lead to higher velocity currents and thus a greater risk of scour occurring. It is believed that the majority of damaging scour occurs during extreme events (hurricanes and northeasters). There is a need for additional studies to determine best methods for predicting and mitigating scour.

- Existing soil and substrate studies onshore are not applicable to offshore.
- Small amount of tilt in tower reduces turbine efficiency considerably.
- Scour is generally a function of sediment disturbance: depth (shallow) and energy - particularly extreme events.
- Scour of piles and cable trenches is common.

The slides for this presentation are provided in Appendix A, Pages A-83 to A-87.

2.3.5 TA&R 627 “Assess/Develop Inspection Methodologies for Offshore Wind Turbine Facilities” and TA&R 650 “Offshore Wind Turbine Inspection Refinements”

Robert Sheppard, Energo Engineering — Operators on BOEMRE renewable energy leases are required to conduct an annual self inspection. Also, BOEMRE plans to have an inspector staff that will inspect these facilities. The purpose of these two studies was to develop guidance for Integrity Management (IM) procedures for offshore wind turbine facilities appropriate for use in U.S. waters. Project 627 provided most of the guidance, and project 650 refined the guideline with additional information on inspecting the turbine blades, and methods to measure tower inclinations. The guideline provides recommended inspection frequency based on facility condition and the consequence of failure. It also identifies critical inspection areas and provides inspection approaches. The slides for this presentation are provided in Appendix A, Pages A-88 to A-91.

2.3.6 TA&R 669 “Floating Wind Turbines” and TA&R 670 “Design Standards for Offshore Wind Farms”

Qing Yu, American Bureau of Shipping — The objective of TA&R 669 Floating Wind Turbines study is to study the critical design load conditions for floating wind turbines and to identify and rank the critical technical challenges to deploying floating wind turbines on the U.S. OCS. It includes case studies of three types of support structures. The study is scheduled to be complete by the end of 2011. The objective of TA&R 670 is to study the governing load cases and load effects for wind turbines subjected to tropical revolving storms on the U.S. OCS, review and evaluate the existing methods of calculating the breaking wave slamming loads inflicted on offshore wind turbine support structures, and provide recommendations to support future enhancements to the relevant design criteria for offshore wind turbines. This study is also
scheduled to be completed by the end of 2011. The slides for this presentation are provided in Appendix A, Pages A-92 to A-96.

2.3.7 TA&R 672 “Development of an Integrated Extreme Wind, Wave, Current, and Water Level Climatology to Support Standards-Based Design of Offshore Wind Projects”

George Hagerman, Virginia Tech Advanced Research Institute — An overview of the program tasks was presented and included the FEMA storm surge study, the analysis of USACE Wave Information Studies (WIS), Synthetic Hurricane Wind Hindcasting, joint storm population probability, water level analysis, wind-driven current analysis, and mapping to IEC design load cases. The FEMA Region III Storm Surge Study aims to identify and reconstruct historical extratropical storms in the region, by analyzing and modeling water levels with all required forcing inputs. Additionally, the study aims to develop a representative set of synthetic hurricanes using validated inputs, including the USACE Wave Information Studies (WIS). An overview of measured current data sets was presented with an example analysis of water level and wind-driven current forecasts for Hurricane Earl. In conclusion, the Expert Group peer review process was discussed. The study is not scheduled to be completed until the end of 2012. The slides for this presentation are provided in Appendix A, Pages A-97 to A-100.


2.3.8 International Electrotechnical Commission (IEC) Technical Committee 88 status update

James Manwell, University of Massachusetts — A summary of the International Electrotechnical Commission (IEC) 61400-3 was presented, explaining that this international standard for offshore wind turbines is being revised to include extensive consideration of metocean external design conditions, and will include additional design load cases beyond those of IEC 61400-1. The approach was described and includes preparation of preliminary design (PD), development of structural dynamic model of PD, specification of external conditions, specification of load cases, determination of structural loads and stresses; verification that stresses are acceptable, given chosen material, adaptation of design if necessary and repeat. Progress, methods, and analysis within each of these steps were presented. It was discussed that IEC 61400-3 is being used in most of the world; however it is also recognized that a second edition of this standard is needed and a team has been established to produce this second edition. The scope and new materials to be included in the second edition were provided. The slides for this presentation are provided in Appendix A, Pages A-101 to A-104.

2.3.9 Transportation Research Board’s “Structural Integrity of Offshore Wind Turbines” report

Walt Musial, National Renewable Energy Laboratory (NREL) — This study had three main tasks: to examine the applicability and adequacy of existing standards and practices for the design, fabrication, and installation of offshore wind turbines; the expected role of the Certified Verification Agent (CVA) in identifying standards to be used and conducting onsite inspections to verify compliance with the standards; and the experience level, technical skills and capabilities, and support equipment and computer hardware/software needed to be considered a qualified CVA. Some significant findings included: no single set of standards exist that covers all aspects of offshore wind - design through commissioning, and many standards and
guidelines exist which collectively are suitable for offshore wind installations but with some gaps. The slides for this presentation are provided in Appendix A, Pages A-105 to A-107.

2.3.10 Round Table Discussion

During the open microphone session a number of potential issues/studies were raised. It was decided to continue quickly with a few of the presentations and spend a majority of the day outlining issues and recommended studies. Some abbreviated presentations were given during Open Mic.

A majority of the day was dedicated to defining, prioritizing and preparing for presentation of the issues and the proposed studies to address the key issues.

2.3.10.1 “Proven Technology” in New Operating Environments

Several differences in the operating environment of the Atlantic seaboard, and the areas where offshore wind turbines currently are sited have been identified (e.g., hurricanes and open-ocean breaking waves). What other issues present unique concerns for the U.S. OCS? What can we adapt from oil and gas experience?

2.3.10.2 Marine Hydrokinetic (MHK) Devices

FERC will be the regulatory agency for construction and operations of some MHK devices on BOEMRE leases, but if the device is not grid connected, BOEMRE will regulate its construction and operations. Design standards have not been developed for these devices. What are the key operational safety/protection and environment concerns? Are API standards, such as those for the design of mooring systems, appropriate for this industry?

A short presentation was given that stressed the need to look at water use conflicts and density of array spreads for anchored/ floating structures (fishing and marine mammals). There was agreement to continue this discussion in developing studies and needs.

Another short presentation provided an overview of a small scale project in Florida’s Gulf Stream by Florida Atlantic University. There was discussion of siting, planning and regulatory issues surrounding installation. The presenter indicated that wind technology is probably 30 years ahead of marine hydrokinetic systems technology and that near-shore marine hydrokinetic systems are further along than deepwater/Gulf Stream systems. The slides for this presentation are provided in Appendix A, Pages A-170 to A-171.

2.3.10.3 Design and Safety Standards Gaps

Several preliminary studies and on-going standards maintenance efforts have been initiated. What gaps have been identified? Are they appropriate for consideration for research under the TA&R program funding?

Very brief presentation overview with focus on establishing needed data and studies. Several items were discussed and are included in the list of key research gaps in Section 3.0 of this report.

2.3.10.4 Regulating Worker Safety

The risks to offshore oil and gas workers and terrestrial wind farm workers will be discussed with the goal of determining the key issues of regulating worker safety on the U.S. OCS. Formal
presentation removed in favor of defining goals and studies. A quick statement indicated that this was likely encompassed by the newly awarded TA&R study 686 “Regulating Worker Safety in Renewable Energy Operations on the OCS” (http://www.boemre.gov/tarprojects/686.htm) with the National Research Council.

2.3.10.5 Working with Intellectual Property in Technology and Safety Assessments

Recent documents submitted to BOEMRE have revealed that offshore wind turbines may contain substances that present hazards that are not obvious (e.g., ethylene glycol contained in a dampening system). What other unknown hazards are there? How do we work around IP issues?

Formal presentation was removed in favor of determining key issues and identifying study needs. It was agreed that further discussion is needed because of industry’s current lack of information sharing. Michele Myers from AWEA indicated that information sharing is an issue for them also. She said that her organization has been working to provide secure ways for the industry and government to share information. It was noted that the oil/gas industry has regulations requiring information sharing but Wind has some legal protections. One of the reasons cites was that oil/gas was mature and for the most part self funded and did not have as much investment concerns. Right now offshore wind is investor funded and output and efficiency and even small technology innovations can provide a significant competitive advantage.

2.4 SOCIAL-ECONOMIC BREAKOUT: ASSESSMENT DRIVEN ISSUES

The Social-Economic Breakout session consisted of four discussion panels, each of which addressed a range of potential social and economic issues associated with offshore wind energy development. These discussion panels included:

- Cultural and Historic Resources;
- Multi-Use Issues/Space Use Conflicts;
- Public Perception, Legal Studies, Visual Impacts, and Tourism; and
- Economic Impact, Regulatory, Policy, Stakeholder Issues, and Infrastructure.

Unlike most of the other breakout sessions, the Social-Economic Breakout did not include formal presentations, but rather had a moderator and panels who helped lead an interactive discussion around the subject of each discussion panel. Each panel’s discussion; however, was focused on impact assessment-related issues. An overview of this “assessment-driven focus” as well as the key topics discussed by each panel is presented below.

2.4.1 Assessment Driven Focus

David Bennett from BOEMRE made a short presentation to help the Social- Economic Breakout understand the desired assessment-driven focus. In accordance with BOEMRE’s regulations (30 CFR Part 285), a commercial wind energy leaseholder has up to five years to conduct research to determine the suitability of the lease area for wind power development. This research involves several site assessment and site characterization activities. The site assessment activities include the construction and installation of meteorological tower and/or meteorological buoys in order to assess the wind resources of a particular site. The site characterization activities include shallow hazards, geological, geotechnical, and archaeological resource surveys, as well as biological data collection (e.g., benthic habitat, avian resources,
marine fauna). These site assessment and characterization activities can affect a wide range of social and economic resources through increased vessel traffic associated with facility construction, which BOEMRE must assess as part of its permitting process and its NEPA responsibilities. The focus of the Social-Economic Breakout was driven by these assessment responsibilities with a goal of identifying and characterizing information gaps and research needs related to potential social and economic impacts to marine space users that might arise from private sector site assessment and characterization activities. The Breakout discussions, however, were far ranging and did include information needs related to wind energy development and operations.

2.4.2 Cultural and Historic Resources Panel

2.4.2.1 Panel Members

The Cultural and Historic Resources Panel included:

- Moderator – Brian Jordan, Ph.D., BOEMRE
- Panelists
  - Mr. David Robinson – Director, Marine Archaeological Services Division, Fathom Research
  - Mr. Doug Harris – Preservationist for Ceremonial Landscapes and Deputy Tribal Historic Preservation Officer, Narragansett Indian Tribe
  - John Jensen, Ph.D. – Maritime Studies and Ocean Policy faculty at the Woods Hole-based Sea Education Association and Professor of History and Nautical Archaeology at the University of Rhode Island
  - Ms. Bettina Washington – Tribal Historic Preservation Officer, Wampanoag Tribe of Gay Head

2.4.2.2 Summary of Key Discussion Points

The Cultural and Historic Resources Panel discussions primarily focused on the topics of submerged ancient tribal sites and tribal/working marine landscapes.

Some tribal oral histories recount the movement from the east associated with rising sea level, which suggests at least the potential for ancient tribal sites/landforms remaining intact submerged on the continental shelf. The identification of any submerged ancient tribal sites would be extremely important to the tribes and historians in general. There are underwater archaeologists who can recognize the landscapes/landforms where these ancient sites may be found, but there is not an accepted systematic methodology for identifying these sites.

Marine landscapes can be of cultural significance from a tribal or historic perspective. For Native Americans, some marine landscapes are important in terms of traditional beliefs and practices (e.g., sunrise over the ocean). Working marine landscapes (e.g., some New England maritime communities) are also an important part of American history and protection of most (if not all) of these landscapes may be needed to maintain the traditional “sense of place” that reflect the historic roots of these seafaring communities. The locations of many of these communities or ritual sites are known, but we lack documentation of the heritage “context” that helps make these sites more meaningful. This context can be obtained by documenting tribal oral histories and mariner folklore. Linking this contextual story with the physical sites would significantly improve our understanding of the importance of various landscapes.
Doug Harris and Bettina Washington, representing two Tribal Historic Preservation offices, raised concerns about the timing of various cultural resource studies. They point out that a better job is typically done in defining potentially important locations than by only documenting the tribal/historical context. Waiting until applications for leases occur may not leave sufficient time to collect these data considering that the recommended participatory mapping technique can be a lengthy process. They strongly encouraged initiating these studies to collect tribal oral histories and mariner folklore as early in the process as possible.

2.4.3 Multi-Use Issues/Space Use Conflicts Panel

2.4.3.1 Panel Members

The Multi-Use Issues/Space Use Conflicts Panel included:

- Moderator – John Primo, Ph.D., BOEMRE
- Panelists
  - Susan Abbott-Jamieson, Ph.D. – Former Senior Social Scientist in the NMFS Office of Science and Technology; Adjunct Professor at the University of Maryland and an independent contractor
  - Kevin St. Martin, Ph.D. – Professor, Rutgers University, Department of Geography
  - Jeremy Firestone, Ph.D. – Professor, University of Delaware, College of Earth, Ocean and Environment
  - Porter Hoagland, Ph.D. – Senior Research Specialist, Woods Hole Oceanographic Institute

2.4.3.2 Summary of Key Discussion Points

The Multi-Use Issues/Space Use Conflicts Panel discussions focused on two key themes – need for stakeholder engagement and the advantages/disadvantages of separating uses versus allowing multiple uses.

There are clearly many users of the ocean for a wide variety of purposes (e.g., navigation, recreation, commercial fishing, tourism-related functions, shoreline property owners), as well as other stakeholders (e.g., NGOs, government agencies) who may not directly use the ocean, but have interests in or are responsible for managing it. Wind energy activities are now being introduced into this mix of stakeholders and uses that have not had to previously share the areas offshore. The panel discussion emphasized the need for wind energy projects to engage these ocean users and stakeholders early and often to ensure they fully understand the other users of the marine space.

The panel also emphasized the need to engage marginalized/vulnerable stakeholders who may not otherwise participate in the process. This engagement may involve directly reaching out to these populations to ensure their opinions are heard and also ensuring that the appropriate socio-economic data are used to adequately represent all affected populations. While mapping is useful it has the potential to relegate a site to a ‘place’ on a map and fail to convey the social, cultural, economic and historic connections people have to that site. In these scenarios decision-makers may be misinformed and their resultant choice may have significant unintended consequences for the people associated with a particular site.

The panel also discussed that stakeholders come from different cultural backgrounds and understand and relate to the ocean in different ways, which can also affect their understanding and acceptance of wind energy. It is important to accurately understand, document and
represent the social, cultural, economic and historic concerns/perspectives of those involved; particularly marginalized groups and those whose lifeways and livelihood can be impacted by energy development. Cultural models and participatory mapping (e.g., tribes and local communities such as fishers) are two techniques that would be very useful in identify and documenting the values and beliefs of stakeholders and their relationships with the associated spaces – i.e., seascape, coastline.

There was also discussion around the need to better understand cross-cutting issues (e.g., wind farms may affect fish, which may affect fishermen, which may affect marine communities). Most effects on natural resources will result in some effect on communities and socio-economics.

The panel discussion participants expressed interest in trying to accommodate overlapping multiple uses of ocean space rather than “zoning” or segregating uses, to the extent that public safety can be maintained. This shared use approach is the traditional paradigm of the ocean and would help avoid the “us vs. them” conflict. Several participants indicated the need to better understand the lessons that can be learned internationally where offshore wind energy projects have been active longer, such as in Europe.

Cable landfall locations were also identified as an often overlooked component of offshore wind energy projects that will have the most direct effect on local communities and should be considered when evaluating space conflict and multi-use issues.

2.4.4 Public Perception, Legal Studies, Visual Impacts, and Tourism Panel

2.4.4.1 Panel Members

The Public Perception, Legal Studies, Visual Impacts, and Tourism Panel included:

- Moderator – Amardeep Dhanju, Ph.D., BOEMRE
- Panelists
  - Jeremy Firestone, Ph.D. – Professor, University of Delaware, College of Earth, Ocean and Environment
  - Ms. Bettina Washington – Tribal Historic Preservation Officer, Wampanoag Tribe of Gay Head
  - Mr. Ben Hoen – Principal Research Associate, Lawrence Berkeley National Laboratory
  - Ms. Barbara Hill – Executive Director, Clean Power Now

2.4.4.2 Summary of Key Discussion Points

The Public Perception, Legal Studies, Visual Impacts, and Tourism Panel discussed that in general, there appear to be a number of national trends that show increasing general public support in the United States for offshore wind (e.g., desire for energy independence, climate change). One study in Delaware found that people living near the beach would accept a wind farm as close as one mile offshore before they would prefer construction of an oil or gas power plant.

There were many questions raised by the group around public perception of wind energy, such as:

- Does the public understand the tradeoffs among energy sources and do they care?
- What drives public opinion about wind energy – educational materials? the media? other drivers?
• Are public perception data from one project transferable to other projects or is each project unique from a public perception perspective?

Better understanding of public understanding and perceptions of offshore wind energy would be very useful in designing public education programs around wind energy and ensuring stakeholders received the information they need to make informed decisions regarding proposed wind energy projects. There was also discussion regarding collecting and distributing scientific knowledge in an easily understandable format regarding some commonly raised questions with respect to wind energy projects (e.g., effects of electromagnetic fields on benthic species – see recent BOEMRE report "Effects of EMF from Undersea Power Cables on Elasmobranchs and Other Marine Species, 2011" - http://www.gomr.boemre.gov/PI/PDFImages/ESPI/S/4/5115.pdf).

Tribal representatives indicated they believe the general public does not understand the basis for tribal concerns about some wind energy projects, nor do they understand the significant tribal role in the NEPA process (e.g., federal agencies' tribal trust responsibilities).

The panel discussion participants discussed the visual effects of offshore wind projects. There was recognition that some view sheds are important to protect, especially for important cultural landscapes, traditional cultural properties, and historic sites. Some willingness-to-pay studies have found that people would be willing to pay more for electricity to have wind turbines located further offshore up to about 9 or 10 mi beyond which this willingness to pay diminishes.

The issue of the potential effect of offshore wind turbines on shoreline property values is a common concern. The studies to date have found relatively little relationship between offshore wind farms and property values, even when considering the distance offshore. Longer term studies are needed once offshore wind projects are built in the United States to document whether any effects are measurable.

In terms of tourism, some municipalities have recommended siting criteria to protect tourism (e.g., Ocean City, Maryland). The few studies available that have studied the potential effect of offshore wind energy projects on tourism have not found much impact. In fact, a survey in Delaware found that 45% of respondents expressed interest in taking a boat tour of offshore wind farms, so perhaps these projects may actually serve as a tourism amenity.

In summary, the Breakout identified the need for:

• More funding on basic socio-economic research around offshore wind energy;
• Better understanding as to whether the level of public information on offshore wind energy is correlated with the level of public support for offshore wind energy projects;
• Better understanding of the type of information needed to enable the public to make informed decisions; and
• More regional studies to better understand public perceptions to supplement the more localized research conducted in Delaware and Cape Cod to date.
2.4.5 Economic Impact, Regulatory, Policy, Stakeholder Issues and Infrastructure Panel

2.4.5.1 Panel Members

The Economic Impact, Regulatory, Policy, Stakeholder Issues and Infrastructure Panel included:

- Moderator – Mr. Gary Norton, Senior Wind Energy Specialist, SRA International/DOE Wind Energy Program
- Panelists
  - Mr. Matt Unger – Energy Research Specialist, Virginia Polytechnic Institute & State University
  - Maureen Kaplan, Ph.D. – Vice President, Eastern Research Group, Inc.
  - Porter Hoagland, Ph.D. – Senior Research Specialist, Woods Hole Oceanographic Institute

2.4.5.2 Summary of Key Discussion Points

The Economic Impact, Regulatory, Policy, Stakeholder Issues and Infrastructure Panel discussions covered a wide range of issues, which are briefly summarized below.

The supply chain for offshore wind energy projects can be quite important as many project components are manufactured internationally. Further, installation vessels are very expensive and can significantly affect construction costs. It is also important to understand the on-shore infrastructure requirements (e.g., cable landings, substation improvements, transmission lines, port facility improvements).

In assessing the economic impact of offshore wind energy projects, the direct, indirect, and induced economic effects must be considered. It can often be difficult to determine where the economic benefits of a project (including employment) will accrue, considering many project components are manufactured internationally and many installation vessels are internationally owned. There are several models that are often used in assessing the economic impact of large construction projects (e.g., IMPLAN, REMI). These models; however, were not developed specifically for a marine application.

Several discussion participants indicated that there are opportunities for the United States and local communities to capture more of the economic benefits of offshore wind projects by developing the manufacturing capability domestically as well as in ancillary areas such as cable laying, but these will require some private sector investment and a commitment to local education and training. In Europe, manufacturing offshore wind energy components has helped reinvigorate some declining maritime economies.

From a policy perspective, two key questions were raised:

- Is offshore wind energy economic or does it require government incentives?
- Should regulatory or policy changes be enacted such that local communities benefit from offshore wind energy projects?
2.5 BIRDS, BATS AND OFFSHORE WIND DEVELOPMENT: REMAINING INFORMATION GAPS

This session presented information on immediate information needs and on current and planned research efforts. Following the presentations, there was a facilitated discussion aimed at identifying and prioritizing the remaining information gaps.

2.5.1 BOEMRE Immediate Information Needs

David Bigger, Ph.D., Avian Biologist, Office of Alternative Energy Programs, BOEMRE — presented “Immediate Information Needs” related to birds. The planning and analysis stage is when potential Wind Energy Areas (WEAs) are identified with extensive input from other federal government agencies, states and local governments, and tribes. Once the areas are identified, there is an environmental review to assess the impacts of issuing the lease and activities that the holder of the lease may do as they prepare a construction and operations plan. In February 2011, BOEMRE announced the WEAs and launched an Environmental Assessment (EA) to evaluate potential impacts of leasing, site assessment and characterization activities off Delaware, Maryland, New Jersey, and Virginia. The Draft EA was released this week for a 30-day public comment period. After a lease is secured, there is a 5-year period to collect site-specific data, which may include archaeological, biological, geophysical, geotechnical, shallow hazard and other site characterization surveys. After the lessee submits the construction and operations plan (COP), which describes the overall site investigation results, BOEMRE prepares the EIS and conducts environmental and consultation and technical reviews. Immediate information needs include the following: maps of species distribution and abundance; identification of priority species; estimated number of surveys needed to detect bird aggregations; and risk assessment for priority species. Species distribution and abundance maps need to be updated as areas are developed. The slides for this presentation are provided in Appendix A, Pages A-174 and A-175.

Studies discussed in the presentation included the following:

Rhode Island Ocean Special Area Management Plan (SAMP).
http://seagrant.gso.uri.edu/oceansamp/

2.5.2 Marine Bird and Offshore Wind Workshop - Summary

Melanie Steinkamp, USFWS — The goals of this workshop were to present current knowledge of the distribution and abundance of marine birds and to identify and prioritize scientific research and monitoring needs for marine birds as they relate to decisions being made about offshore wind development and marine bird population management. Preparation for the workshop was extensive and included compiling maps of seabird distribution and abundance using data from the historic seabird database housed by USGS. Maps were specific to regions and time periods. The maps initiated lively discussions about data adequacy, persistent aggregations (hot spots) and the need to have clearly documented metadata about the underlying data. Breakout sessions were held on identifying overlap between birds and wind structures, defining "persistent aggregations", and determining confidence level with existing data. During one of the breakout sessions, participants identified physical oceanographic features that are likely predictors of where bird congregations will occur and the factors that make an area more or less desirable for wind development. There was consensus among all breakout groups on these factors which include physical characteristics such as currents and land features, species life history traits/behaviors, and species status. The last day of the workshop focused on future
efforts to gather information needed to help make the most informed decisions about sighting wind facilities in the near term. Data gaps identified include baseline information and movement patterns (diurnal and nocturnal) for the south Atlantic Bight; nocturnal movement patterns (everywhere); migratory routes (including passerines); fine scale near shore information; bird prey data; integration of radar with other seabird data; small boat surveys of targeted areas; pre-development monitoring at colonies; commuting patterns of post-breeding birds; matrix of science needs according to risk; and a clearinghouse of all data. Future science needs include predictive modeling to help us forecast where we expect to find birds in the system, given a set of ocean habitat variables or characteristics and existing distribution and abundance data. The slides for this presentation are provided in Appendix A, Pages A-176 to A-180.

Studies discussed in the presentation included the following:

Database of historic (and most recent) seabird data compiled by the USGS.

The summary and presentations from the June 2011 Workshop on Offshore Marine Bird Science and Wind have been posted on the Northwest Atlantic Marine Bird Conservation Cooperative website. You can find the information at the following link:

http://www.acjv.org/marinebirds.htm

2.5.3 BOEMRE Research on Birds on the Atlantic OCS

James Woehr, Ph.D., BOEMRE — This presentation summarized nine studies that BOEMRE is involved in, including the high-def and endangered species studies that Dr. Caleb Gordon discussed earlier. Other studies mentioned included the Massachusetts Audubon Study, which tracks movements of long-tailed ducks using satellite telemetry and is important to determine nocturnal locations, and a project on the movements of American Terns and Oystercatchers near Nantucket Sound, which will utilize VHF receivers to monitor birds. A new study to begin in the fall will involve surgical implantation of placing satellite transmitters on seaducks scoters, gannets and red-throated loons to identify their winter congregations and both spring and fall migration corridors and track them during migrations. The study will look at scoters, northern gannets, and red-throated loons. The study will also include the experimental use of externally attached transmitters that are solar powered, as well as surgically implanted transmitters. The slides for this presentation are provided in Appendix A, Pages A-181 and A-182.

Studies discussed in the presentation included the following:

http://www.pandionsystems.com/Resources/PandionProjects/FeaturedProject/tabid/145/ArticleId/20/Offshore-Wind-Wildlife-Monitoring-Technologies-for-BOEMRE.aspx

Automated Analysis of Bird Vocalization Recordings (Cornell University).

Compendium of Avian Information and Comprehensive GIS Geodatabase (USGS-PWRC).
http://www.pwrc.usgs.gov/resshow/windpower/occonnell_seabird_dist.cfm


http://www.pandionsystems.com/Resources/PandionProjects/FeaturedProject/tabid/145/ArticleId/20/Offshore-Wind-Wildlife-Monitoring-Technologies-for-BOEMRE.aspx

Potential study – Movements of Common Terns and American Oystercatchers around and near Nantucket Sound (probably private contractor).

Potential study – Spring and Fall Migration Corridors and Winter Aggregations of Scoters, Northern Gannets, and Red-throated Loons between Long Island Sound and the Carolina Outer Banks (probably USFWS-SDJV and USGS-PWRC).

Surveying for Marine Birds in the Northwest Atlantic (USFWS-ACJV).

2.5.4 Emerging Results and Technologies for Offshore Wind Wildlife Studies

Caleb Gordon, Ph.D., Normandeau Associates — This presentation summarized three current research and development projects by Normandeau Associates for BOEMRE:

Endangered Bird Species Risk Assessment on AOCS. BOEMRE contract M08PC20060, “Potential for interactions between endangered and candidate bird species and wind facility operations on the Atlantic OCS.”


http://www.pandionsystems.com/Resources/PandionProjects/FeaturedProject/tabid/145/ArticleId/20/Offshore-Wind-Wildlife-Monitoring-Technologies-for-BOEMRE.aspx

Aerial High-definition Imaging Pilot Study. BOEMRE Contract M10PC00099, “Pilot study of aerial high-definition surveys for birds, marine mammals and sea turtles on the Atlantic Outer Continental Shelf.”

http://www.pandionsystems.com/Resources/PandionProjects/FeaturedProject/tabid/145/ArticleId/20/Offshore-Wind-Wildlife-Monitoring-Technologies-for-BOEMRE.aspx

The objectives of the Endangered Bird Species Risk Assessment were to evaluate the potential for the three endangered, threatened, and candidate species of interest (Red Knot, Piping Plover, Roseate Tern) to be impacted by wind facilities located on the Outer Continental Shelf (OCS) and to determine the best methods to evaluate locations of future wind facilities to minimize risks to the species. It was a multifaceted project that included studies of bird mortality and behavior near a wind turbine, tracking migratory patterns of Red Knots using light-sensitive Geolocators, Geospatial analysis of migratory pathways using Avian Knowledge Network data, and the development of a new collision risk model that incorporates behavioral avoidance. The overall conclusion of the study was that risk to all three focal species from offshore wind development on the AOCS is generally low.

The objective of the Acoustic/Thermographic Offshore Monitoring (ATOM) System is to gather species-specific data on birds and bats flying at rotor swept altitudes at proposed offshore wind facility locations, using the species-diagnostic power of animal vocalizations, with quantification power bolstered by thermographic video data. This technology was deployed for the first time this summer, and the first marine deployment on the AOCS will be in fall, 2011.
The objective of the Aerial High-definition Imaging Pilot Study is to determine optimal technology and methodology for conducting high-definition aerial ocean wildlife surveys in the U.S. Aerial imaging is popular in Europe (UK) because it has the advantage of better quality data that's more repeatable. Also, animals aren’t disturbed as the studies are conducted from high altitude. The technique is more cost effective than boat-based surveys for most offshore wind survey areas. A multi-camera system is envisioned that utilizes newer cameras and higher flights versus what is currently used in Europe. They are aiming for high quality pictures. The slides for this presentation are provided in Appendix A, Pages A-183 to A-189.

Other studies discussed in the presentation included the following:

Burger et al., in review, Renewable Energy – Red Knot risk analysis
Hatch and Brault. 2007. Collision mortalities at Horseshoe Shoal of bird species of special concern. Report No. 5.3.2-1. Cape Wind Associates. Boston, Massachusetts
Vlietstra et al. in review, JFO – Mortality monitoring results.
Warren-Hicks et al. in review, JWM – Collision Risk Modeling.

2.5.5 Seabird Survey and Observation Database & Hierarchical Models for Estimating Seabird Distributions in the U.S. Atlantic

Allan O’Connell, Patuxent USGS — This presentation summarized a study that was conducted to 1) compile all available seabird survey data for the western Atlantic between Maine and Florida and 2) using these datasets, evaluate seabird distribution in anticipation of offshore development. The Atlantic Seabird Database (ASD) now includes 75+ datasets dating back to the early 1900’s with the bulk of it collected between the 1970s and the present. All data was standardized for modeling, georeferenced, and a survey effort map was created, merging both air and vessel survey methodologies. The database continues to grow and now houses >400,000 observations, including data from Canada. The database includes both scientific and non-scientific data. There are approximately 70 seabird species in the ASD, with approximately 10 to 15 sensitive species of interest to regulatory agencies such as BOEMRE and the FWS. Modeling exercises have included broad species distribution mapping species richness modeling, and models of count data for species of interest. The ASD will be transitioned to the USFWS. The slides for this presentation are provided in Appendix A, Pages A-190 to A-195.

An example of datasets in the ASD:

Georgia pelagic surveys, 1982-1985, South Atlantic Bight.
Cape Wind, Mass Audubon, 2002-2006, Nantucket Sound.

Publications from current project:


2.5.6 At-Sea Distributions of Pelagic Seabirds off the East Coast of the United States, 2010, A Preliminary Report to BOEMRE

Richard Veit, Ph.D., College of Staten Island — This study includes large scale data from research vessels. One survey is the Ecomon (ecosystem monitoring) survey, which had a stratified sampling regime (seasonal) and included samples of zooplankton using nets. The second survey was the herring cruise, which only occurred in the fall. During this cruise acoustic data on zooplankton and fish were collected with bird observations. Data from 3 Woods Hole Oceanographic Institute (WHOI) cruises was also used. Hotspots were determined by combining shipboard data with large spatio-temporal databases. This is important information for offshore wind turbines. It is known that seabirds are highly aggregated species - the challenge is getting models to fit these areas. In summary, the findings indicate that hotspots are evident and persistent, there are changes evident since 1970s, and that changing climate has affected birds. The slides for this presentation are provided in Appendix A, Pages A-196 to A-202.

Studies discussed in the presentation included the following:

Ecosystem Monitoring Program (EcoMon), NOAA Herring Acoustic Survey (2006-2010), and WHOI cruises.

Manomet Bird Observatory Data 1970s-1980s.


2.5.7 Ongoing Offshore Bat Studies in the Gulf of Maine – Steve Pelletier, CWB

Steve Pelletier, CWB — Studies in 2004-2005 showed a lot of mortality (100s) of bats near terrestrial wind turbines. Projects that are 40 km apart show similar activity trends. Much can be learned about biology, range, patterns from this data. There are historical coastal observations of bats by Maine lighthouse keepers, who saw many migratory bats, and there have been a number of recent studies on offshore bats. Bats typically fly <10 m above sea level and rise rapidly when near vertical objects (e.g., ships, turbines, lighthouses). Acoustic surveys were conducted from April to November in 2009 and 2010 along the coast of Maine to document offshore bat activity. Deployment options were limited by island/lighthouse accessibility. The islands had a mix of habitats and the study extended over an area of 125 mi in 2009 and 175 mi in 2010. A few acoustic monitors were also installed onshore, overlooking the coast. Bats were detected at all sites in 2009 and 2010. Peak movement periods of resident and non-migratory species were detected. There was an overall decline in activity between July-November. There were no clean patterns in species composition at the sites. Migratory patterns may be seen in the data for green hoary bats and pink silver haired bats. The slides for this presentation are provided in Appendix A, Pages A-203 to A-210.

Studies discussed in the presentation included the following:

Merriam. 1887. Lighthouse counts, Mt. Desert Rock, Maine.
Miller. 1897. Highland Lighthouse, Truro, Massachusetts.
T. Kunz, Boston University. 1990. Mist netting, Cape Cod, Massachusetts.
3.0 INFORMATION GAPS AND RECOMMENDATIONS

3.1 PLENARY SESSION

This panel provided direction and an overview of the objectives of the Atlantic Wind Energy Workshop and set the stage for content to be included in the breakout sessions. This session also provided a panel comprising Federal agency representatives that have roles in offshore renewable energy, either as a regulator or resource agency. The outcomes of this panel included that this workshop provided the starting point to continue interagency coordination and communication and the recognition that Workshops like this one and other information transfer meetings (ITMs) are excellent venues for continued coordination and communication.

3.2 ENVIRONMENTAL BREAKOUT SESSIONS: MONITORING AND BASELINE STUDIES

The Environmental Breakout identified priority information gaps/research needs throughout each panel, which are described below. These themes were all deemed important and are not prioritized. The slides for the Environments Breakout sessions summary presentation are provided in Appendix A, Pages A-211 to A-214.

3.2.1 Information Management and Data Sharing

There are multiple databases and portals aimed at providing user-friendly platforms to support dissemination of the science needed for planning, decision making, and stewardship. There are many current databases that exist and were discussed that cover varying regional areas and contain a range of resource specific data layers. Data sources and data collection methods vary throughout the portals, but the goal is the same, to provide existing data and tools for analysis. However, with all the various databases available, there are common challenges and needs identified:

- Continued transparency and data sharing;
- Organization and availability of data;
- Data storage capacity;
- Raw data needs;
- Complete coverage of regions;
- Cataloging of existing data; gap analysis; and
- Data quality and comparability (apples to apples).

3.2.2 Developers’ Perspective

The developers provided insight on current and ongoing projects, including individual wind projects and the offshore transmission backbone. As developers make decisions regarding offshore projects, the existing regulatory process is viewed as extensive and unclear which provides a lot of uncertainty; and therefore, risk in potential projects. Four key issues were identified with the existing process for project development and permitting that would assist existing developers and encourage more developers to explore offshore wind projects:

- Timeline for permitting is a big risk for developers; developers are looking for an efficient and established/known timeline from the agencies;
Established timelines would encourage more interest from developers;
Permitting requirements are perceived as extensive and unclear and may be prohibitive for many developers; and
Need for consistency within Federal agencies between offices.

3.2.3 State Planning and Information

Many states have conducted baseline studies and developed state planning tools and documents to support offshore renewable energy development. The approach taken by each state varied based on existing information and specific goals and was driven by their State Coastal Management Plan. Developers must also keep in mind that in addition to the Federal process that must be followed for projects; there is also a State process that must be followed as well. There is information available at the State level can assist with the planning of projects. All of the State panelists discussed common challenges and needs that were also similar to the Federal challenges and needs including:

- Data are more regional in nature, limited site-specific data;
- Large quantity of data to process;
- Lack of standard survey methods;
- Lack of data quality guidelines (QA/QC);
- Reliable data standards will ensure that investors are making wise decisions by siting a wind project within areas identified using baseline data; and
- Ensure redundancy is not occurring.

3.2.4 Broad Scale Habitat, Abundance and Distribution – Consultation Process

A key component of the consultation process includes compliance with the applicable environmental laws and regulations that govern offshore renewable energy activities and are enforced by Federal agencies, including NOAA and USFWS. Two primary Acts that require compliance include the ESA and Section 7 Consultation and the MMPA. Compliance with these two Acts requires very specific information and data. Specific recommendations that were identified for assisting with compliance with these key Acts include:

- Proper characterization data is needed to adequately prepare take estimates (IHA, LOA);
- Developers need to identify project-specific risks; common impacts noted – noise, entanglement, bird strike, vessel strike, oil/fuel spill;
- Need to begin consultation early;
- Joint guidance between BOEMRE, NMFS, and USFWS for data collection; and
- Establish timelines for consultation.

3.2.5 Broad Scale Habitat, Abundance and Distribution – Baseline Data

There are numerous projects and studies (completed and ongoing) to collect data specific to multiple resources. The data provides information on a wide variety of species that are being studied, in what locations, during which seasons, and using which technologies. The common needs identified include:

- Data sharing between stakeholders and agencies to be able to assess and identify impacts to fisheries (one stop shop);
3.2.6 Acoustic Monitoring Technology and Impacts

There are many different monitoring methods and technologies that are currently being used, both successfully and unsuccessfully, for a variety of species, locations, and seasons, for which impacts have been identified. Monitoring methods varied based on the specific information goals and impact types being assessed. The common challenges and needs identified were:

- Data management can be challenging (non-homogenous, differing formats, data volume);
- Impacts of EMF (DC vs. AC transmission) to Atlantic marine species have not been studied;
  - Species’ sensitivity has not been characterized
  - Species at risk have been identified (slow-moving benthic species)
- Data processing capability – make it more available, better ways to process the data, and data processing standards; and
- Tools available to integrate acoustic data into spatial models.

3.2.7 Common Themes

The primary common themes throughout the environmental studies sessions included:

- The need for data collection, processing, quantity, and quality standards and protocols;
- Data management and sharing is challenging but key to the process;
- Establishment of timelines throughout the process is needed; and
- Consistency and cooperation between agencies, State and Federal, is essential.

3.3 TECHNOLOGY ASSESSMENT & RESEARCH PROGRAM: RENEWABLE ENERGY STUDIES

The Technology Assessment & Research (TAR) Program Breakout included representatives from BOEMRE, the commercial wind industry, contractors conducting studies funded under BOEMRE’s TA&R Program and other interested individuals. The Breakout had an open forum and attendees discussed the various technical issues raised by the presentations and general comments raised during the course of the sessions. From these discussions the group collaborated and identified the key research gaps and data needs required to advance BOEMRE’s technical and regulatory missions. As outlined below the attendees developed a list of 10 topics that needed to be addressed and reached agreement on a priority ranking for each in terms of funding.

A majority of the breakout session was dedicated to identifying the studies that should be included in order to properly address or establish baseline data to address the topic. By direction the descriptions of proposed studies were left at a high level in order to encourage creativity and flexibility in proposals/white papers that would be requested if the studies are to be funded.

The below topics are ranked in order 1 through 10 based on participant agreement.

Key: RG: Research Gap  KDN: Key Data Need
The slides for the Technology Assessment & Resource Breakout summary presentation are provided in Appendix A, Pages A-219 and A-220.

**Suggested Research Topics:**

**Gulf Stream/OCS Mooring Issues – (RG); Ranking 3**
- Evaluate mooring load and power transmission cable requirements and systems
- Analyze station keeping alternatives for optimizing device capacity factor
- Develop model inputs/outputs relative to Guidelines API RP 2SK and other applicable class rules

**MHK Mooring Space and Use Conflicts – (RG); Ranking 2**
- Estimate density of proposed systems as function of device type
- Evaluate proposed mooring systems for installation practicality and safety.
- Identify marine mammal entanglement potential
- Identify fisheries conflicts by gear type and mooring type

**Managing Risk for Multiple uses of Wind and MHK Projects – (RG); Ranking 10**
- Project developer risk for damage to vessel or injury to personnel
- Vessel operator risk for damage to project facilities
- Exclusion zone requirements (turbine vs. electric service platform)
- Surveillance/deterrent technology evaluation

**Example Formats/Templates for key BOEMRE document submission requirements – (KDN); Ranking 4**
- Develop a Safety Management Plan for a hypothetic wind farm to serve as an example.
- Develop Facility Design Report template consistent with regulatory requirements
- Develop Fabrication and Installation Report template consistent with regulatory requirements

**Audit Standards/Procedures Audit Criteria/Procedures Template and Checklist – (KDN); Ranking 7**
- Develop Safety Management System Criteria for Audit of systems/facilities (turbines and cables) to support Industry system integrity management and Audit Checklists for regulators

**Incident Reporting and Lessons Learned for Development of Safety Management Systems – (KDN); Ranking 8**
- High failure rates have occurred over time with concerns over timely/accurate/complete reporting. Need timely feedback to the industry

**Wind Turbine Condition Monitoring for Safety and Inspection – (KDN); Ranking 1**
- Structural condition monitoring is not currently required
- Structural monitoring requirements as contrasted to monitoring output and efficiency
- What are opportunities to add onboard monitoring to optimize or reduce inspection requirements, measure fleet-wide response of structural systems, and determine response to structure over time to project practical design and life extension of structures/project?
- What instrument state of the art technology options are available?
- How should data be interpreted/used?
- What levels initiate action – What Action?
• Industry/manufactures should supply some set of specifications that could be monitored and action levels for monitoring data
• How should data be collected: real time; some regular interval; after extreme event; or black box?

Study of Fundamental/Structural Soil Conditions Requirements – (RG); Ranking 6
• Lateral load deformation predictions based on methodology used for oil and gas API-RP 2A unverified for large diameter relatively short monopiles
• Industry needs improvement in the ability to predict the long term performance and response of foundations

Fatigue Design Methodologies and Design Criteria – (RG); Ranking 5
• Study fatigue design methodologies applicable to complex fixed and floating offshore wind turbine support structures
• Recommend a rational, practical fatigue design method for offshore wind turbine support structures
• Evaluate fatigue design criteria for offshore wind turbine support structures

Design Guideline for Stationkeeping Systems of Floating Wind Turbines – (RG); Ranking 9
• Study simulation methods for the design of stationkeeping systems of floating wind turbine
• Identify critical design parameters for various types of stationkeeping systems (mooring, tendon, anchor, etc.) of floating wind turbine
• Recommend a design guideline for stationkeeping systems of floating wind turbine
• Initiate/Cooperate in international Studies to Support IEC Standard Development, particularly differences between offshore floating wind and MHK

3.4 SOCIAL-ECONOMIC BREAKOUT: ASSESSMENT DRIVEN ISSUES

The Social-Economic Breakout identified five priority information gaps/research needs themes, which are described below. These themes were all deemed important and are not prioritized. The slides for the Social-Economic Breakout summary presentation are provided in Appendix A, Pages A-215 and A-216.

3.4.1 Cultural Landscapes

Cultural landscapes include both tribal and working marine landscapes. These landscapes, especially those that are relatively intact, have special meaning and importance from a tribal and historic perspective. These landscapes are truly a case where the whole is equal to more than its parts. Simply protecting an historic building or an archaeological site, or even a traditional cultural property, will not preserve these landscapes. Fully understanding these landscapes is a critical first step to predicting how offshore wind energy projects may affect them. Two specific information gaps/research needs were identified:

• Collect and map historic/current social-cultural landscape data using participatory tribal (indigenous) and community mapping techniques; and
• Collect marine cultural heritage landscape “context” from tribal oral histories/mariner’s folklore within designated Wind Energy Areas.
This research will help BOEMRE to better describe these cultural landscapes in their NEPA documents and enable decision-makers to make more informed decisions.

3.4.2 Submerged Ancient Tribal Sites

Native Americans inhabited what is now the Outer Continental Shelf thousands of years ago before it was inundated by rising sea levels. Although most evidence of their presence was probably eroded away by the rising shoreline, some geomorphic settings could have been quickly flooded potentially preserving some archaeological sites in the sediments. These sites are of special value as they can assist in understanding and adding detail to tribal oral histories of their ancestors moving west from the sea. This information also has the potential to reveal much about how the earliest populations of North America lived on and used the coastal lands that are now submerged.

In terms of data information gaps/research needs, the following were identified:

- Need to develop a standardized methodology or guidelines for identifying submerged ancient landforms and tribal sites during the site characterization activities; and
- Use available research data to start developing a tribal-sensitive predictive model of where submerged ancient tribal sites are more likely to be found, similar as to the predictive models that are routinely used in terrestrial settings.

The development of a standardized methodology and a predictive model will enable BOEMRE to more thoroughly assess the potential for and protect submerged ancient tribal sites as part of their review of offshore wind proposals.

3.4.3 Multiple Use of Ocean Space

As discussed above, there are many users of the ocean and even more stakeholders. Rather than “zoning” the ocean for single uses, the Social-Economic session advocated for multiple use of the ocean to the extent it can be done safely. The session recommended the following research needs to better characterize the potential for multiple use of ocean space:

- Research and characterize (i.e., social, cultural, economic and historic) current multiple use of the ocean within the designated Wind Energy Areas, as well as successes and failures with multiple uses in other parts of the United States, techniques such as cultural models and participatory mapping are means of providing the necessary data characterizing stakeholder space use, particularly for those groups that are potentially the most vulnerable (i.e., Tribes, fishers, local communities, and other potentially marginalized groups); and
- Evaluate and identify lessons learned from international offshore wind experience with accommodating multi-users, as they have a longer track record of dealing with these issues.

Documentation regarding multiple use of ocean space will enable BOEMRE to better evaluate and disclose potential use conflicts in their NEPA documents and develop appropriate mitigation measures.

3.4.4 Economic Impact Modeling

Economics are always a key consideration in evaluating proposed wind energy projects. Project sponsors/proponents often tout a project’s employment benefits, while other stakeholders often question where these economic benefits will be realized and raise concerns
about a project’s effect on local property values. There are several widely used and accepted models for evaluating the economic effects of proposed construction projects (e.g., IMPLAN, REMI), but these models need to be adapted to a more coastal/offshore-oriented setting. There is clearly a need for an objective and defensible model to quantify the economic effects of wind energy projects. Therefore, the Social-Economic session identified the following research needs:

- Adapt current economic models in a contextually appropriate and transparent way to more accurately assess socio-economic effects of offshore wind (e.g., jobs, impacts on ports, property values); and
- Better understand and predict where the economic costs and benefits will occur (e.g., locally, regionally, domestically, and internationally).

The development of a better economic model will enable BOEMRE to more accurately predict the economic effects of a proposed wind energy project, especially in terms of local benefits.

### 3.4.5 Public Perceptions and Understandings

There are major gaps in our understanding of public perceptions about offshore wind energy. In addition, different stakeholder groups may culturally approach similar issues differently. A better understanding of the public’s knowledge and concerns about offshore wind development could enable the development of better public engagement and education programs, and allow resource managers to make more informed decisions. Therefore, the Social-Economic session identified the following research needs:

- Identify, characterize and document key values and beliefs of stakeholder groups that influence their perception of the seascape and offshore wind energy development, using techniques such a cultural models, oral histories, and participatory mapping.
- Expand the scope of current localized perception studies to cover large coastal regions such as the Mid-Atlantic.

### 3.5 BIRDS, BATS AND OFFSHORE WIND DEVELOPMENT: REMAINING INFORMATION GAPS

The Birds, Bats and Offshore Wind Development session identified five priority information gaps/research needs themes, which are described below. These themes were all deemed important and are not prioritized. Data pertinent to these themes should be compiled into a wind development scale risk model along with available existing information. The slides for the Bird, Bats and Offshore Wind Development Breakout summary presentation are provided in Appendix A, Pages A-217 and A-218.

#### 3.5.1 Nocturnal Patterns

Nocturnal movement patterns of birds and bats offshore are not well understood. A detailed understanding of these patterns is critical to predicting how offshore wind energy projects may affect birds and bats that migrate during the night. In addition, it is important to understand how species that fly at night and are attracted to light may be affected by turbine lighting. Specific information gaps/research needs identified were:
• Develop technology to study offshore nocturnal movements of birds and bats;
• Research and characterize nocturnal movements of birds and bats within the designated WEAs; and
• Research and characterize the issue of light attraction to better understand how species may be affected by turbine lighting.

Research in these areas will help BOEMRE to better describe the nocturnal movements of birds and bats in their NEPA documents and more thoroughly assess the potential impacts to birds and bats.

3.5.2 Migratory Data

There is a lack of existing data on offshore migration routes and migration shortcuts. These routes need to be identified for targeted species or areas in order to ascertain where birds and bats are likely to fly within the WEAs. Specific information gaps/research needs identified were:

• Develop technology to study the offshore migration patterns of birds and bats; and
• Research and characterize offshore migration routes, including migration shortcuts, of birds and bats in relation to the designated WEAs.

Research in these areas will help BOEMRE to better describe the offshore migration routes and patterns of birds and bats in their NEPA documents and more thoroughly assess the potential impacts to birds and bats.

3.5.3 Sensitivity Analysis

A sensitivity analysis determines species vulnerability based on population status and behavior, including flight characterization and flight altitude. This information is needed to prioritize species in study areas. Specific information gaps/research needs identified were:

• Identify and compile existing data on species vulnerability; and
• Continue to fill in information gaps as new data are collected.

Research in this area will help BOEMRE to better prioritize species of birds and bats in their NEPA documents and more thoroughly assess the potential impacts to these species.

3.5.4 Distribution Data

There is a lack of data on species distribution offshore. These data are critical to determine which species of birds and bats are likely to fly within the WEAs and their key use areas. Specific information gaps/research needs identified were:

• Identify and compile existing species distribution models that extend offshore; and
• Continue to fill in information gaps as new data are collected.

Research in these areas will help BOEMRE to better describe the offshore distribution of birds and bats in their NEPA documents and more thoroughly assess the potential impacts to birds and bats.
3.5.5 Abundance Data

There is a lack of data on species abundance offshore. These data are critical to determine the number of birds and bats that are likely to fly within the WEAs. Specific information gaps/research needs identified were:

- Identify and compile existing species abundance data; and
- Continue to fill in information gaps as new data are collected.

Research in these areas will help BOEMRE to better describe the offshore populations of birds and bats in their NEPA documents and more thoroughly assess the potential impacts to birds and bats.

3.5.6 Decision Support Tool

The group recommended that a decision support tool, or “Best Bird Map”, be developed from information generated during the five research topics described above. A “Best Bat Map” would follow the same theme. The group agreed that the next steps in developing the maps include:

- Get the most out of existing data (improving metadata, removing data artifacts, and developing data quality estimates);
- Hold a Structured Decision Making (SDM) workshop for sensitivity analysis (identify species vulnerabilities, risks, and priority species);
- Determine predicted distribution (i.e., where we expect to find birds given a set of variables or characteristics) and abundance; and
- Weight distribution and abundance by risk (model output e.g., color coded Best Bird or Bat Map).

3.5.7 Other Data Needs

The group identified other bird-related data needs as pre-development monitoring at colonies, distribution and behavior of post-breeding birds, and the effects of turbines/structures on environmental conditions that influence bird distribution and abundance (attraction, eddies). Additionally, the group stressed the need for a permanent full time data manager for the seabird database and continued improvement in data sharing.

Other bat-related data needs include annual variability in distribution and abundance, regional use, flight characterization (foraging, migration, and breeding), distance to shore gradient, influence of white nose syndrome on behavior and populations, turnover rates, and standardization of data collection (e.g., identifying the metrics/answers needed to make decisions – this is also needed for birds).
4.0 ADDITIONAL TOPICS DISCUSSED

This section provides additional information on topics that were discussed during the closing breakout sessions. This information includes the following:

- BOEMRE’s Environmental Studies Program (Section 4.1)
  BOEMRE Fact Sheet – Environmental Studies Program provides numerous links to on-going studies at http://www.boemre.gov/eppd/PDF/BOEMREEnvironmentalStudiesfactsheet.pdf.
- The Draft BOEMRE “Smart From the Start” Atlantic OCS Initiative – Sufficient Conditioning of Commercial Wind Lease Issuance Memo (Section 4.2).
- BOEMRE Fact Sheet – Renewable Energy on the OCS that provides a summary of the regulatory process and the Obama Administration Goals for Offshore Renewable Energy (Section 4.3).
- A summary of the U.S. Army Corps of Engineers role in the offshore renewable Energy projects (Section 4.4).
- Additional information regarding Section 2.2.1.1: the EcoSpatial Information Database (Section 4.5).
- Additional information regarding Section 2.1.1.3: Energy Market and Infrastructure Information for Evaluating Alternative Energy Projects for OCS Atlantic (Section 4.6).
- NOPP presentation summary. The slides for this presentation are provided in Appendix A, Pages A-220 to A-223 (Section 4.8).

4.1. OVERVIEW OF BOEMRE’S STUDIES AND RESEARCH PROGRAMS

BOEMRE is the federal bureau responsible for overseeing the safe and environmentally responsible development of energy and mineral resources on the OCS. This includes oil and natural gas, renewable energy and marine minerals. BOEMRE’s stewardship of the nation’s offshore resources is guided by the National Ocean Policy vision of a “healthy and resilient, safe and productive, understood and treasured” OCS.

BOEMRE is one of the leading contributors to the growing body of scientific knowledge about the nation’s marine and coastal environments. The bureau’s Environmental Studies Program (ESP), which was established in 1973, funds on average $30 million per year for scientific studies in the Atlantic, the Gulf of Mexico, the Pacific and Alaska. Data gained from these studies inform policy decisions regarding leasing and development of OCS energy and mineral resources. The information is also used by other federal, state and local agencies, by researchers in the nation’s universities, and by the private sector.

Since its inception, the ESP has been committed to quality science by funding more than 1,000 studies in many areas: physical oceanography, atmospheric sciences, biology, protected species, social sciences and economics, submerged cultural resources, and fates and effects (which refers to understanding and reducing the environmental impacts of energy development projects).

BOEMRE oversees scientific research conducted through contracts, cooperative agreements with state institutions or universities and inter/intra-agency agreements. These arrangements, such as through the National Oceanographic Partnership Program, allow the bureau to leverage federal resources, meet national priorities, satisfy common needs for robust scientific
information and contribute to the global effort of better understanding the marine and coastal environment.

For the most up-to-date information on current studies, please visit:  
http://www.boemre.gov/eppd/sciences/esp/HappeningNow.htm

4.1.1  Environmental Studies Process

ESP planning includes multiple and diverse inputs from citizens and organizations, national and regional scales, and work with stakeholders to better define information needs. The process from development to approval is described below.

First, Studies Development Plans (SDP) are written by Headquarters and each Regional Office which contain descriptions of expected OCS Program activities covering a designated three year period and the proposed studies that have been designed to collect information to meet the needs of users. Information users include groups such as BOEMRE scientists, rule writers, modelers, and decision makers. To create the SDP, each Regional Office solicits staff and external public and local/state/Federal government input during the development of the SDP. The goal is to anticipate potential OCS activities and describe the environmental information and scientific research needed for future management decisions.

Some of the environmental information needs may be met through existing research programs, but others lead to the development of study proposals. The proposed studies are evaluated by the Headquarters office for program relevance, programmatic timeliness, and scientific merit. One of those methods is BOEMRE’s OCS Scientific Committee (SC), a federal advisory committee. The SC advises the bureau on the feasibility, appropriateness and scientific value of the studies proposed for the Environmental Studies Program.

For more information, see:  
http://www.boemre.gov/mmab/scientificcommittee/ocssc.htm

As described above, the ESP integrates advice from a wide range of sources when formulating the annual research program plan known as the National Studies List (NSL). The NSL for each fiscal year contains all the approved studies for the ESP. A priority order for the many proposed studies is developed and evaluated again by Headquarters, principally considering program relevance, timing, and budgetary constraints. Discussions are conducted with each of the program offices in the Regions and when consensus is achieved, the NSL is recommended to the Associate Director for approval.

Once the annual appropriations for the Department have been approved, studies on the NSL are procured via competitive procurements, cooperative agreements with a State institution or university, or through interagency agreements with other Federal agencies. Standard reporting and distribution requirements for conveying findings are included in all contracts and agreements. The ESP makes all studies results available to the public by publishing reports on the Internet through the Environmental Studies Program Information System (ESPIS).
https://www.gomr.boemre.gov/homepg/espis/espismaster.asp?appid=1

4.1.2  Technology Assessment & Research (TA&R) Program

In addition to the ESP, BOEMRE’s TA&R Program supports research associated with operational safety and pollution prevention as well as oil spill response and cleanup capabilities.
The TA&R Program was established in the 1970's to ensure that industry operations on the OCS incorporated the use of the Best Available and Safest Technologies (BAST) subsequently required through the 1978 OCSLA amendments and Energy Policy Act of 2005. The TA&R Program is comprised of three functional research activities: For more information on the TA&R program: http://www.boemre.gov/tarphome/index.htm

- Operational safety and engineering research;
- Oil spill response research; and
- Renewable energy research.

4.1.3 Renewable Energy Studies and Research

To review the more than 40 BOEMRE studies that specifically apply to our renewable energy programs, go to: http://www.boemre.gov/eppd/sciences/esp/RenewableEnergyResearch.htm. Each listing not only describes the research being conducted but also shows the institution performing the work, the cost of the effort, timeframe, and any associated publications, presentations, or affiliated web sites.

4.1.4 Next Steps

The findings of the workshop will play a significant role in developing future studies and research through the ESP and TA&R Program. Some of the data gaps and research needs identified through the workshop are already being addressed by the ESP and TA&R Program.

Within funding restraints, the remaining data gaps and research needs that are clearly understood will be addressed in the FY 2013-2015 Studies Development Plan and or future Broad Agency Announcements. Data gaps and research needs requiring more discussion will likely be addressed as topics at BOEMRE’s next renewable energy workshop.

In addition, BOEMRE is often approached by other agencies and organizations interested in funding or addressing data gaps and research needs related to offshore renewable energy. This workshop summary is also intended to benefit those agencies and organizations.

4.1.5 Other Relevant Workshop Reports

The DOE Wind and Water Power Program sponsored the Offshore Resource Assessment and Design Conditions Public Meeting on June 23-24, 2001 in Crystal City Virginia. The meeting focuses on the critical meteorological and oceanographic measurements and data needed for successful deployment of offshore renewable energy technologies, including wind and MHK. The report may be found here: http://www1.eere.energy.gov/water/pdfs/ radc_public_meeting_9-14-11.pdf

The DOE Wind and Water Power Program sponsored the Advanced Marine Renewable Energy Instrumentation Experts Workshop, April 5-7, 2011 in Broomfield, CO. This workshop brought together technical experts from government laboratories, academia, and industry representatives from marine energy, wind, offshore oil and gas, and instrumentation developers to present and discuss the instrumentation needs of the marine energy industry. http://www.nrel.gov/docs/fy12osti/51584.pdf
The Ocean Research & Resource Advisory Panel held a workshop on *Offshore Renewable Energy: Accelerating the Decision-Making Process* on May 24-25, 2011. This meeting featured federal agencies and members of industry, in a forum to facilitate open discussions and creative problem-solving to overcome impediments to industry progress toward deploying operation projects. The report may be found at: [http://www.nopp.org/publications-and-reports/](http://www.nopp.org/publications-and-reports/) once available.

The USFWS sponsored, *Marine Bird and Offshore Wind Workshop* to present current knowledge of the distribution and abundance of marine birds and to identify and prioritize scientific research and monitoring needs for marine birds as they relate to decisions being made about offshore wind development and marine bird population management. You can find the information at the following link: [http://www.acjv.org/marinebirds.htm](http://www.acjv.org/marinebirds.htm)
Overview:

The Obama Administration’s recently announced offshore wind initiative for the waters off the Atlantic coast states, “Smart from the Start,” seeks to expedite the development of first generation offshore wind projects on the East Coast, while ensuring that these projects are carefully and appropriately sited. As a first step, the Department of the Interior is working with the Governors of the Atlantic coast states to identify “wind energy areas” which may be appropriate for the development of offshore wind. The Bureau of Ocean Energy Management, Regulation, and Enforcement (BOEMRE) is soliciting comments by March 11th on the proposed Environmental Assessment (EA) for renewable energy leasing and site assessment activities to be conducted within wind energy areas (WEAs) along the coasts of New Jersey, Delaware, Maryland, and Virginia. Our groups will be commenting on this notice and hope your organizations will as well. As part of our comments, we are seeking clarification of two key issues, namely the nature of the leases that would be issued and assessed in the EA and the nature of the environmental review that will be performed in connection with the Construction and Operation Plan (COP). We hope that your groups will include a similar request for clarification in your comments.

Our organizations support well-planned offshore wind energy development given its enormous potential to expand the supply of clean and climate-friendly energy sources. We recognize that more certainty is needed for developers to commit the millions of dollars necessary to conduct site assessment and site characterization activities on an area of the OCS. This lack of certainty is a significant deterrent to attracting the early investment needed to make large-scale offshore wind generation a reality.

We are also committed to ensuring that this development proceeds in an environmentally sound way. To this end, we support a process that will expedite prompt site characterization and assessment, while at the same time ensuring that no development rights are granted until after there has been a full environmental review of the proposed project and the project has been approved.

For these reasons, NWF and NRDC believe that it is essential that Interior clarify the nature of the leases that it intends to issue for these WEAs and that it clarify that a full Environmental Impact Statement will be prepared in connection with the COP. The following principles, which have been developed after consultation with the Offshore Wind Development Coalition, are being offered to clarify these two key issues. We believe that the multiple goals of thorough and well-timed environmental review, investor certainty, and a streamlined process will be achieved by adhering to these basic principles.
Principles:

- The lease shall ensure that no other party will be granted any right or interest that would interfere with the conduct of reasonable site assessment and characterization activities for the lease site;
- The lease shall provide the lessee with the exclusive right to apply for the approval of a Construction and Operation Plan (COP) for the site and with the right to have no COP application from other potential lessees considered unless the lease has been terminated by the Secretary. A basis for termination shall include but is not limited to the lessee's failure to make sufficient progress toward an approvable COP or the lessee's abandonment of the lease;
- The lease shall confer no right of occupancy on submerged lands of the OCS other than for routine site characterization and assessment activities;
- The grant of a lease shall in no way affect or impair the Secretary of the Interior’s authority to deny pursuant to the factors in OCSLA section 8(p), without compensation, development rights to the lessee in connection with its review of the COP.

Background:

On February 9, 2011, BOEMRE issued a Notice of Intent (NOI) to prepare a regional Environmental Assessment (EA) for commercial wind lease issuance and site assessment activities for WEAs off the coasts of New Jersey, Delaware, Maryland and Virginia. According to the NOI:

“The proposed action is the issuance of renewable energy leases within the WEAs described in Section 3 of this Notice, and approval of site assessment activities on those leases. The regional EA will consider the environmental consequences associated with reasonably foreseeable leasing scenarios, reasonably foreseeable site characterization scenarios in these lease areas (including geophysical, geotechnical, archeological and biological surveys), and reasonably foreseeable site assessment scenarios (including the installation and operation of meteorological towers and buoys) on the potential leaseholds.”

The NOI defines a renewable energy lease as giving “the lessee an exclusive right to apply for subsequent approvals that are necessary to advance to the next stage of the renewable energy development process.” The next stage is described as review and approval of a site assessment plan (SAP), and after sufficient collection of site characterization and assessment data, the lessee would submit a construction and operation plan (COP).

The notice envisions that the proposed regional EA would constitute NEPA compliance throughout both the leasing and SAP stages for all leases issued in the areas covered by the WEAs (approximately 900 square miles). However, the NOI notes that NEPA analysis for the COP will likely take the form of an Environmental Impact Statement (EIS).

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2 Id.
Full environmental review of any project is required under law, and is needed to protect wildlife and other natural resources and secure public support for projects. This can be achieved in the “Smart from the Start” initiative if the initial lease for any part of the WEA’s covered by the current NOI is sufficiently conditioned so as to not constitute an irreversible or irretrievable commitment of resources by the Government. Developers would not receive right to erect any wind turbines until the Government reviews and approves the developer’s COP and issues an EIS analyzing all potential impacts of the project.
Renewable Energy on the Outer Continental Shelf

In 2009, President Barack Obama and Secretary of the Interior Ken Salazar announced the final regulations for the Outer Continental Shelf (OCS) Renewable Energy Program, which was authorized by the Energy Policy Act of 2005 (EPAct). These regulations provide a framework for leases, easements, and rights-of-way for activities on the OCS that support production, and transmission of energy from sources other than oil and natural gas.

The Department of the Interior (DOI) and its Bureau of Ocean Energy Management, Regulation and Enforcement (BOEMRE) continue to seek ways to improve the leasing and permitting process for developing this vital component of our nation’s comprehensive energy policy without cutting corners on safety or environmental protection. In the foreseeable future, we anticipate development of renewable energy from three general sources on the OCS:

**Ocean Wave Energy (Hydrokinetic)**

There is tremendous energy in ocean waves. Wave power devices extract energy directly from the surface motion of ocean waves. A variety of technologies have been proposed to capture that energy, and some of the more promising designs are undergoing demonstration testing.

**Ocean Current Energy (Hydrokinetic)**

Ocean currents contain an enormous amount of energy that can be captured and converted to a usable form. Some of the ocean currents on the OCS are the Gulf Stream, Florida Straits Current, and California Current. While technology is still at an early stage of development, it is likely that submerged water turbines similar to wind turbines would be employed to extract energy from ocean currents.

**Offshore Wind Energy**

Offshore wind turbines are being used in a number of countries to harness the energy of the moving air over the oceans and convert it to electricity. Offshore winds tend to flow at higher sustained speeds than onshore winds, thus making turbines more efficient.

### Estimated Offshore Wind Resources

A sustainable source of wind, wave and ocean current energy can be added to our nation’s portfolio by tapping into offshore energy resources in an environmentally responsible manner.

Despite tremendous offshore wind capacity, the United States has no offshore wind energy production to date. Offshore Atlantic winds could produce an estimated 1,000 gigawatts of energy.

The first commercial wind lease was signed in 2010 by Secretary Salazar and Cape Wind Associates for a project in federal waters offshore Massachusetts.
The Process

There are several federal agencies with responsibilities for the regulation and development of offshore renewable energy. BOEMRE issues leases and grants for both OCS wind and hydrokinetic projects. BOEMRE also permits the construction and operation of wind facilities, while the Federal Energy Regulatory Commission will permit the construction and operation of hydrokinetic facilities on BOEMRE-issued wave and current leases.

As required by EPAct, BOEMRE will issue leases on a competitive basis unless it determines that no competitive interest exists. After a lease is acquired, the developer must submit and receive approval of appropriate plans (wind) or license applications (hydrokinetic). At the end of the lease term, the developer must decommission facilities in compliance with BOEMRE regulations.

In the fall of 2010, Secretary Salazar launched the “Smart from the Start” wind energy initiative to expedite the responsible development of wind energy projects off the Atlantic coast. In coordination with the relevant states, BOEMRE has identified Wind Energy Areas (WEAs) offshore the Atlantic coast that appear most appropriate for renewable energy development, and will take steps to make the permitting process for projects more efficient. The “Smart from the Start” initiative will be integrated fully with President Obama’s Executive Order on coastal and marine spatial planning efforts.

A number of states on the Atlantic coast have initiated planning for projects to support their renewable energy portfolio standards and developers are pursuing leases. For example, Florida is interested in developing ocean current energy. Pacific Northwest states are looking into developing wave energy. On both coasts, BOEMRE is working with interested and affected federal, state, local and tribal governments through individual state intergovernmental renewable energy task forces, memoranda of understanding (MOU), and other arrangements to assure proper consultation and coordination. Secretary Salazar and the Governors of 11 east coast states signed a MOU that established the Atlantic Offshore Wind Energy Consortium in May 2010. The Consortium has been working with BOEMRE on regional issues relating to siting, data and science, and authorization of renewable energy projects on the OCS.

BOEMRE and the Department of Energy (DOE) signed a MOU to address numerous offshore renewable energy issues of mutual interest; and DOI and DOE issued the first interagency plan on offshore wind energy, demonstrating a strong federal commitment to expeditiously develop a sustainable, world-class offshore wind industry in a way that reduces conflict with other ocean uses and protects resources. BOEMRE is also working with other interested federal agencies to establish MOUs to coordinate OCS renewable energy activity.

BOEMRE also has the authority to issue Rights-of-Way (ROW) for offshore transmission lines linking OCS renewable energy installations to facilitate efficient interconnection to the onshore electrical grid. To date, BOEMRE has received one application for such a ROW—a project entailing a 750-mile backbone transmission line running about ten miles offshore from New York to Virginia.

Obama Administration Goals for Offshore Renewable Energy

- Achieve 10 megawatts of wind capacity in the OCS and Great Lakes by 2020 (Great Lakes are not regulated by BOEMRE);
- Complete a non-competitive offshore wind lease in 2011;
- Complete a competitive offshore wind lease in 2012; and
- Implement a streamlined, yet rigorous, environmental review process to facilitate responsible OCS renewable energy development.

For more information, please visit: http://www.boemre.gov/offshore/RenewableEnergy/index.htm
Summary for Workshop Report

The Regulatory Program of the U.S. Army Corps of Engineers plays a key role in authorizing offshore renewable energy projects, including wind. Pursuant to Section 10 of the Rivers and Harbors Act of 1899, the Corps regulates construction activities in navigable waters and devices affixed to the seabed of the Outer Continental Shelf (OCS). Discharges of dredged and fill material into inland and coastal waters of the United States (within the three-mile limit of state waters) are regulated pursuant to Section 404 of the Clean Water Act.

BOEMRE is the lead federal agency under the National Environmental Policy Act (NEPA) for wind energy projects on the OCS. The Corps participates in the NEPA process as a cooperating agency. Both agencies are currently working on a Memorandum of Understanding to synchronize administrative processes for authorizing projects on the OCS.

The litmus test for deciding whether a proposal receives a permit is the public interest review process. The Corps must determine that a given proposal would not be contrary to the public interest in order to issue a permit. There are approximately two dozen public interest review factors that we consider in the review process. Some factors may or may not be applicable to a given proposal, and the specific weight that each factor carries in the review process varies from project to project.

The Corps district offices stand ready to work collaboratively with applicants, federal and state agencies, and other key stakeholders in reviewing offshore wind energy projects.
AMEC is currently developing an ecological information database (ESID) of the Atlantic Planning areas on the Outer Continental Shelf off the East Coast of the U.S. This project will support ecosystem-based management of activities permitted by the Department of the Interior/Bureau of Ocean Energy Management Regulation and Enforcement (DOI/BOEMRE) in the Atlantic Planning Areas by compiling ecological information resources and associated data into a searchable database with a mapping interface. Ecological data will be referenced to spatial layers, source documents, and metadata.

The ESID will provide a robust decision support system to assist DOI/BOEMRE with new activity in alternative energy likely to occur in the BOEMRE Atlantic Planning Areas and the possibility of new oil and gas activity.

Tasks for the project include:

- Collect documents, data, and GIS spatial layers relevant to ecology for specified subjects within the study area
- Create an annotated and georeferenced bibliography
- Extract ecological data from the documents for selected geographic areas
- Create comprehensive metadata to assist in data searches and ensure data integrity
This project is implemented using BOEMRE GIS Application Development requirements to include:

- Implementation and enforcement of BOEMRE database standards definition
- Utilizes BOEMRE specified UML Data modeling for ESRI Geodatabases
- Development of functions and managed linking of documents (images, web pages, etc) to geospatial features for display through web applications

The ESID will consist of data with emphasis on the ecology for the specified subjects including pelagic ecology (plankton, nekton, sargassum), infauna, meiofauna, demersal fishes, coral and hardbottom, seagrass, water quality and geology.

Because of the criticality of the ESID database architecture, the database is being designed using the ESRI ArcMarine data model. This will also help in meeting a system requirement to provide cadastral data to the Multi-purpose Marine Cadastre (MMC) currently in development and co-managed by BOEMRE and the National Oceanic and Atmospheric Agency.
Energy Market and Infrastructure Information for Evaluating Alternative Energy Projects for OCS Atlantic

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The presentation for the Atlantic Wind Energy Workshop focuses on supporting infrastructure for wind energy for the Atlantic OCS region, particularly in the Mid-Atlantic region. Topics reviewed include ports, vessels, shipbuilding and repair facilities, submarine electric cable manufacture and installation, electric substations, and transmission lines. Based on the information provided for proposed projects on the ports potentially used for the construction and operation phases of a windfarm, the set of 35 large deep-water ports along the East Coast could be supplemented by up to 223 additional ports. The final set of potential ports will be identifiable once we learn the channel draft needed for vessels installing meteorological towers and routine operations and maintenance. The DE/MD/NJ/VA region contains 36 ports.

MARAD’s 2008 survey of the U.S. privately-owned fleet identified 98 ocean-going vessels and 551 oil and gas industry vessels meeting Jones Act requirements. A better understanding of the modifications needed to lift boats, lift barges, jack-up rigs, or semisubmersible vessels to equip them for installing wind turbines is needed before examining the competition for these vessels by the oil and gas industry. If new vessels are needed, there are four major shipyards along the East Coast, 16 smaller shipyards in the DE/MD/NJ/VA region, and at least one shipyard expressing an interest in building a turbine installation vessel.

The capability to manufacture and install submarine electric cables lies primarily overseas, as does the manufacture of offshore wind turbines. The level of demand needed to prompt investment in domestic capabilities has not yet been identified.

ERG examined commercial GIS-based data for electric substations, transmission lines and other parameters. The sparse availability of appropriate substations near the coast (within 20 miles) and transmission costs appear to be the weakest link in the infrastructure needed to get offshore wind power integrated in the onshore electric grid.
Conceptual Model of Offshore Wind Environmental Risk Evaluation System

Environmental Effects of Offshore Wind Energy
Fiscal Year 2010

RM Anderson  SD Unwin
AE Copping  EL Hamilton
FB Van Cleve

June 2010
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(9/2003)
Conceptual Model of Offshore Wind Environmental Risk Evaluation System

Environmental Effects of Offshore Wind Energy Fiscal Year 2010

RM Anderson
AE Copping
FB Van Cleve

SD Unwin
EL Hamilton

June 2010

Prepared for
the U.S. Department of Energy
under Contract DE-AC05-76RL01830

Pacific Northwest National Laboratory
Richland, Washington  99352
Summary

In this report we describe the development of the Environmental Risk Evaluation System (ERES), a risk-informed analytical process for estimating the environmental risks associated with the construction and operation of offshore wind energy generation projects. The development of ERES for offshore wind is closely allied with a concurrent process undertaken to examine environmental effects of marine and hydrokinetic (MHK) energy generation, although specific risk-relevant attributes will differ between the MHK and offshore wind domains.

During fiscal year 2010, a conceptual design of ERES for offshore wind will be developed. The offshore wind ERES mockup described in this report will provide a preview of the functionality of a fully developed risk evaluation system that will use risk assessment techniques to determine priority stressors on aquatic organisms and environments from specific technology aspects, identify key uncertainties underlying high-risk issues, compile a wide-range of data types in an innovative and flexible data organizing scheme, and inform planning and decision processes with a transparent and technically robust decision-support tool. A fully functional version of ERES for offshore wind will be developed in a subsequent phase of the project.
## Acronyms and Abbreviations

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<th>Acronym</th>
<th>Description</th>
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<tr>
<td>DOE</td>
<td>U.S. Department of Energy</td>
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<td>ERES</td>
<td>Environmental Risk Evaluation System</td>
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<tr>
<td>FY</td>
<td>fiscal year</td>
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<tr>
<td>GIS</td>
<td>geographic information system</td>
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<td>GPS</td>
<td>Global Positioning System</td>
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<td>KMS</td>
<td>knowledge management system</td>
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<td>MHK</td>
<td>marine and hydrokinetic</td>
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<td>PNNL</td>
<td>Pacific Northwest National Laboratory</td>
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1.0 Introduction

The Wind and Water Power Program of the U.S. Department of Energy (DOE) Office of Energy Efficiency and Renewable Energy is working with wind industry partners to develop clean, domestic, innovative wind energy technologies. The generation of energy from offshore wind has the potential to play a significant role in the nation’s renewables portfolio. The first U.S. offshore wind farm has recently been granted rights to develop off the Atlantic coast; to date, no offshore wind farms have been developed. It is commonly believed that the lack of information on potential environmental impacts from the installation and operation of the facilities has slowed and confounded regulatory processes for moving forward efficiently on offshore wind development in the United States.

Pacific Northwest National Laboratory (PNNL) plans to evaluate the available information on environmental impacts from the installation and operation of offshore wind farms through the design and application of a risk framework entitled the Environmental Risk Evaluation System (ERES). The application of ERES and the specific decision-support tools developed to evaluate environmental effects of offshore wind will address the most important issues, risk categories, and information needs identified by stakeholders. During fiscal year (FY) 2010, a conceptual design of ERES for offshore wind will be developed. A visualization interface that will display output from ERES will be outlined, and a mockup created to demonstrate the usage and utility of the approach. A fully functional version of ERES for offshore wind will be developed in a subsequent phase of the project. Stakeholder input as well as guidance from the DOE Wind Program will be solicited in developing the design and specifications for this future version.

2.0 Conceptual Design of the Risk-Informed Decision Support Framework

The development of the ERES for offshore wind is closely allied with the process undertaken to examine environmental effects of marine and hydrokinetic (MHK) energy generation, although specific risk-relevant attributes will differ between the MHK and offshore wind domains. For both offshore wind and MHK, the ERES is tied closely to a knowledge management system (see below). The following description of the design of the ERES provides the overall concepts, while later sections address the specific application of the ERES for offshore wind.

Development and Application of ERES for Water Power. The concept for the ERES has been developed for application to MHK energy generation under the DOE Water Power program. As the U.S. MHK industry moves forward to deploy pilot, demonstration and commercial projects in coastal waters, concerns from regulators and stakeholders have focused on potential threats to marine life and to existing beneficial uses of marine waters. The ERES is under development to evaluate the relative risks of the many potential interactions between stressors (i.e., MHK systems and their component parts) and receptors in the marine environment (i.e., organisms such as marine mammals, fish, turtles, diving birds, as well as the waterbodies themselves through deteriorating water quality or changes in sediment transport).
The tools and processes developed under the ERES will be common between MHK and offshore wind, while the application of those tools, the specific risk models, and the outputs of the two renewable energy sources will be distinct. In addition, the cases, tools, and processes of the ERES developed for MHK and offshore wind can be disassociated from one another at any time if necessary or desirable.

**Knowledge Management System.** A knowledge management system (KMS) has been created for MHK to organize and manage data and information for the ERES. This KMS is called *Tethys*, after the mythical Greek titaness of the sea. We propose to develop a parallel KMS named *Zephyrus*, after the Greek god of the west wind, to house and organize offshore wind environmental effects data. There are obvious crossovers between MHK environmental effects and those for offshore wind, notably the effect that wind platforms or wave buoys have on animals and physical processes in the ocean. In addition, many effects will be peculiar to offshore wind, most notably the effect that the rotors will have on migratory seabirds and perhaps bats. To best accommodate the needs of MHK and offshore wind, portions of the KMS will be shared, while other portions will contain data used only for one or the other renewable energy source. However, the structure of the KMS will allow separation of the MHK and offshore wind databases and all their relevant content at any time, if that becomes necessary or desirable.

The primary function of a KMS is to facilitate the creation, annotation, and exchange of information on environmental effects of offshore wind technology. The offshore wind KMS would be populated with data from multiple sources, including existing pilot and commercial offshore wind projects from the United States and abroad, from targeted environmental studies supported by DOE and other sources, and data generated by PNNL, other national laboratories, and universities. Data will eventually include tabular and geospatial data, text-based electronic documents, maps and geographic information system (GIS) layers, photographs, engineering drawings and specifications, technology descriptions, and demographic data. Figure 1 shows the similarities and differences between ERES processes for MHK and offshore wind.

---

**Figure 1.** Relationship between the marine and hydrokinetic (MHK) and offshore wind environmental risk evaluation systems and knowledge management systems.
Table 1 provides a conceptual representation of the process of developing the ERES and the KMS for offshore wind and MHK. Risk analysis steps include identification of analysis cases, risk analysis screening to identify highest risk-relevant issues, and risk modeling to estimate risk metrics for risk-relevant stressor–receptor interactions. The risk metrics will be used to develop risk management and mitigation strategies and to communicate those risks.

**Table 1.** Steps and outcomes for offshore wind ERES development.

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<th>Purpose</th>
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<td>1. ERES framework development</td>
<td>Definition of domain for risk-relevant factors</td>
<td>Stressor, receptor, and context data</td>
<td>Risk-relevant attributes</td>
<td>Conceptual description</td>
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<td>2. Initial case selection</td>
<td>Priorities include “spanning the analytical space”</td>
<td>Project info, selection criteria</td>
<td>3 initial cases selected for analysis</td>
<td>Conceptual description</td>
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<td>3. Screening analysis on initial cases</td>
<td>Highest risk issues identified</td>
<td>Data for verification</td>
<td>Risk-relevant issues</td>
<td>Conceptual description</td>
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<td>4. Risk modeling</td>
<td>Cumulative risk output calculated</td>
<td>Deterministic, probabilistic, impact models, sensitivity analysis</td>
<td>Risk metrics that relate each stressor to receptor</td>
<td>Conceptual description</td>
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<td>5. Risk management and mitigation</td>
<td>Strategies developed, verified by field data</td>
<td>Risk-relevant issues, risk metrics</td>
<td>Risk mitigation strategies</td>
<td>Conceptual description</td>
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<td>6. Risk communication</td>
<td>Risk and risk tools presented in formats accessible to stakeholders</td>
<td>Risk metrics, risk-relevant issues</td>
<td>Risk visualization, communication tools</td>
<td>Conceptual description, mockup of visualization tools</td>
</tr>
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### 3.0 Risk Evaluation Process for Offshore Wind

The process for developing the ERES for offshore wind follows the six steps laid out in Table 1. Due to funding and schedule constraints, each step will consist of a limited mock up during FY10. Key portions of the ERES development include identifying and developing analytical tools to carry out screening analyses and risk modeling, developing risk management and mitigation strategies, and creating methods for risk communication.

**Identifying or Creating Analytical Tools.** Analytical tools that will be included in the ERES will be useful in performing risk- and decision-related analysis. Existing tools will be used where available and
tools will be adapted or developed where necessary. Deterministic models may include detailed hydrodynamic models to examine circulation spatially and temporally in the vicinity of proposed wind farms. Probabilistic models will be used to understand other interactions such as collision risk for migrating birds at wind turbine rotor altitude. More complex models such as hydrodynamic models or models based on geographic information system (GIS) platforms will remain outside the ERES and be available as linked models. Tools that are locally available (embedded within the ERES) will perform simpler analyses based on spreadsheet functionality and other features. These will include tools to conduct sensitivity/what-if analyses, and functionality to perform Monte Carlo simulation. Visualization and animation tools will be applied to display risk communicative results.

The analytical tools will be applied to create estimates of risk; analysis outputs will be summarized and entered into the KMS. These results might include risk data sheets that list scenarios, impact severities, and measure(s) of uncertainty. As much as possible, these results will be spatially specific, including Global Positioning System (GPS) and/or latitude-longitude coordinates. Displays and animations created for risk communication will also be added to the KMS. These outputs might include cumulative distribution functions and risk contour maps.

**Linking the KMS to the Analytical Tools.** The KMS will be linked to the analytical tools as an evidence marshaling tool, allowing users to bring together disparate pieces of evidence (e.g., documents, database records, data values from tables, simulation results), in order to make them available as input parameters for risk models. This linkage from the KMS to the ERES will provide an unprecedented level of transparency in the use of data to support the analysis tools and risk outcomes.

In addition, outputs from the risk analyses, as well as supporting evidence provenance and other annotations, will be entered into the KMS, linking back to the input data files. This association of data will allow analysis results to be linked to specific candidate sites, geographic regions, site developers, or other attributes, creating patterns and linkages that may be of interest to the offshore wind stakeholder community.

### 4.0 Risk Management and Communication

Risk metrics will be used to develop risk management and mitigation strategies to address the most pressing issues identified in the study. Consultation with a wide range of stakeholders and regulatory agency staff will be necessary to develop acceptable mitigation strategies.

Outputs of the risk modeling within the ERES will be used to drive visualization, animation, and other displays to provide accessible outputs of the analyses. These visualizations will include ancillary environmental- and technology-related data as well as data of risk-relevance. Figure 2 provides an illustration of the functionality of the ERES user interface. The menu-driven structure allows users to select features that relate to the specific cases of interest from drop-down menus.

Different categories of users will use output data from ERES in different ways, constituting different “use cases”. For example, MHK device developers and project developers may be most concerned with details of different technologies and wind farm geometries and the environmental risks each may pose. Regulators and researchers may be concerned with all the details of risk computations as well as the
outputs and visualizations. Members of the interested public may be most concerned with the degree of impact expected and how those risks may affect them individually—for example, in terms of electricity costs, property values, and viewshed impacts.

Figure 2. Stylized example of the ERES user interface. The boxes represent drop-down menus that will allow the user to interact with the ERES and KMS. The user would be able to customize a risk analysis by choosing specific case attributes (receptors or technologies) and environmental data, then applying analytical tools (risk models), customizing the outputs (risk datasheets or matrices), and specifying the communication products (visualization, cumulative frequency distributions).

Under the current project, a mockup of the visualization interface will be presented in the form of a series of PowerPoint slides. The mockup will represent selected modes of application of the ERES in a decision environment and will convey the overall vision for this risk-informed decision support tool. For the purposes of the mock up, three use cases will be defined; the themes that will be mocked-up for each case are outlined below.

1. **Developer Use Case:**
   - different sizes and locations of wind farms
   - different wind turbine generator technologies
   - aggregated and disaggregated risk metrics (e.g., risk contours, cumulative distribution functions, measles chart, spatial dependence).
2. **Regulator and Researcher Use Case:**
   - model/analytical flow diagram
   - knowledge management system
     - multiple study comparisons
     - input uncertainty depiction
     - input characterization (time and space, metadata, other assumptions)
     - environmental data (birds, whales, fish, winds, other)
     - receptor data (bird migration routes, fish harvest activity, shipping lanes)
   - complex model
     - multiple model icons, model choice (e.g., bird/ship collision risk, viewscape visualization, noise propagation contours, electromagnetic field densities)
     - functionality of model(s)
     - output of model(s).

3. **Interested Public Use Case:**
   - viewshed visualization
     - alternative wind farm locations and sizes
     - alternative vantage points
     - alternative visibility conditions
   - social networking data, comment information.

As an example, Figure 3 displays environmental data on wind speed vs. elevation (e.g., regulator and researcher use case) as it could appear within the ERES software interface. This elementary example shows wind speeds over an ocean area at an elevation of 50 m. The stippled areas show layouts for offshore wind farms at two locations, nearshore and in deeper water. The relative risk of deployment and environmental effects could be derived from applying the ERES tools to determine tradeoffs between the increased cost of deploying farther from shore and capturing the stronger winds.
5.0 Transition from Mockup to Full Functionality

The offshore wind ERES and KMS mockup described in this report will provide a preview of the functionality of a fully developed risk evaluation system that could be used to assess environmental risks associated with offshore wind energy development. The fully functional waterpower ERES and KMS will be developed by PNNL in the 2010–2012 fiscal years and will demonstrate capabilities of the system as it applies to MHK. For both water and wind power, when fully developed, the proposed risk evaluation system and associated KMS will use risk assessment techniques to determine priority stressors on aquatic organisms and environments from specific technology aspects, identify key uncertainties underlying high-risk issues, compile a wide range of data types in an innovative and flexible data organizing scheme, and inform planning and decision processes with a transparent and technically robust decision-support tool.
During the afternoon of Day 3, an open-discussion session was held with Federal partners and collaborators to develop future study projects based on the information provided during the workshop. A presentation was given by the National Ocean Partnership Program (NOPP) to explain the NOPP is a long-term interagency, inter-sector collaboration motivated by common needs. NOPP was established to promote national goals of assuring national security, advancing economic development, protecting quality of life, and strengthening science education and communication through improved knowledge of the ocean; and to coordinate and strengthen oceanographic efforts in support of those goals by: a) Identifying and carrying out partnerships among federal agencies, academia, industry, and other members of the oceanographic scientific community in the areas of data, resources, education, and communication, and b) Reporting annually to Congress on the Program.

NOPP facilitates partnerships and inter-agency coordination through interagency discussion forums, interdisciplinary workshops, and funding of inter-sector, collaborative research projects (http://www.nopp.org/). Funding is granted through a proposal review process by an advisory committee that looks at relevance of project, project goals, partnerships proposed, capabilities and qualifications, and appropriateness of cost. Previous collaborative projects were outlined to provide examples of the partnerships and types of projects. Partners often included members of regulatory agencies, industry, and academia to achieve a common goal through cross-sector collaboration and joint funding. The slides for the Environments Breakout sessions summary presentation are provided in Appendix A, Pages A-221 to A-223.
APPENDIX A:
PRESENTATIONS
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Renewable Energy Activities

Anticipate three types of electricity-generating activities requiring BOEMRE authorization:

- **Wind**—numerous commercial projects from Maine to North Carolina, technology testing off Georgia, and research off Hawaii
- **Wave**—preliminary interest in research and eventual commercial leasing and development off Oregon
- **Ocean Current**—resource data collection and technology testing off southeast Florida

Applicable Laws and Executive Orders

- National Environmental Policy Act
- Endangered Species Act
- Marine Mammal Protection Act
- Magnuson-Stevens Fishery Conservation and Management Act
- Marine Protection, Research, & Sanctuaries Act
- National Marine Sanctuaries Act
- E.O. 13186 (Migratory Birds)
- Coastal Zone Management Act
- Clean Air Act
- Clean Water Act
- Marking of Obstructions
- E.O. 13547 (Stewardship of the Oceans, Our Coasts & the Great Lakes)
- Ports and Waterways Safety Act
- Rivers and Harbors Appropriation Act
- Resource Conservation and Recovery Act
- National Historic Preservation Act
- Archaeological and Historical Preservation Act
- American Indian Religious Freedom Act
- Federal Aviation Act
- Federal Power Act
- E.O. 13607 (Indian Sacred Sites)

OCS Renewable Energy Program Philosophy

- Coordinate with federal, state, and local agencies, tribal governments, and stakeholders
- Apply our renewable energy regulatory framework in conjunction with interagency-led planning activities
- Focus on multiple-use
- Work within the current authorities and responsibilities of agencies and continue ongoing activities

Regulatory Framework

- **Coordination (throughout rule)**
  - Federal/State/Local/Tribal Task Forces
- **Lease and Grant Issuance (Subparts B and C)**
  - Commercial and Limited Leases
  - Competitive and Noncompetitive Leasing
  - Rights-of-Way and Rights-of-Use and Easements
  - Research Activities
- **Payments (Subpart E)**
  - Bonding, Payments, Revenue Sharing
- **Plans (Subpart F)**
  - Site Assessment and Construction & Operations
  - General Activities
- **Conduct of Approved Plan Activities (Subpart H)**
  - Environmental and Safety Monitoring & Inspections
- ** Decommissioning (Subpart I)**

Research and Studies Efforts

- Environmental Studies Program
- Technology Assessment and Research
- International Energy Agency (IEA) Annex
- Partners include National Oceanic Partnership Program, DOE, FERC, industry, academia, Marine Board, and BOEMRE Scientific Advisory Committee
- Use results to inform leasing, plan review, and program decisions
BOEMRE Consultation and Coordination

- Serves as lead Federal Agency for environmental compliance reviews under the National Environmental Policy Act (NEPA) and will use cooperating agency agreements
- Completes all required consultations (e.g., Endangered Species Act, National Historic Preservation Act)
- Documents compliance with the Federal consistency provisions of the Coastal Zone Management Act
- Assures compliance with all other applicable laws

Intergovernmental Task Forces

- Affected State, local, & tribal governments and federal agencies participate
  - Does not replace consultation under existing federal laws and regulations
- Forum to:
  - Educate each other about permitting and statutory responsibilities, and stakeholders’ issues
  - Exchange data about biological and physical resources, uses, and priorities
  - Continue dialogue about renewable energy activities throughout the leasing process
- BOEMRE considers task force input in our renewable energy leasing decisions

Intergovernmental Task Forces

- Task Force States: Maine, Massachusetts, Rhode Island, New York, New Jersey, Delaware, Maryland, Virginia, North Carolina, Oregon
- On the Horizon: Hawaii, Florida, South Carolina

Planning and Analysis Stage

- Engage intergovernmental task force, stakeholders, and public
- Publish planning notices
  - Request for Interest (RFI)
  - Call for Information and Nominations (Call)
- Announce Area Identification (Wind Energy Areas)
- Conduct environmental compliance and consultation

Key Stages of Renewable Energy Program*

Planning and Analysis
Lease or Grant
Site Assessment
Commercial Development

* Engage intergovernmental task forces, stakeholders, and public throughout

Lease or Grant Stage

- Engage intergovernmental task force, stakeholders, and public
- Publish notices
  - Request for Competitive Interest
  - Determination of No Competitive Interest (Noncompetitive)
  - Proposed and Final Sale Notices (Competitive)
- Issue leases or grants
  - Negotiate lease or grant (noncompetitive)
  - Hold lease or grant auction (competitive)
Lease Site Assessment Stage

- Lease provides a 5-year period to collect site-specific data:
  - Informs preparation of the lessee’s construction and operations plan (COP)
  - May include archaeological, biological, geophysical, geotechnical, shallow hazard and other site characterization surveys
- BOEMRE conducts environmental and technical reviews of the lessee’s site assessment plan (SAP)
  - Submitted for planned bottom-founded data collection facilities (e.g., meteorological towers or meteorological buoys)

Lease Construction and Operations Stage

- Lease provides a 25-year period to construct and generate electricity
- Lessee submits construction and operations plan (COP) that describes:
  - Overall site investigation results (includes physical and biological survey results)
  - Offshore and onshore support
  - Any proposed mitigation and monitoring and lease stipulation compliance
  - Design, fabrication, installation, and operations concepts
  - Decommissioning and site clearance concepts
- BOEMRE prepares an EIS and conducts environmental & consultation and technical reviews
- After 25 years of operation, lease expiration occurs and decommissioning is required unless a renewal is granted

Opportunity to Provide Comment

All stages provide for public comment:
- Stakeholder meetings
- BOEMRE intergovernmental task force meetings: public Q&A session
- Notice of Intent to Prepare an EA or EIS
- Scoping meetings for EISs
- Hearings and comment periods for draft EISs

Guidance Documents


Future Guidance Documents

- Site Assessment Plan Requirements
- Data Collection Protocols:
  - Avian
  - Benthic
  - Marine fauna

Regional Environmental Assessment

- Feb 2011: Announced WEAs and launched Environmental Assessment (EA)
  - EA will evaluate potential impacts of leasing, site assessment and characterization activities off DE, MD, NJ, and VA
  - WEAs identified following outreach, collaboration through Interagency Task Forces, may be modified through evaluation process and by EA analysis
  - Draft EA released this week for a 30-day public comment period
**Delaware**
- NRG Bluewater Wind (BWW) only entity that expressed interest qualified to hold lease
- BWW also holds Interim Policy lease
- Noncompetitive lease negotiation to follow completion of the EA in 2011

**Maryland**
- 9 expressions of interest and dozen comments in response to RFI
- Preparing Call
- Competitive lease sale in 2012

**Atlantic Wind Connection**
- Right-of-Way Grant (ROW) Application received in March
- 750-mile ROW installed in 5 phases
- Off NY, NJ, DE, MD, VA
- Preparing Request for Competitive Interest
- Anticipate preparing an EIS

**New Jersey**
- 11 nominations and over dozen comments received
- Competitive lease sale in 2012
- Three Interim policy leases issued in 2009

**Virginia**
- Working on navigation issues with Commonwealth, USCG, with input from maritime interests
- Preparing draft Call
- Anticipate holding competitive lease sale in 2012

**Massachusetts**
- 11 expressions of interest and over 260 comments in response to the RFI
- Reduced size of RFI area - fishing and other concerns
- Preparing the draft Call and Notice of Intent to prepare NEPA analysis
- Public information sessions with MA Fisheries and Habitat Workgroups, RI Fishery Advisory Board and stakeholders June 7-9
- Commercial Fishing & Offshore Wind workshop hosted by MA & RI June 9

**Rhode Island**
- Preparing Call and Notice of Intent to prepare NEPA analysis
- Public information sessions with MA Fisheries and Habitat Workgroups, RI Fishery Advisory Board and stakeholders June 7-9
- Commercial Fishing & Offshore Wind workshop hosted by MA & RI June 9

**North Carolina**
- Working to identify a WEA
- Developing modeling protocols with the National Park Service to address visual effects
- Analyzing vessel traffic and synthesizing other resource data from the State and other agencies
**Task Force and Stakeholder Compatibility Concerns**
- Commercial fishing
- View shed
- Port Access
- Navigation and safety
- Archaeological and cultural sites
- Historic sites and places
- Protected species (marine mammals, birds, turtles)
- Migratory birds
- Sensitive offshore habitats (e.g., cold water corals and EFH)
- DOD and NASA offshore training and exercise areas

**Next Steps**
- Issue a planning notice for the AWC ROW
- Process requests for 5-year leases authorizing:
  - wind resources data collection off Georgia
  - ocean current resource data collection and technology testing off southeast Florida
- Continue consulting on wave energy research and leasing and development through the Oregon intergovernmental task force
- Establish a Hawaii intergovernmental task force to consider research and commercial leasing
- Monitor Deepwater Wind’s expected deployment of a meteorological buoy off New Jersey
- Oversee Cape Wind’s construction of a commercial wind facility in Nantucket Sound off Massachusetts
- Decide on issuing commercial wind leases off NJ, DE, MD, and VA in late 2011 or early 2012
- Continue planning and consultation to identify WEAs off ME, MA, RI, NY, and NC

**Workshop Objectives**
- Identify key data needs
- Prioritize data collection and research initiatives
- Develop potential synergies for future studies
- Cultivate partnerships
Day 1 - 12 July 2011
Presentations/Introduction

National Offshore Wind Strategy

A commitment by the federal government to facilitate responsible deployment of offshore wind energy

- Provides long range strategy for
  - Lowering cost of energy
  - Prioritizing federal R&D investments for maximum economic impact
  - Addressing the full range of stakeholder issues limiting industry growth
  - Reducing timeline for permitting and deployment

- Announced by Secretary Chu and Secretary Salazar on February 7, 2011

- Backed by an initial $50.5 M in funding by DOE for offshore wind research and development

Key Points of National Strategy

1. Offshore wind can create substantial benefits for the nation:
   - Reduced GHG emissions
   - Diversified energy supply
   - Economic revitalization

2. The challenges facing offshore wind deployment are daunting:
   - High capital & financing costs
   - Lack of specialized infrastructure
   - Lack of site data and experience with permitting processes

3. To realize these benefits in spite of the challenges, DOE will:
   - Reduce the levelized cost of energy from 26.9¢/kWh to 7¢/kWh by 2030
   - Help reduce market barriers: understand and mitigate environmental and socioeconomic impacts, build up infrastructure and transmission
   - Partner in the installation of the first demonstration-scale projects

4. Understanding and reducing market barriers to offshore wind are critical to this strategy

DOE Offshore Wind Strategy

Meeting our Critical Objectives

Cost of Energy

- Reduce capital costs
  - Larger scale systems with greater capacities
  - Innovative foundations and platforms
- Decrease O&M costs
  - Ruggedized designs to reduce offshore maintenance
- Decrease financing costs
  - Design codes & standards to reduce deployment risks
  - Offshore wind characterization to improve output projections
- Increase energy capture
  - Larger rotors, longer blades, and taller towers

Deployment & Infrastructure

- Support effective siting and permitting
  - Provide technical input & assistance to federal & state agencies
  - Applied research on key environmental and socioeconomic issues
  - Policy and economic analysis to inform decision-makers
- Support wind resource planning
  - Gather wind resource data for CMS
  - Provide technical input and data
- Promote infrastructure development
  - Domestic supply chain development
  - Interconnection planning
  - Research on specialized vessels and O&M technology
Day 1 - 12 July 2011
Presentations/Introduction

**DOE's Strategy for Reducing Market Barriers**

- **Impact**
  - Develop core technologies for next-generation turbines, ensuring sufficient number of domestic O&M.
  - Develop modeling tools, optimized system designs, and components necessary for long-term R&D to reduce cost of energy

- **Topics**
  - Stage 1: Conceptual design
  - Stage 2: Pre-license and pre-operating

- **Stage 1**
  - Fully integrated wind plant designs
  - Dynamic simulation models
  - Long-life components to reduce O&M

- **Stage 2**
  - Market analysis
  - Environmental risk reduction
  - Supply chain development

- **Market Barriers**
  - Close data gaps needed for efficient permitting
  - Cost and net benefits analysis

- **Total DOE Funding**
  - $71M

- **Cost-Share**
  - $3.7M

- **Timeline**
  - 2 years

- **Applicants**
  - Industry, NGOs, universities, and engineering firms

- **Success Metrics**
  - Reduced overall cost of siting and permitting, faster time to deployment

**Offshore Wind Research Solicitations**

- **National Offshore Wind Demonstrated Development**
- **Onshore Technology Development**
- **Market Barriers**

**Infrastructure**

- **Activity**
  - National offshore wind energy demonstration study
  - Offshore transmission and integration case studies
  - Wind energy studies
  - Increased utilization of existing transmission
  - Optimal design and analysis assessment

- **Consortiums**
  - DOE, NMFS, USGS, USFWS, NCC, etc.

- **Supporting organizations**
  - Indian council, National Energy Technology Laboratory, National Oceanic and Atmospheric Administration, etc.

**Environmental and Social Impacts of Offshore Wind**

- **Wide range of potential impacts, little U.S. data:**
  - **Environmental impacts**
    - Sound communities
    - Bird and bat mortality
    - Construction and operation noise
    - Migratory displacement
    - EMF effects
  - **Socioeconomic impacts**
    - Cultural impacts
    - Competing human uses
  - **Public perception**

- **Substantial European experience:** 350+ studies, no showstoppers identified

From the Final Report of Danish Monitoring Program, 2006: "Offshore wind power is indeed possible to engineer in an environmentally sustainable manner that does not lead to significant damage to nature...the prospects for future expansion of offshore wind farms look bright."
Day 1 - 12 July 2011
Presentations/Introduction

Key Takeaways

1. The environmental & economic benefits of ocean renewable energy are significant, and the resources are abundant.

2. The Department of Energy is leading the nation’s efforts to develop and deploy ocean renewable energy technologies:
   - Developing next generation offshore wind technology
   - Developing innovative wave, current, and tidal energy devices
   - Researching the potential effects of these technologies on wildlife, ecosystems, and alternative human uses of the ocean
   - Engaging with regulatory agencies and other stakeholders to realize efficiencies in siting and permitting processes.

3. The Department’s effort will ultimately:
   - Reduce the levelized cost of energy from these technologies
   - Help reduce project deployment timelines
   - Enable the growth of a robust offshore renewable energy industry

A Call to Action

Thank You

Chris Hart
US DOE Offshore Wind Manager
chris.hart@ee.doe.gov

Offshore Wind: Huge Potential

Offshore Wind Benefits

<table>
<thead>
<tr>
<th>Energy</th>
<th>Environment</th>
<th>Economy</th>
</tr>
</thead>
<tbody>
<tr>
<td>Large renewable resource close to load (1070 GW in shallow waters; 4150 GW total)</td>
<td>Reduced GHG emissions (2.7 T M tons CO2 emissions avoided / GW / year)</td>
<td>Jobs manufacturing, installing, operating, and maintaining systems (54 GW of offshore = 43,000 permanent jobs)</td>
</tr>
<tr>
<td>Availability matches peak load (28 coastal states consume 78% of electricity)</td>
<td>Reduced water consumption (81 billion gallons saved annually)</td>
<td>Economic recovery and industrial development (1 GW offshore = $4.2B investment)</td>
</tr>
<tr>
<td>Energy diversity &amp; security</td>
<td>Reduced need for new land-based transmission</td>
<td>Potential for cost-competitive electricity in high-price markets</td>
</tr>
</tbody>
</table>

DOE Offshore Wind Funding Opportunities: $50.5 million, 5 years

- Technology Development FOA (up to $25M, 5 years)
  - Long-term technology R&D to reduce cost of offshore wind energy
- Market Barriers Removal FOA (up to $13M, 3 years)
  - Research to close data gaps needed for project permitting; expand knowledge base on offshore wind environmental effects; develop strategies & planning for long-term industry cost-competitiveness
- Topics:
  1. Offshore wind market & economic analysis
  2. Environmental & socioeconomic risk reduction:
     - Mid-Atlantic Baseline Study, Environmental Monitoring Methods and Technologies
     - Manufacturing & supply chain development
  3. Transmission planning & interconnect strategies
  4. Ports, vessels & operations
- Wind energy resource characterization & design conditions
- More to come – Stay tuned
Energy Market and Infrastructure Information for Evaluating Alternative Energy Projects for OCS Atlantic

Atlantic Wind Energy Workshop
July 12-14, 2011

Dr. Maureen F. Kaplan
Eastern Research Group, Inc.
Lexington, MA 02421
BOEMRE Contract M08PD20146

Introduction

- Energy Policy Act of 2005
- Project Began in September 2008
- Support NEPA process
- Snapshot in time
- Maritime Infrastructure
- Energy Infrastructure

Maritime Infrastructure

- Ports
- Vessels
- Shipbuilding and Repair
- Submarine Electric Cable Manufacture and Installation

Ports

- 35 deep draft ports along East Coast

What Size Port Do We Need? Part 1

- 2 in DE (Newcastle, Wilmington)
- 1 in MD (Baltimore)
- 3 in NJ (Camden, Paulsboro, Trenton)
- 3 in VA (Hampton Roads, Hopewell, Richmond)
- Quonset Point, RI
- New Bedford, MA
- Falmouth, MA
- Wilmington, DE
- Camden, NJ
- Paulsboro, NJ
What Size Port Do We Need? Part 2

- Up to 223 additional ports along East Coast
  - 27 in DE/MD/NJ/VA region
- How large a vessel is needed to
  - Install a met tower?
  - Maintain a wind farm?

U.S. Privately Owned Fleet by Segment, 2008

<table>
<thead>
<tr>
<th>Fleet</th>
<th>Ocean</th>
<th>Great Lakes</th>
<th>Coastal and Waterways</th>
<th>Offshore</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total owned</td>
<td>628</td>
<td>47</td>
<td>38,502</td>
<td>689</td>
</tr>
<tr>
<td>Foreign flag</td>
<td>437</td>
<td>0</td>
<td>0</td>
<td>138</td>
</tr>
<tr>
<td>U.S. flag</td>
<td>191</td>
<td>47</td>
<td>38,502</td>
<td>551</td>
</tr>
<tr>
<td>Jones Act</td>
<td>98</td>
<td>47</td>
<td>38,502</td>
<td>551</td>
</tr>
<tr>
<td>Other</td>
<td>93</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
</tbody>
</table>

What Type of Vessels Have Been Mentioned for Installation?

- Installation Barge (100x400x24 ft)
- Auxiliary Trencher-pulling barge (40 x 100 ft)
- Anchor Handling Tugs
- Cable Burial Barge
- Hydroplow Cable Burial Machine

Turbine Installation Vessel

- Europe moving to specialized ships for installation
- First TIV 428x124 ft
- Do not know what modifications need to be done to convert a jack-up or lift barge

Shipbuilding and Repair

- NAICS 336611
  - Census = 656
  - EPA = 346
  - Colton = 343 (www.shipbuildinghistory.com)
- 4 with 400ft+ capability and water depth at least 12 ft
- 16 shipyards in DE/MD/NJ/VA

Submarine Cable

- Case Studies
  - Cross Sound Cable
  - Neptune Regional Transmission System
- Newer Developments
  - Hudson Project (2013)
Domestic Turbine Manufacturing

- Land-based = Yes
- Offshore = Not Yet
- What level of demand is necessary for a manufacturing plant to be built in the US?

Energy Infrastructure

- Platt’s data
  - Power plants
  - Substations
  - Transmission lines
  - GIS format
  - BOEMRE (Feb 2009)
**Observations - Part 1**

- Getting the power onshore might be weakest link
  - Availability of appropriate substation
  - Transmission costs
  - Intermittent nature of wind power
- Governors’ suggestion
  - Marine transmission cable (“Backbone”)

**Observations - Part 2**

- Consistent theme
  - Identify the “tipping point” where demand is sufficient to support a domestic supply chain

**Workshop Goal**

*Where do I put it in?*
Federal Agency Panel

Day 1 - 12 July 2011

Moderator – Joel Whitman, CEO, Global Marine Energy, Inc.
BOEMRE – Maureen Bernholz, Program Manager, Office of Offshore Alternative Energy Programs
FERC – Tim Konnert, Fish Biologist, Office of Energy Projects
FWS – David Cuttington, Senior Advisor to the Director
USGS – Walter Bernhard, Director, Woods Hole Coastal & Marine Science Center
NPS – Sarah A. Quinn, J.D., External Renewable Energy Specialist
NOAA – Emily Lindow, Senior Policy Advisor
FAA – John Pog, Obstruction Evaluation Group
USACE – James Haggerty, N-AD Program Manager
USCG – George Detweiler, Marine Transportation Specialist
DOD – Frederik Eng, Office of the Secretary of Defense
EPA – Susan F. Brown, Director, Office of Federal Activities
ACHP – Tom McCahill, Senior Program Analyst

Atlantic Wind Energy Workshop July 12, 2011

Federal Agency Panel

Gave the Secretary of the Interior the authority to regulate a broad spectrum of activities:
- Production, transportation, or transmission of energy from sources other than oil and gas – “Renewable Energy”
- Use of currently or previously OCSLA-authorized facilities for energy-related purposes or for other authorized marine-related purposes – “Alternate Use”

Bureau of Ocean Energy Management, Regulation and Enforcement

Key Stages of Renewable Energy Program*
Planning and Analysis
Lease or Grant
Site Assessment
Commercial Development
* Engage intergovernmental task forces, stakeholders, and public throughout

Bureau of Ocean Energy Management, Regulation and Enforcement
Federal Agency Panel

Moderator – Joel Whitmore, CEO, Global Marine Energy, Inc.

- BOEMRE – Maurice Berndt, Program Manager, Office of Offshore, Alternative Energy Programs
- FERC – Tim Kenney, Fish Biologist, Office of Energy Projects
- FWS – David Cottinham, Senior Advisor to the Director
- USGS – Walter Burnhardt, Director, Woods Hole Coastal & Marine Science Center
- NPS – Sarah A. Quinn, J.D., External Renewable Energy Specialist
- NOAA – Emily Lushus, Senior Policy Advisor
- FAA – John Poggi, Obstruction Evaluation Group
- USACE – James Hagerty, N-5 Program Manager
- USCG – George Detweiler, Marine Transportation Specialist
- DOD – Frederick Engle, Office of the Secretary of Defense
- EPA – Susan E. Bromm, Director, Office of Federal Activities
- ACHP – Tom McCullock, Senior Program Analyst

Federal Energy Regulatory Commission

Regulate siting of natural gas and non-federal hydropower projects, as well as interstate transmission of natural gas, oil, and electricity.

***No authority to site wind energy projects***

- FPA requires FERC authorization for non-federal hydropower projects that:
  - are located on navigable waters;
  - are located on public lands of the United States;
  - use surplus water from a federal dam;
- OR are located on non-navigable waters over which Congress has Commerce Clause jurisdiction, were constructed after 1935, and connected to the interstate grid.

***Includes marine hydrokinetic projects***

Federal Agency Panel

- Memorandum of Understanding
  - Oregon
  - Washington
  - Maine
  - California
- BOEMRE
  - U.S. Army Corps
  - U.S. Coast Guard (in development)
- National Ocean Council
- Annex IV

U.S. Fish and Wildlife Service

- Endangered Species Act
- Migratory Bird Treaty Act
- Memorandum of Understanding between FWS and BOEMRE (June 2009)
  - Required by Executive Order 13186 “Responsibilities of Federal Agencies to Protect Migratory Birds”
  - To strengthen migratory bird conservation through enhanced collaboration between the agencies
  - To evaluate potential impacts to migratory birds and design or implement measures to avoid, minimize, and mitigate such impacts as appropriate
Federal Agency Panel

- Moderator – Joel Whitten, CEO, Global Marine Energy, Inc.
- BOEMRE – Marvin Bordbard, Program Manager, Office of Offshore, Alternative Energy Programs
- FERC – Tom Keenan, Fish Biologist, Office of Energy Projects
- USGS – Walter Barnhardt, Director, Woods Hole Coastal & Marine Science Center
- ACHP – Tom McCulloch, Senior Program Analyst
- FAA – John Puglisi, Obstruction Evaluation Group
- USACE – James Haggerty, NAD Program Manager
- NOAA – Emily Lindow, Senior Policy Advisor
- USGS – Sarah A. Quinn, J.D., External Renewable Energy Specialist
- NHQ – Walter Barnhardt, Director, Woods Hole Coastal & Marine Science Center
- ACHP – Tom McCulloch, Senior Program Analyst

National Park Service

U.S. Department of the Interior

- Jurisdiction: National Parks, National Seashores, National Historic Trails, Wild and Scenic Rivers, National Natural Landmarks, National Historic Landmarks, National Wilderness Areas, National Wildlife Refuges, National Monuments, National Seashores, National Historic Sites, National Parks, National Seashores, National Historic Trails, Wild and Scenic Rivers, National Natural Landmarks, National Historic Landmarks, National Wilderness Areas, sites on National Register of Historic Places, National Natural Landmarks, National Historic Landmarks, Land & Water Conservation Fund Program lands, and other such designations

Legal Mandates and Authorities

- NPS Organic Act of 1916 (the “Non-Impairment” Mandate)
  NPS “shall promote and regulate the use of said national parks by such means as conform to the fundamental purpose of said parks, viz. to conserve the scenery and objects of the wild life therein and to provide for the enjoyment of the same by future generations.”
- NPS General Authorities Act, 1978 Amendment (Special Park Uses)
  NPS “shall promote and regulate the use of national parks by such means as conform to the fundamental purpose of said parks . . . The authorization of activities shall be construed and the protection, management, and administration of these areas shall be conducted in light of high public value and integrity of the National Park System . . .”
- NPS Management Policies of 2008
  Also requires protection of natural conditions, natural soundscapes, clear skies, scenic views, physical and biological processes, and ecosystems

U.S. Geological Survey

- Assets for CMS:
  - Mature Information Systems
  - The National Map
  - National Water Information System (NWIS)
  - Center for Earth Resources Observation and Science (EROS)
  - National Geologic Map Database (NGMDB)
  - Ocean Biodiversity Information System (OBIS-USA)

National Park Service

U.S. Department of the Interior

NPS Coordination on Offshore Wind

- Atlantic Offshore Wind Energy Consortium Working Groups
  - Cooperation with land leasing/permitting agencies under the National Environmental Policy Act, National Historic Preservation Act, and other federal laws and mandates
  - “Cooperative Conservation” for shared resources (e.g., air, water)
  - Regional transmission corridor identification
  - Responses to specific NPS Special Use Permit requests for transmission generation intertie facilities and related renewable energy infrastructure

Priority Interests

- Appropriate lease-block, project, and infrastructure siting
- Noise modeling and natural sounds protection
- Visual simulations, including night skies and the use of Audio Visual Warning Systems (e.g., OCAS) for FAA compliance
- Impacts to avian and bat species, fish, and marine mammals
- Scenario Planning, Conceptual Modeling, and landscape/ecosystem conservation
- Understanding and protecting public values associated with park experience
National Oceanic Atmospheric Administration

Key Mandates:
- Endangered Species Act
- Marine Mammal Protection Act
- Magnuson-Stevens Fishery Conservation and Management Act
- Fish and Wildlife Coordination Act
- National Environmental Policy Act
- National Marine Sanctuaries Act
- Coastal Zone Management Act

Key Federal Coordinating Partners
- NOAA-BOEMRE MOU on Outer Continental Shelf Energy Development and Environmental Stewardship

Priority research interests
- Impacts of installation and operation of offshore wind facilities and associated infrastructure on marine resources, marine and coastal habitats, and coastal communities
- Potential user-conflicts (especially impacts to commercial and recreational fishing)

National Oceanic Atmospheric Administration

Key NOAA Non-Regulatory or Service-Oriented Mandates:
- National Weather Service
- Marine Resource Conservation

Key Federal Coordinating Partners
- DOE-NOAA MOU on Weather-Dependent and Oceanic Renewable Energy Resources
- Multipurpose Marine Cadastre co-led by BOEMRE

Priority research interests
- Detailed Action Plan for implementing the DOE-NOAA MOU (wind resource characterization and improved forecasting)
- Data collection for CMSP

Federal Agency Panel

- Moderator: Joe Whitman, CEO, Global Marine Energy, Inc.
- BOEMRE: Massimo Barbaldi, Program Manager, Office of Offshore Alternative Energy Programs
- FERC: Tim Kinnison, Fish Biologist, Office of Energy Projects
- FWS: David Costagon, Senior Advisor to the Director
- USGS: Walter Terhune, Director, Wind and Coastal Marine Sciences Center
- NOAA: Tommy Laidler, Senior Policy Advisor
- NGS: John Page, Obstruction Evaluation Group
- USACE: James Huguet, NAD Program Manager
- USCG: Greg Detolle, Marine Transportation Specialist
- DOD: Frederick Popps, Office of the Secretary of Defense
- EPA: Susan L. Brown, Director, Office of Federal Activities
- ACHP: Tony McCall, Senior Program Analyst

Federal Aviation Administration

Scope of FAAO JO 7400.2

Obstruction Evaluation Study Identifies
- On existing and proposed public-use and military airports and/or aeronautical facilities.
- Existing and proposed visual flight rules (VFR)/instrument flight rules (IFR) departure, arrival, and en route operations, procedures, and minimum flight altitudes.
- Airport capacity, as well as the cumulative impact resulting from the structure when combined with the impact of other existing or proposed structures.
- Physical, electromagnetic, or line-of-sight (LoS) interference on existing or proposed air navigation, communications, radar, and control systems facilities.
- Whether marking and/ or lighting is necessary.

Federal Aviation Administration

Our Focus in Evaluating the Effect of Proposed Wind Turbines
- Safety of aircraft and efficient use of airspace (flying public)
- Protecting the navigable airspace
- Proposed structures’ effect on the navigable airspace
Near a public-use or military airport heliport or seaplane:
- Greater than 200 feet in height above ground level
- Near a public-use or military airport, heliport or seaplane base and will exceed the slope ratio
- The proposed object is a traverse way which would exceed one or more of the standards listed above
- When requested by the FAA
- On a public-use or military airport or heliport

Who must file notice?
- ACCHP
- EPA
- DOD
- FAA
- NOA
- NPS
- FWS
- FERC
- BOEMRE
- Moderator
- ACHP
- USCG
- USACE
- James Haggerty, NAD Program Manager
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- Joel Whitman, CEO, Global Marine Energy, Inc.

Federal Agency Panel

Volume of Wind Turbine Numbers

- 2004: 3,030
- 2005: 5,600
- 2006: 13,526
- 2007: 15,403
- 2008: 21,251
- 2009: 25,618
- 2010: 34,184
- As of 06/09/11: 17,458 WT
- 15,449 Non-WT

Federal Aviation Administration

U.S. Army Corps of Engineers

1. The U.S. Army Corps of Engineers has a regulatory role in OCS Wind Energy Development pursuant to Section 30 of the Rivers and Harbors Act of 1899. Discharges of dredged/fill material in coastal and inland waters associated with power cables and infrastructure are regulated pursuant to Section 404 of the Clean Water Act.
2. The Corps is working on a Memorandum of Understanding with BOEMRE to synchronize administrative processes for authorizing OCS Wind Energy projects.
3. The Corps’ Regulatory Program does not have any research interests in OCS Wind Energy Development.
Overview: DoD Operating Areas (OPAREAs) & Warning Areas

Methodology

- Categorize DoD offshore equities and potential wind energy development using:
  - Unrestricted
  - Site Specific Stipulations
  - Wind Energy Exclusion Area
- DoD Operating Area (OPAREA) overlaid with the proposed RFI/CFI or broader area of potential interest; e.g., North Carolina
- Extensive analysis and coordination process with military services

Federal Agency Panel

- **Moderator** – Joel Whitman, CEO, Global Marine Energy, Inc.
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- **DOD** – Frederick Engle, Office of the Secretary of Defense
- **EPA** – Susan E. Bromm, Director, Office of Federal Activities
- **ACHP** – Tom McCulloch, Senior Program Analyst
Review of and comment on National Environmental Policy Act (NEPA) documents, and
EPA is participating in a variety of interagency coordinating efforts including:
- Interagency Memorandum of Understanding (MOU) on Transmission Siting
- Atlantic Offshore Wind Interagency Working Group
- Great Lakes Wind Collaborative

EPA’s regulatory mandates for OCS Wind Energy Development include:
- Prevention of Significant Deterioration (PSD) permit for air emissions under the
  Clean Air Act. [Wind farm construction will be subject to General Conformity Rules
  of the adjacent state and if it is in non-attainment of the National Ambient Air
  Quality Standards (NAAQS).]
- National Pollutant Discharge Elimination System (NPDES) permits for discharges
  in federal offshore waters under the Clean Water Act.
- Review of and comment on National Environmental Policy Act (NEPA) documents,
  as mandated by Section 309 of the Clean Air Act.

EPA is participating in a variety of interagency coordinating efforts including:
- Atlantic Offshore Wind Interagency Working Group
- BOEMRE State task forces
- FAA's Office of Energy Projects
- USACE’s Office of Offshore Alternative Energy Programs
- NOAA’s Office of Ocean and Coastal programs
- USGS’s Office of Offshore Alternative Energy Programs
- NPS’s Office of Federal Activities
- USGS’s Marine Science Center

EPA’s Clean Energy Programs

What’s New:
- Updated Power Profiler and Greenhouse Gas Equivalencies Calculator.
- Released eGRID2010.
For further information:  http://www.epa.gov/cleanenergy/

Wind Energy Projects

- ACHP is the primary policy advisor to President and Congress on Historic preservation matters and issues.
- ACHP oversees “Section 106 process” ([§]36 CFR Part 800)
- Section 106 of the National Historic Preservation Act requires all Federal Agencies to:
  - “Take into account” the effects of their actions on historic properties
  - Provide the ACHP a “reasonable opportunity” to comment on federal agency actions

ACHP’s BOEMRE staff contact is Dr. Tom McCulloch
202-606-8554; tmcculloch@achp.gov
What is the ESID?

It’s an open system that supports ecosystem-based management decisions for offshore energy projects.

- Provides relevant, verified scientific information to scientists.
- Adds geography to the science, as a search criteria.
- Includes a readily accessible application to assist scientists with identifying environmental impacts.

Steps for Verified Scientific Information

1. Develop data prioritization strategy
   - Prioritize information for subject matter and geography
2. Select appropriate bibliographic tool
   - Effective bibliography and data management tool
3. Rigorous QA/QC procedures
   - Iterative review process by principal investigator

Geographically Relevant Scientific Information

- Ecological source material tied to the “study footprint”
- All resource documents collected available and accessed through a map
- Find what’s needed where it’s needed
- Like Google map - for ecological documents

Geographically Relevant Scientific Information

- Unleash the power of a “where”
- Access to thousands of data tables extracted from resource documents
- Find and locate data within or near your specified area of interest AOIs
- Conveniently limit or expand your request for information both geographically (map) and textually (keywords, subject matter, etc.)
Day 1 - 12 July 2011
Presentations/Information Management and Data Sharing Products Panel

**Accessible Application to Find Scientific Information**

**Desktop Version**
- System is a comprehensive spatial ecological library
- Database architecture based on Esri ArcMarine model
- Contains full bibliographic entries and abstracts for scientific studies
- Geo-referenced ecological information (study footprints)
- Searchable electronic scientific studies (OCR)

**Cloud Version**
- Convenient access anywhere
- Eliminates user software requirements
- Enhanced functionality for BOEMRE scientists to add resources to the system
- Open to the public with restricted functionality (copyright)
- Provides comprehensive data sharing ability for multiple entities (Federal, state, academia, industry, stakeholders, etc.)

**Benefits and Synergies of ESID**
- Centralized accessible system providing access to thousands of ecological research documents
- Full functionality and access for all BOEMRE Regions including ability to add additional resources
- Public access and functionality
- Scalable and sustainable system design to accommodate growth and expansion
- Expedited access to information needed eliminating vast amount of data searching time

**Contact Project Representatives**

<table>
<thead>
<tr>
<th>Name</th>
<th>Title</th>
<th>Organization</th>
<th>Phone</th>
<th>Email</th>
</tr>
</thead>
<tbody>
<tr>
<td>James Sinclair</td>
<td>Contracting Officer</td>
<td>BOEMRE</td>
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<td><a href="mailto:james.sinclair@boemre.gov">james.sinclair@boemre.gov</a></td>
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<td><a href="mailto:michael.rasser@boemre.gov">michael.rasser@boemre.gov</a></td>
</tr>
</tbody>
</table>

**Acknowledgements**

CSA, Inc.
- Will Inger (Manager)
- Kel Phillips
- Danib Stauder
- Les Logsdon

ESRI
- Doug Criddle (Manager)
- Eric Schaefer

ATKINS
- David Thompson
- Jeff Bonner
- Rachel McConkey

CSA, Inc.
- Leslie Fong
- Shane Munro
- Scott Lapham
- Dave Woodbridge
- Jason Evans

AMEC
- Doug Criddle (Manager)
- Eric Schaefer

ESRI
- Doug Criddle (Manager)
- Eric Schaefer
Mapping Habitats and Species to Meet Local & Regional Needs

NOAA’s Biogeography Branch

To develop information and analytical capabilities through research, monitoring, and assessment on the distribution and ecology of living marine resources and their associated habitats for improved ecosystem-based management

Biogeographic Assessment Approach

Habits Step 1: Engagement

Habits Step 2: Technology Selection

Habits Step 3: Analytical Approach
Objective: To synthesize and integrate ecological data to support management plan review process. To provide spatial models of resource distribution to inform MA Ocean Plan. Balancing needs of shipping community and conservation.
Species Step 5: Data Dissemination
Integrated Ocean and Coastal Mapping Workshop
Data Collection Recommendations

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>Requirement</th>
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</thead>
<tbody>
<tr>
<td>Instrument</td>
<td>MBES Echosounder with Full Time-Series Backscatter</td>
</tr>
<tr>
<td>Coverage Mode</td>
<td>Full bottom coverage (exceptions possible)</td>
</tr>
<tr>
<td>Object Detection</td>
<td>IHO Order 1A (IHO S.44 Sed) [&lt;2m in &lt;40m Depth]</td>
</tr>
<tr>
<td>Horizontal Uncertainty</td>
<td>IHO Order 1A (IHO S.44 Sed) [5m+5% Depth (m, 2d, m)]</td>
</tr>
<tr>
<td>Vertical Uncertainty</td>
<td>IHO Order 1A (IHO S.44 Sed) [0.05m (m, 2d, m)]</td>
</tr>
<tr>
<td>DTM Resolution</td>
<td>≤2m in &lt;40m Depth</td>
</tr>
<tr>
<td>Reference Frame</td>
<td>WGS-84 [H]; MLLW or WGS-84 (preferred) [V]</td>
</tr>
<tr>
<td>Metadata</td>
<td>FGDC (new typ. ISO19115/19139)</td>
</tr>
<tr>
<td>Data Sharing</td>
<td>To NGDC within 1 yr of collection</td>
</tr>
</tbody>
</table>
“Map once, use many times”

Needs agreement on:
- What (extra) field data to collect
- Data accuracy (and datums) required
- Calibration schedules for all sensors
- Data formatting and distribution processes
- Metadata formats & content (in multiple levels)

Problems:
- Direct v’s Opportunity cost
- Common data processing procedures
- Coordination of efforts across multiple agencies
Project objectives

- Identify and characterize potential space and use conflicts that could result from OCS renewable energy activities in the Atlantic and Pacific regions.

- Describe strategies and specific measures for avoiding or mitigating these conflicts, including mechanisms for improved communication and cooperation among stakeholders.

Project elements

1. Literature review and annotated bibliography.

Database navigation

- Data by category
- Datasets by lease block
MARCO Mapping & Planning Portal

Mid-Atlantic Regional Council on the Ocean (MARCO)

- June 2009 the five governors of NY, NJ, DE, MD and VA signed the Mid-Atlantic Ocean Governors’ Agreement on Ocean Conservation

Protect Key Ocean Habitats

- 10 major offshore canyons
- Cold water corals
- Key fish habitats
- Bird, marine mammal, sea turtle and other migration corridors

Promote Renewable Offshore Energy

- Requires knowledge of best locations for wind energy facilities.
- Requires knowledge of where use conflicts may arise.

Improve Water Quality

- Not on MARCO’s agenda as a spatial planning task. MARCO is working on this from policy perspective.
- But water quality data may be important for some facility siting and habitat protection issues.

Adapt to Climate Change

- Identify key infrastructure vulnerable to sea level rise and flood hazards at a coarse scale
**MARCO Structure**

Five Action Teams:

1. **Offshore Renewable Energy**
   - Lead: MD – Gwynne Schultz

2. **Offshore Habitats**
   - Lead: NY – Greg Capobianco

3. **Climate Change and Coastal Resiliency**
   - Lead: DE – Sarah Cooksey

4. **Water Quality**
   - Lead: MD – Matt Fleming

5. **Coastal & Marine Spatial Planning (CMSP)**
   - Lead: VA – Laura McKay

---

**MARCO Portal Creation**

1. Used VA CZM funds to contract with TNC
2. TNC surveyed a small group of potential users
   - What portal functions do you want?
   - What data do you have?
3. Create internal test portal
4. TNC collected feedback from survey group and revamped as needed
5. MARCO portal went live in December 2010

---

**3 Guiding Principles**

- Stay focused on immediate planning needs first and "satisfice" where possible.
- Trust the portal will grow, evolve and adapt over time.
- Make data needs known over a wide audience and remember to seek traditional knowledge from tribes and others who have spent their lives “on the water.”

---

**MARCO Website**

Mid-Atlantic Regional Council on the Ocean (MRCO) focused has about 30 layers, NROC has about 50.

---

**Critical Data Needs for MARCO**

<table>
<thead>
<tr>
<th>Category</th>
<th>Data Type</th>
<th>Description</th>
<th>Source of Data</th>
<th>Data Type</th>
</tr>
</thead>
<tbody>
<tr>
<td>Benthic Odore</td>
<td>Temperature</td>
<td>Temperature</td>
<td>NODC</td>
<td>Day 1 - 12 July 2011</td>
</tr>
<tr>
<td>Benthic Odore</td>
<td>Dissolved Oxygen</td>
<td>Dissolved Oxygen</td>
<td>NODC</td>
<td>Day 1 - 12 July 2011</td>
</tr>
<tr>
<td>Benthic Odore</td>
<td>Salinity</td>
<td>Salinity</td>
<td>NODC</td>
<td>Day 1 - 12 July 2011</td>
</tr>
<tr>
<td>Benthic Odore</td>
<td>DOGSP</td>
<td>DOGSP</td>
<td>NODC</td>
<td>Day 1 - 12 July 2011</td>
</tr>
<tr>
<td>Benthic Odore</td>
<td>DOGSP</td>
<td>DOGSP</td>
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<td>DOGSP</td>
<td>DOGSP</td>
<td>NODC</td>
<td>Day 1 - 12 July 2011</td>
</tr>
</tbody>
</table>

16 data gaps have been identified.
MARCO Mapping & Planning Portal
Available at www.midatlanticocean.org

MARCO Mapping & Planning Portal
6 Data Categories:
1. Administrative (6)
2. Decision Support (2)
3. Human Use (4)
4. Biological (7)
5. Geophysical (8)
6. State Specific (2)
29 data layers

MARCO Portal Features
• 3 base maps: streets, aerial or topo
• Pan and zoom
• Select layers to create customized map
• Dynamic map legend
• Layer transparency adjustment
• Save and print maps
• Search, identify, draw and measure tools
• User friendly fact sheets through “help” button

MARCO Area
Waterbirds, Wind Energy Areas, Shipping Separation Zones, OCS Boundaries, Major Canyons

Next Steps
• Find a host server
• Develop a maintenance plan
• Seek missing needed data layers

Next Steps
• Find funds for and develop decision support tools as envisioned by MarineMap
**Progress to Date – Data Integration**

- Identification of Regional Data Priorities
  - Analysis of recent documents – including from two regional CMSP workshops
  - Interviews

- Draft Data Profiles
  - Scoping documents for data priorities
  - Identify products and potential for ongoing

- Collaboration with Data Providers on Regional Data Product Development

**Progress to Date - Website**

- [northeastoceandata.org](http://northeastoceandata.org)

**Example Ocean Use Data – AIS vessel traffic – MA and RI merged**
Example Ocean Use Data – Commercial Fishing Effort

Example Biological Resource Data – Fall Cod Abundance from NMFS

Example Physical Data – Wind Energy Potential

Combining data from external sources with our catalogue (Example of biological resource data, right whale siting)

Data package and download

Next Steps & Ongoing Efforts

- Release late June
- Stakeholder feedback
  - Current products
  - Priorities for Regional Planning Body and other stakeholders
  - More advanced functionality?
  - Decision support tools?
- Coordination and Engagement
  - Regional Planning Body including Native Americans and NROC
  - Liaison with NOC data working group and MMC to ensure national consistency
  - Continue coordination with MARCO portal group
Next Steps & Ongoing Efforts

Continued data product development and collaboration with data providers, especially for the data priorities:

Ocean Uses
- Vessel traffic patterns – AIS and VMS
- Shipping channels
- Energy facilities
- Pipelines and cables
- Commercial fisheries
- Recreational boating & fishing
- Shipwrecks

Administrative & Regulatory
- Fishery management areas
- Dangerous and restricted areas

Habitat
- Benthic communities
- Bathymetry
- Seafloor geomorphology
- Wind regime
- Surface current and waves (circulation)

Day 1 - 12 July 2011
Presentations/Information Management and Data Sharing Products Panel
Data needs for renewable energy siting & permitting

The significant correspondence between migratory corridors and wind-energy potential on the Atlantic Coast suggests that understanding the potential interaction of migratory species and wind energy development will require long-term data aggregation to support environmental impact analysis and forecasting models.

Data needs for renewable energy siting & permitting

We need to be able to provide necessary data and models to answer renewable energy siting questions at multiple scales:

- Atlantic Coast scale
- Lease-block scale

OBIS-SEAMAP

Spatially referenced online database, aggregating marine mammal, seabird and sea turtle data from across the globe

OBIS-USA, OBIS-SEAMAP, iOBIS

OBIS-USA
- Protected species data / tools
- Telemetry / tracking data
- Passive acoustics
- Spatial Decision Support
- Mapping & Analysis R&D*

OBIS-SEAMAP
- International marine biodiversity data archive

iOBIS
- Marine biodiversity data archive

OBIS-SEAMAP Niche:
- Protected species data / tools
- Telemetry / tracking data
- Passive acoustics
- Spatial Decision Support
- Mapping & Analysis R&D*

2,625
Thousands
310 datasets
1935 – 2011
>2,625,000 records

Day 1 - 12 July 2011
Presentations/Information Management and Data Sharing Products Panel
OBIS-SEAMAP supports multiple data types

- Ship & aerial surveys
- Telemetry tracking
- Acoustic
- Colonies & sites
- Models
- PhotoID
- Genetics

Passive acoustic data in OBIS-SEAMAP

New NOPP / NSF funding: “Expansion of metadata management, visualization and data processing functionality of OBIS-SEAMAP for passive acoustic monitoring data”

Objectives of the new project
- To expand the existing metadata standards to incorporate Passive Acoustic Monitoring (PAM) specific elements
- To improve OBIS-SEAMAP visualization features for PAM data
- To facilitate data / metadata exchange between acoustic data portals (partnerships with NOAA NEFSC, Cornell Lab of Ornithology, Scripps, San Diego State)

A sample of the proposed date-hour plot

Observation data in OBIS-SEAMAP

The inclusion of survey effort (tracklines) and additional attributes is essential for the development of statistical models of density or habitat preference.

- Observation data
- Survey effort data
- Survey metadata
- Links to species pages
- Links to data providers

Telemetry data in OBIS-SEAMAP

- Movement of individual animal
- Animation of movement
- Movement of multiple animals in an area of interest within a defined time period

Passive acoustic data in OBIS-SEAMAP

- Various acoustic data types
- Fixed sensors with jittered sensor locations
- Towed array with ship tracklines

Newly-funded DCAF datasets are in the final stages of approval for publishing through OBIS-SEAMAP.

Turtle nesting data in OBIS-SEAMAP

New approach ties genetic research with nesting site data

DNA sampling sites along with nesting sites (both are downloadable)
Community-oriented expansion of OBIS-SEAMAP

- Started for Mid-Atlantic Bottlenose Dolphin Catalog
- Provides an online scientific workflow for fin matching processes

Building common framework to incorporate other PhotoID catalogs

Initial application for MABDC

New interface for MABDC built on the common framework

Same framework applied to PIPIN (Spinner dolphins in Hawaiian waters)

Model outputs presented with original data (including effort)

Critical habitats evaluated with ROC analysis

Queries by regions of interest

Note: in support of the NOAA Cetacean and Noise CetMap project, we are currently revising the Atlantic and GoMex density models

Queries can be calculated against pre-defined areas (e.g. Navy operation areas)
Data needs for renewable energy siting & permitting

Observation data

Habitat / Density models

Access to “raw” observation and survey effort data

Access to fully documented habitat & density models

Working on new collaborative ventures to incorporate high resolution data collection into the information and modeling process

Proposed imaging system (at left, blue plane) with 16-camera image gathering configuration, 1 km survey width, and 1.3 km survey altitude. Red plane represents current standard position in European surveys; (offshore 450-600 m; 500 m altitude for higher resolution). Green plane represents observer-based aerial survey design (e.g. AMAPPS) (altitudes 50-150 m). (from Normandeau Associates 2011)

Take-home Messages

• OBIS-SEAMAP is the protected species observation data & modeling node of the larger OBIS information network;
• OBIS-SEAMAP specializes in R&D for the synthesis and analysis of marine biological data for applied science and management uses;
• The OBIS-SEAMAP team is very interested in formally coordinating our work with emerging DOI / BOEMRE wind energy initiatives in the Atlantic Coast region.

Thank you
The Multipurpose Marine Cadastre
A Tool for Planning & Decision Making in the Marine Environment

Christine Taylor
Bureau of Ocean Energy Management, Regulation and Enforcement
Brian Smith
National Oceanic and Atmospheric Administration (NOAA)
Coastal Services Center

MMC Summary

Overview of Layer Use and Tools

Why is the Multipurpose Marine Cadastre Valuable?

- Improves coordination and decision making
- Venue to resolve and modernize boundaries
- Venue for new data
- Relevant to all ocean planning issues
- Reduces data costs for users

Who’s Using the Multipurpose Marine Cadastre?

- Bureau of Ocean Energy Management, Regulation and Enforcement
- NOAA National Information Management System (TBD how)
- Regional Ocean Councils – NROC, MARCO
- NOAA – Fisheries, ERMAs
- Energy Industry
- Policy Makers
Day 1 - 12 July 2011
Information Management and Data Sharing Products Panel

Multipurpose Marine Cadastre
Data Themes

- Jurisdictional Boundaries
- Federal Agency Regions
- Federal Conregulations
- Navigation & Marine Infrastructure
- Marine Habitat & Biodiversity*
- Human Uses*
- Physical and Oceanographic Basemaps

* Denotes significant gaps in data

Data We’re Working On

- Marine Mammal Data
- Turtle Data
- Avian Data
- NavyNGA Areas
- Raster Nautical Chart background.
- Selected State planning data
- AIS tracks and hotcold maps
- Hurricane and extra-tropical storms
- IOOS data collector locations
- Environmental Studies Footprints with links to studies.
- TNC NAMER – selected layers
- Special Mashups in ArcGIS Online – Map Gallery on MMC

Improvements for the Near Future

- Enhanced and new data sets
- Improve current tools, and provide new tools based on user feedback (reporting, select by, add WMS, etc)
- Links to data not available on the viewer (too complex for the viewer)
- Links to other similar portals
- Community of practice (standards, how to’s, etc)
- Links to other Decision Support Tools
- AIS converter and specialized output tools (stand alone for ArcMap users)
- Special apps – provided by ESRI

Looking Forward...

ESRI – Developing an online decision support tool for assessing site suitability in the marine environment.

Going Regional - Support the development of regional CMSP. 8 planning bodies.
- Data, Tools, Templates, and Tech Support
History

The Federal Geographic Data Committee Marine Boundary Working Group was formed in 2001 to address a number of issues pertaining to legal and technical aspects of marine or maritime boundaries. As co-chairs of the Marine Boundary Working Group, the NOAA Coastal Services Center and the Bureau of Ocean Energy Management, Regulation and Enforcement worked with other partner agencies to create the original implementation plan, elements of which later served as building blocks of the Multipurpose Marine Cadastre.

About the Multipurpose Marine Cadastre

The Multipurpose Marine Cadastre (MMC) data viewer is an integrated marine information system that provides legal, physical, ecological, and cultural information in a common geographic information system (GIS) framework. In particular, the MMC is beneficial to those involved in coastal and marine spatial planning efforts that involve finding the best location for renewable energy projects. Users pick the ocean geography of their choosing and quickly see the applicable jurisdictional boundaries, restricted areas, laws, critical habitat locations, and other important features. With the MMC, potential conflicts can be identified and avoided early in the planning process. The MMC is also a helpful tool in the permit review process. All organizations considering an offshore activity can benefit from this comprehensive, visual approach to data analysis.

Audience

This tool is used by federal regulatory agencies and others who are screening renewable energy sites and other offshore activities. The tool is also being used by people working on regional and state coastal and marine spatial planning efforts.

Contacts:
Christine Taylor, Bureau of Ocean Energy Management, Regulation and Enforcement
Christine.taylor@boemre.gov  703-787-1606

David Stein, Coastal Services Center, NOAA
Dave.stein@noaa.gov  843-740-1310
Site Assessments and Environmental Monitoring for Offshore Windfarm Design, Construction, and Operation

FISHERMEN’S ENERGY, LLC – LESSONS FROM THE FIELD
Aviv Goldsmith, Managing Director of Development

ATLANTIC WIND ENERGY WORKSHOP
July 12-14, 2011
Myrtle Beach, South Carolina

Fishermen’s Energy
- A community-based offshore wind developer
- Formed by principals of the New Jersey fishing companies to enable the fishing industry to participate in and invest in offshore wind energy
- Presenting a constructive program for alternative uses of waters off the East Coast
- Agents of Change rather than Victims of Change
- Extending participation to fishing and maritime industry participants from Maine to South Carolina

Fishermen’s Energy Investors are principals of the fishing industry

www.atlanticcapes.com
www.lundsfish.com
www.esst.com
www.seawatch.com
www.thelobsterhouse.com
www.seawatch.com

Cold Spring Fish & Supply Co.
Atlantic Shellfish
Dock Street Seafood
Truex Enterprises
Foxy Investments

Fishermen’s most advanced project is a 25 MW windfarm, 2.8 miles east of Atlantic City, NJ

Fishermen’s Atlantic City Wind Farm, LLC
12m water depth
6 turbines parallel to shore
90m to hub, 499 feet to tip height (for FAA)
Electricity to power 12,500 homes
Start construction in fall 2011; commission project in fall 2012
1st offshore windfarm in the US

350MW Project in Federal Waters

6 Turbine - State Waters Project
Fishermen’s Atlantic City Wind Farm, LLC

Day 1 - 12 July 2011
Presentations/Developers Panel
Data collection and site assessments to support:

- **Electrical Generation**
  - Wind speeds and shear to calculate output of turbines

- **Engineering / Structural Design**
  - What are the expected wind, wave, and current loads (average and extreme)?

- **Environmental Impact Studies**
  - Presence of birds, bats, marine mammals and condition of habitat and benthic communities
  - Risk assessments to living resources

- **Construction Planning**
  - Quantify weather windows for construction
  - Adequately budget for weather contingency

- **Maintenance Planning**
  - Turbine seasonal accessibility

All impact project costs, ability to permit, and overall viability of wind farm

---

**Required Data Types**

- **Oceanographic** – waves, currents, tide
- **Meteorological** – wind, air temp, baro pressure
- **Geophysical** – sonar imaging, magnetometer, sub-bottom profiling
- **Geotechnical** – drilling to measure sub-bottom characteristics and properties
- **Living Resources** – benthic, fisheries, avian, turtle, and marine mammal studies

---

**Project Area Data Sources**

- **Historical data**
  - Publicly funded research and studies
  - Commercial fishery effort / VMS data
  - Contracted desktop studies

- **Real-time Data in the public domain**
  - NOAA data buoys
  - PORTS and NWLON data

- **Project Specific Field data collection**
  - Initiated during Spring 2010

---

**Living Resources - Boat Transects for Species Surveys**

- Start May 2010 - weekly pre, during, and post construction

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**October 2010 - Avian Radar on Steel Pier monitoring for 25MW State Waters Project**

- Provides near surface wind data for extrapolation to hub height
- Real time data transmissions to shore
- Bankable report for full year being compiled
December 2010, Installed Monitoring Buoy #2

- Wind, current, wave and wildlife sensors
- Bottom mounted AWAC with acoustic telemetry to buoy

Acoustic Monitoring – Buoy #2

Wave data from Buoy #2 AWAC

System health data from Buoy #2

Geophysical Surveys – 2010-11

Multibeam bathymetry of turbine field and cable route

Geophysical Surveys – 2010-11

Side Scan sonar imaging of turbine field and cable route
Next Phase - Wind Resource Assessment:
Innovative Approach - Research Partners

- Fishermen’s Energy
  - Garrad Hassan for validation and certification
- NJ BPU
  - Co-funding
- Academic Institutions
  - Stockton College
  - Rutgers University
  - Stevens Institute
- USCG
- NREL
- AXYS Technologies
- Lockheed Martin

Wind Resource Assessment: Program Validation

- Both Floating vertical LIDAR and Horizontal scanning LIDAR will be validated for offshore wind assessment
- Technologies have the potential to lower the capital needed to develop an offshore wind project
- Using land-based met towers and buoy resources uniquely available for Block 6931, these innovative technologies can be calibrated and verified

Innovative Wind Assessment Program

- Block 6931
  - AXYS Technologies – deploy August 2011
    - Nomad Buoy – Wind Sentinel Vertical Lidar – Catch the Wind Vindicator
    - Woods Hole Group NOAA Style Met Buoy
  - Margate – Roof of Building
    - Lockheed Martin – deploy September 2011
    - Wind Tracer Horizontal Lidar – 25km radius
- Additional Control Validation data
  - Woods Hole Group NOAA Met Buys at State Water Site
  - ACUA – Jersey Atlantic Wind Farm
  - Three 60 meter shore based met towers
AXYS Buoy to be deployed in August 2011 to commence validation

- AXYS Wind Sentinel, LIDAR wind profiles to 150m
- Near surface winds, Aquadopp current profiler, TriAXYS waves

Fishermen’s Site Assessment Objectives for 2011-12

- Continue operation of Buoys #1 & 2. Collect multi-year time series of wind, wave, current, and wildlife data
- Install buoy based vertical LIDAR, wave and current measurement system at Federal waters site along with Horizontal LIDAR for 3-year data collection program
- Develop site specific predictions of oceanographic parameters, and two years post construction living resources species surveys to document impact of windfarm on living resources
- Complete State Waters Windfarm

Thank you

Fishermen’s Energy looks forward to working together with all stakeholders ....

..........Fishermen, Local, State & Federal Agencies, Environmental Groups, Equipment Manufacturers and all of society

.....to responsibly develop and manage the offshore natural resources along the east coast!
Environmental Studies and Monitoring for Offshore Wind Energy

Atlantic Wind Energy Workshop
July 12, 2011
Aileen Kenney, Director of Permitting: akenney@dwwind.com

“Over the horizon wind”
- Reduced visibility. Locate 15-20+ miles offshore to avoid controversy.
- Proven technology. Use jacket foundations to build in deep water.
- Stronger wind resource. Deep water sites are more energetic.
- Economies of scale. Build bigger projects to achieve lower cost.
- Results in Regional Energy Centers. Providing jobs and clean power to entire regions, not just individual states.

Regional Project Portfolio

- New England Region
  - Chosen as the preferred developer for an offshore wind project in New England
  - Memorandum of Understanding with DEP and DOE to develop offshore transmission infrastructure and provide energy
- Greater New York Region
  - Comprehensive detailed site suitability studies on multiple sites
  - Developing offshore transmission infrastructure to form regional energy center
- Southern New Jersey Region
  - Chosen as the preferred developer
  - Partnership with PSEG – Garden State Offshore Energy (GSOE) to form a regional transmission network (NY and NJ)

Typical Studies and Associated Technology

- Meteorological
  - Need: estimates of long-term site-specific wind speed for design and financing
  - Challenge: conventional monitoring devices – mechanical and sonic anemometers – have significant limitations in offshore applications
  - Surface buoys not stable enough to generate reliable long-term data
  - Meteorological tower on fixed platform is very costly and slow to develop
  - State-of-the-Art: many new technologies show promise for offshore wind resource assessment
    - Scanning Light Detection and Ranging (LiDAR) affixed on a spar buoy
    - Pulse LiDAR or SoDAR (Sound Detecting and Ranging) on a surface buoy
    - Regional land-based data synthesized using a Meso-Scale Met Model

- Avian and Bat
  - Avian Radar: provides an assessment of migration; spatial and temporal occurrence patterns
  - NEXRAD (Next Generation Radar): U.S. National Weather Service network; provides landscape-scale regional migration trends
  - Ship based surveys: used to assess species composition, abundance and distribution
  - High definition aerial videography/photography surveys: innovative technology that provides temporal and spatial data on the avian species and marine mammals in the Project Area
- Oceanographic
  - Acoustic Doppler Current Profiler (ADCP) to collect current profile, wave height, wave direction
  - Conductivity, Temperature and Depth Logger (CTD) to collect salinity, conductivity, temperature and depth

Deepwater Wind Credentials

- Selected through a competitive solicitation by Rhode Island to be the state’s preferred developer of offshore wind, and partnered with the largest utility in New Jersey (PSEG) to form Garden State Offshore Energy, the state’s preferred developer of offshore wind.
- Our management team includes: CEO Bill Moore, who led the development of the 322 MW Maple Ridge wind farm, the largest wind farm east of the Mississippi, and Chris van Beek, recently Chief Operating Officer of Hereema, one of the most established marine construction firms worldwide, responsible for tens of billions of dollars of offshore construction
- Our principal investor is the D. E. Shaw Group, a $19b investment firm with extensive experience in the energy sector. Since the D.E. Shaw Group’s investment, First Wind has grown to an expected 700+MW of installed capacity by 2011
- We have an exceptional advisory board consisting of representatives from the D. E. Shaw Group, First Wind, and a strong line-up of independent directors:
  - Tony Maggs, former Group VP for Technology of BP and co-chair of the MIT Natural Gas Study
  - Spencer Abraham, former Secretary of Energy and Michigan Senator
  - Stephen Key, former CEO of ConAgra and Textron
  - Paul Gaynor, CEO of First Wind

Hereema, one of the most established marine construction firms worldwide, and a regional transmission network (NY and NJ)

Hereema, one of the most established marine construction firms worldwide, and a regional transmission network (NY and NJ)
Typical Studies and Associated Technology

- **Geophysical Surveys**
  - *Hydrographic survey* to determine water depths and general bottom topography in the study area
  - *Seafloor mapping* to identify natural and man-made acoustic targets resting on the bottom and any anomalous features
    - **Technology:** Side Scan Sonar, Multibeam Sonar, Sound Velocity Profiler
  - *Magnetic intensity measurements* to detect ferrous objects on and below the seafloor
    - **Technology:** Magnetometer
  - *Shallow sub-bottom profiler* to map the near surface geologic strata and features
    - **Technology:** High-resolution "chirp" sub-bottom profiler
  - *Intermediate sub-bottom profiler* to map deeper subsurface stratigraphy
    - **Technology:** Boomer profiler system

- **Geotechnical Surveys**
  - Protocols generally use one or more of the following: soil borings, cone penetrometers, and vibracores

- **Fish Assessment**
  - Trawl surveys to provide data on the seasonal abundance of fish in the Project Area
  - Analysis of electromagnetic field generated by power cables in the seabed and potential impact on electrosensitive fish

- **Sound**
  - Collection of baseline data
  - Acoustic modeling and analysis

- **Other studies/assessments:**
  - Visual
  - Navigational Safety
  - Air Emissions
  - Commercial Fishing

- **Marine Mammal and Sea Turtle Surveys**
  - Vessel based surveys
  - Acoustic monitoring
  - High definition aerial videography/photography surveys

- **Marine Benthic and Biological Surveys**
  - Utilizes results of side scan sonar to identify potentially sensitive habitat
  - Remote sampling techniques include videography and still photography

- **Cultural Resources**
  - 3 different types of surveys required: upland archaeological, historic archaeological, and marine cultural resources
  - Marine cultural resources study relies heavily on geophysical remote sensing data including review of magnetic and acoustic anomalies and magnetometer anomalies

**CLEAN ENERGY IS JUST OVER THE HORIZON**
NRG Bluewater Wind

- NRG Energy, Inc.
  - Listed on NYSE (NRG)
  - Market Cap.: ~$6 billion
  - Employees: ~4,600
  - Generating Assets: over 25,000 MW, primarily in four U.S. domestic regions
    - Member of S&P 500
    - Keep the lights on while we repower our fleet with cleaner technologies and increasingly invest in renewables
    - Pursuing and supporting the growth of the electric vehicle ecosystem
    - Own and operate one of the industry’s most diverse generation portfolios (including nuclear, wind, and solar power)
- Leading offshore wind developer
  - Bluewater Wind was acquired by NRG in November 2009
  - Developing the Mid-Atlantic Wind Park, 13 miles east of Rehoboth
    - Project size of 492-518 MW
    - 25 year Power Purchase agreements signed with Delmarva Power and Light
    - Supported by DE Governor and Legislature
  - Own and operate one of the industry’s most diverse generation portfolios (including nuclear, wind, and solar power)

NRG Bluewater Wind is leading offshore wind developer in the U.S., with a focus on clean energy solutions. Their project in Delaware is a prime example of their commitment to sustainable development and renewable energy. This project includes a meteorological data collection facility (MDCF) or met tower, which collects crucial data for wind and avian information. The met tower will be approximately 16 miles offshore and in about 30 feet of water.

Met Tower Permits

- Four permits and a BOEMRE Project Plan required prior to construction:
  - EPA/DMRREC Air permit: August 20, 2010
  - NOAA Incidental Harassment Authorization: secured for 2010 construction season
  - Army Corps Nationwide Permit 5: December 29, 2010
  - Coast Guard Private Aids to Navigation: to be secured prior to construction
  - BOEMRE Project Plan: to be submitted

Survey Work Completed

- Geophysical and geotechnical (G&G) in Delaware and New Jersey IP lease blocks
- Marine archaeological reports
- Biological resource reports
Lessons Learned

- G&G is expensive to mobilize and possibly the most important survey information for met tower construction
- Timing survey work, permits and construction can be tricky
- Offshore wind activities are new to most agencies
- Relative lack of metocean information on the Atlantic OCS versus the Gulf of Mexico

Thank you.
For more information contact:
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Director of Permitting
NRG Bluewater Wind
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A Big Step Toward Energy Independence

July 12, 2011
Kris Ohleth

AWC project overview

- AWC addresses the basic challenge of juggling variable load and variable production of a product that cannot be stored.
- Mid-Atlantic critically congested area
- Deliver wind energy efficiently
- Strengthen the regional grid
- 5 project phases
- Two independent circuits
- Up to 7,000 MW of capacity

AWC transmission system components

- Pushing the technical envelope with a multi-terminal HVDC network
  - Buried transmission cable
  - Terrestrial converter stations
  - Offshore converter hub platforms

High voltage direct current (HVDC) technology

- Interconnected wind farms and converter electronics allow us to balance the variability of offshore wind with conventional power resources
- HVDC technology provides controllability of power flows – meaning that we can direct power to grid connection points where it is most valuable or most needed to support reliability

AWC modeled offshore wind energy production costs

- AWC hubs should be close to where wind farms will likely be built.
- The yellow areas are lower cost.
- Given current turbine sizes and cost, water depth drives projects towards the coast.

“Local roads or an interstate highway network?”
Planning ahead to avoid obstacles will save ratepayers money in the long run

“Awards are late”
Unless we get coordination between offshore and onshore right, the investment overall will be much higher than it needs to be.”

- Steve Holliday, CEO, National Grid

Adequate infrastructure makes progress efficient by helping to avoid uncertainty, expensive delays and suboptimal solutions.

Let’s build offshore wind right from the start!

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Day 1 - 12 July 2011
Presentations/Developers Panel
1. Use Conflict
   - Shipping Lanes / Navigational Channels
   - TSS
   - Submarine Cables
   - Dumping Grounds
   - Fish Havens / Shellfish Harvest & Management Areas
   - Dump Sites

2. Air Space Designation
   - VA Capes Operating Area
   - Other Space Designated by FAA & NOAA & NAVY as prohibited, restricted and warning

TIER I: uses and conditions that preclude, wind farm development

TIER II: uses and conditions that influence, but do not preclude, wind farm development

Project Status:
AWC has filed with BOEM to obtain cable ROW and hub sites

AWC Timeline
- Regulatory, permitting, and planning - in process
  - FERC rate treatment
  - BOEM environmental review and permitting
  - State environmental review and permitting
  - PJM transmission planning process
- Notice to Proceed (Phase A) - 2013
- Commercial Operation Date (Phase A) - 2016
- Other phases built on 1-2 year intervals thereafter

Coordinating with wind developers
- Critical to the success of our project
  - Increasing efforts to coordinate
- AWC project can be integral component of the offshore wind industry
  - Offshore wind at scale and drive down costs
- Site cables at perimeter of WEA
  - Fewest cable-crossings as possible
  - Best locations for offshore hubs to service wind farms

Consulting with regulators
- Critical to the success of our project
- What the regulators and agencies do has profound impact on the industry
- Appreciate the time and opportunity that have already been given to the AWC project
Kris Ohleth
Atlantic Wind Connection
(240) 396-2567
KOhleth@AtlanticWindConnection.com
BOEMRE’s Technology Assessment and Research (TA&R) Program

TA&R Program Overview

- Established in 1970’s
- Ensure use of Best Available and Safest Technologies (BAST) required through the OSC Lands Act Amendments of 1978
  - Focus on:
    - Operational Safety
    - Protection of the Environment

Primary Objectives

- Technical Support
  Providing engineering support to the Bureau decision makers in evaluating industry operational proposals and related technical issues.
- Technology Assessment
  Investigating and assessing industry applications of technological innovations and promoting the use of BAST in Bureau regulations, rules and operational guidelines.
- Research Catalyst
  Promoting leadership in the fields of operational safety and pollution prevention in offshore energy extraction activities.
- International Regulatory Support
  Providing international cooperation for Research initiatives to enhance the safety of offshore energy extraction activities and the development of appropriate regulatory program elements worldwide.

Tasks:

1. Identify any gaps and/or overlaps in jurisdictional authority.
2. Identify unique risks to worker safety in renewable energy operations, as compared to oil and gas operations on the OCS.
3. Provide recommendations on how the existing 30 CFR 285 regulations need to be enhanced to provide for worker safety in renewable energy operations on the OCS.


API RP-2A does not address:

- Turbine-specific design load cases
- Wind fatigue loading
- Soil-structure interaction for large diameter piles
- Grouted connections carrying significant moment load

Approach of IEC 61400-3:

- Comprehensive set of design load cases for turbine support structure
- Uses a Partial safety factor format
- Does not address structural capacity
- Does not provide regional environmental data
- Refers to other codes for turbine machinery & design checks

External conditions: Wind

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<th></th>
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<th>IEC 61400</th>
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<td>Hub height</td>
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<tr>
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<td>Log</td>
<td>Exponential</td>
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<tr>
<td>Turbulence</td>
<td>Log law</td>
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<td>Turbulence</td>
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<tr>
<td>Oust specification</td>
<td>Stochastic</td>
<td>Stochastic &amp; Deterministic</td>
</tr>
</tbody>
</table>

MHK Studies conducted:
• Standards were reviewed and recommended for further consideration.

• Hardware was investigated and classified into subsystems.

• Gaps were identified and research recommended.

• Existing inspection methodologies applied to oil and gas were identified for their potential application to wave and current energy conversion on the OCS.

Criteria & Standards: Wave & Current Energy Generating Devices

Tom Hudon & Jared Dabling, PCCI
George Hagerman, Virginia Tech ARI

Step 1 – Find Device in Taxonomy

Step 2 – Find Applicable Criteria

Step 3A – Obtain Details for Design

Step 3C – Obtain Details for Operations

Note: Maintenance and exploitation of certificates is subject to the design and operational requirements of the system.
Day 1 - 12 July 2011
Presentations/Technology Assessment & Resource (TA&R)

636 - Characteristics, Behavior and Response Effectiveness of Spilled Dielectric Insulating Oil in the Marine Environment

648 – Offshore Wind Decommissioning Costs

Questions?
Purpose of Research

- Wind turbine farms on continental shelf
- Large offshore construction activity
- High underwater noise levels – impacts on marine life
- Pile driving is source of highest noise levels
- Must identify feasible, cost effective noise mitigation for pile driving noise

More Context for Research

- Construction noise far worse than operational noise
  » Primarily due to pile-driving
- Pile driving impulsive
  » Up to 30 to 60 pulses per minute
  » Very high peak sound pressures
  » > 200 dB re 1uPa at 30 meters
- Broad band of frequency content, peak levels at 100 Hz to 1 kHz
  » Low frequencies - difficult to mitigate
- Construction noise propagation
  » Tens of kilometers at potentially disruptive levels
- Incorrect notion: construction temporary, sea life will repopulate
  » Critical disruptions, such as spawning, can cause drastic harm
- Securing construction during critical marine life activities infeasible
  » Could substantially increase construction duration and cost

Technical Approach Outline

Scenario
  - Shallow water typical of Mid-Atlantic continental shelf
  » 15m/30m deep, sand/silt and sand/clay bottom layers over bedrock
  - Large monopiles - dimensions determined as part of tasking
  » 5.5m/7.5m diameter, 42m/65m long
  - Metric: transfer function (underwater noise normalized by force input)

Goals of Study
  - Rank contributions of different acoustic paths
  - Assess mitigation options against untreated baseline
  - Develop recommendations for further development, testing and evaluation

Methodology
  - Radiation from Structure: high fidelity multi layer waveguide transmission line model for the Navy
  - Airborne Transmission: also use multi layer waveguide model
  - Seismic: coupled seismic / fluid model using OASES (H. Schmidt of MIT)
  » Input source strengths derived from multi layer waveguide model for both fluid and bottom layered boundaries
**Analysis Cases**

**Treatment Configurations**

- **Case 1**: Baseline monopile representing air, water, and soil boundary conditions.
- **Case 2**: Baseline with addition of a bubble screen with 5% volume fraction.
- **Case 3**: Baseline with addition of a bubble screen with 5% volume fraction.
- **Case 4**: Baseline with addition of a 2.5 inch thick closed foam compliant layer external to the pile.
- **Case 5**: Baseline with addition of a 4 inch thick closed foam compliant layer external to the pile.
- **Case 6**: Baseline with addition of a 8 inch thick closed foam compliant layer external to the pile.
- **Case 7**: Bare pile with a dewatered cofferdam, inside of pile filled with air.
- **Case 8**: Bare pile with a dewatered cofferdam, inside of pile filled with water.
- **Case 9**: Bare pile with a dewatered cofferdam, inside of pile filled with mud.

**Case Study**

- **Baseline Cases 4-6**: Compliant treatments.
- **Cases 7-9**: Dry cofferdam.
- **Cases 2-3**: Bubble screen.

---

**Assessment of Sound Transmission Paths**

1. **Structureborne radiation**: dominates underwater noise for nearly all cases.

2. **Seismic propagation**:
   - Not significant for untreated case, where seismic contribution is 10-30 dB below combination of all paths.
   - Is limiting factor on the overall effectiveness of treating the structureborne radiation path.
   - With bubble screen or compliant layer treatments, seismic path is contributing at some frequencies.
   - With dewatered cofferdam installed (most effective treatment), seismic path is controlling at most frequencies.

3. **Airborne transmission**:
   - Not a significant contributor to underwater sound in any case.
   - Even with cofferdam, the airborne path contribution is 50 dB or more below the combination of all paths.

---

**Evaluation of Sound Mitigation Options**

1. **Bubble screen**: predicted to reduce noise levels approximately 10 dB.
   - Variation of air volume fraction 2.5% to 5% does not significantly affect this result.
   - Note that currents will severely degrade bubble screen performance.

2. **Compliant surface treatment**: predicted to reduce noise levels approximately 10 dB.
   - Varying treatment thickness 2 inches to 8 inches affects performance at some individual frequencies, but does not significantly affect the overall result.

3. **Dewatered cofferdam**: predicted to reduce noise levels approximately 20 dB.
   - Water pumped from annular region between the cofferdam and pile (may require continuous operation).
   - Bulk of water pumped (may require continuous operation).

---

**Ongoing Work**

- **Phase 2**: BOEMRE sponsored effort to develop and evaluate specific noise mitigation concept designs
  - Enable building prototype for validation
  - Accommodate requirements/restrictions of offshore process for installing piles
  - Usable by industry to mitigate pile driving noise as part of overall installation plan

---

**Cofferdam Design**

- Focus on cofferdam
  - Found to be reasonable approach
  - Best acoustically
  - Most robust in offshore environment
  - Specific concept design being documented

---

**Concept of Operations**

- Turbine installation vessel (TIV) with dynamic positioning and jack-up capability
- Views of pile & cofferdam assembly deployed from false rotary on TIV
Recommendations to Move Forward

- Solicit comments at workshop and refine design and operational concept as necessary
- Build and test prototype
  - Identify offshore pile installation for testing
  - Refine concept design drawings as required to develop producible construction drawings for selected pile
  - Conduct model runs to verify construction drawings meet acoustic requirements
  - Fabricate cofferdam
  - Install and conduct acoustic testing - compare cofferdam-enclosed to untreated pile driving

Outline of Study

Goals of Study
- Establish relative ranking of the contributions of different paths to sound transmission and propagation from pile driving activities
- Determine the limiting factors/contributors to noise mitigation performance
- Assess a range of basic mitigation options against a baseline untreated case
  - Overall performance and limiting factors
  - Ideal performance cases
- Flexible engineering concepts
- Develop recommendations for further development, testing and evaluation of approaches

Assumptions
- Emphasis on large monopile installation scenarios
- Dimensions determined as part of testing
- Shallow water typical of Mid-Atlantic continental shelf
  - 15m and 30m deep
- Sandflat and sand/silt bottom layers over bedrock (based on Mid-Atlantic data)
- Consider impact of flat and sloping bottom geometries
- Performance metric - transfer function (resultant underwater noise normalized to a force input magnitude of 1 pound, directed axially at the top of the pile)
  - Enables direct comparison of component noise paths and different treatment options
  - Common basis for comparing analysis cases that are valid for any input force magnitude

Previous Examples of Mitigation Designs

- Many examples of past attempts to mitigate pile-driving noise in the literature
- Little documentation of any pre-test predictions of performance or analyses that support the concepts
  - "Intuitive Engineering"
- Past Examples
  - Source treatments include cushion blocks on top of the piling where the hammer strikes
    - Various materials have been used
    - Limited performance at a price including decrease of the impact force, deterioration of the cushion blocks, and (in the case of wooden blocks) combustion of the blocks
  - Treatments for transmission mechanisms include bubble curtains (constrained and unconstrained), thin layers of foam and cofferdams
    - Bubble curtains ineffective in currents (bubbles swept away)
    - Often not always reduces levels, varied performance / too high or too low frequency
    - Performance often noted at "high frequencies"—above frequency range of maximum noise levels

On the right track but lacking an understanding of the physics

Noise Mitigation “101”

- Fundamentally - Two options for reducing noise
  - Reduce the source (reduces force imparted to the pile)
  - Treat the transmission path
- Damping (reduces vibration amplitude)
- Decoupling (isolates the pile from the fluid)
  - Decoupling performance begins above resonance between stiffness of the compliant material and mass loading of the fluid
  - Achieving performance in a target frequency range requires “tuning” the stiffness of the treatment
- Different Materials, Modulus / Volume / Thickness
  - Rubber / foam (Thickness, Modulus)
  - Bubbles (bubble fraction / size)
  - Air bladder (Volume / Pressure)
  - Open air (Volume)

Our Overall Approach

- Address the path
  - Demonstrate the ability to predict performance of multiple configurations
  - Assess relative contributions of different source/path combinations
  - Develop appropriate mitigation concepts based on understanding of the controlling physics – “Tuned” to the right frequency band
    - Assess different material options & configurations to achieve performance in the 100 Hz – 1000Hz frequency band
    - Requires very high compliance (low stiffness) treatment
- Predict mitigation performance & limiting factors
- Develop recommendations for moving forward with testing and design development of promising concepts
**Modeling Approach**

**All Paths Considered**

**Structureborne Radiation**
- Use high-fidelity multi-layer waveguide transmission line code APS developed for the Navy
- Computationally efficient & rigorous
- Ideal for "layered" cases (e.g. layered treatment)
- Automatically determines what waves are generated and how they radiate to the environment for a given input
- Fluid
- Seismic

**Airborne Transmission**
- Also uses multi-layer waveguide model
- Limited by critical range of angles – most sound in air reflects off water surface or is lost in bottom

**Fluid & Seismic Propagation**
- Coupled fluid / seismic propagation model using OASES code developed by Henrik Schmidt of MIT
- Input source strengths derived from multi-layer waveguide model for both fluid and bottom layered boundaries

**Environmental Parameters**

- Representations of Mid-Atlantic region, based on the Army Corps of Engineers Draft Environmental Impact Statement sections 5.1.1.1 and figures 5.1.2 and 5.1.3
- Material parameters are based on Hamilton (1982, 1985) (also in Computational Ocean Acoustics table 1.3)
- Core samples contain many layers of similar acoustic composition. Acoustically similar layers are consolidated in the model.

<table>
<thead>
<tr>
<th>Water</th>
<th>Sand/Silt</th>
<th>Sand/Clay</th>
<th>Bedrock</th>
</tr>
</thead>
<tbody>
<tr>
<td>cp=5250 m/s, cs=2500 m/s</td>
<td>cp=1613 m/s, cs=95(z-9)0.3 m/s</td>
<td>cp=1575 m/s, cs=105(z-9)0.3 m/s</td>
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<tr>
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<td>p=0.5 dB/λ</td>
<td>p=0.9 dB/λ</td>
<td>p=0.2 dB/λ</td>
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<tr>
<td>z=0m</td>
<td>z=9m</td>
<td>z=27m</td>
<td>z=35m</td>
</tr>
</tbody>
</table>

**Pile Construction**

Not to scale

- **Airborne Transmission**
  - Critical duct normal angle which permits Airborne transmission into water
  - Reflection at bottom which is required for long range propagation

- **Structureborne Radiation**
  - Maximum shear speed on insertion loss
  - vp=0.1 dB/λ

- **Environmental Parameters**
  - Note the dependence of noise level on depth z (in meters)

**Analysis Flow – Radiation into Water and Bottom**

- Generate Equivalent Source Model for Below Water Surface Structures (Replace Wall Velocities with a Distributed Source Array)

**Analysis Flow – Airborne Transmission into Water**

- Equivalent Source Model for Above Water Structure

**Structural Acoustics Model**

- Waveguide transmission line model
- Efficient Full Physics Modeling Tool for Layered Axisymmetric Structures
- Structural acoustic Wave-based formulation
- Rigorously handles internal and external fluid
- Ideal for predicting radiation from pile treatment
Representative plots of sound transmission into the water column resulting from individual paths.

- **OASES** is a numerical propagation code for estimating the acoustic and seismic field (pressure and/or stress) in complex layered waveguides. The OASES code was developed by Dr. Henrik Schmidt of MIT.
  - The waveguide may include fluid (water, loose silt) and/or solid (packed sand, rock) layers each with its own acoustic and seismic properties.
  - OASES captures the coupling of acoustic and seismic energy across the layer boundaries. Thus acoustic sources may lead to a seismic field in the bottom and seismic sources may lead to an acoustic field in the water.
  - Acoustic and seismic source levels will be based on the modeling of the pile using waveguide transmission line models.
- The narrowband pressure and/or power caused by the acoustic and seismic sources may be compared to determine their relative importance.
Outline

- Purpose of Research
- Technical Approach
- Results
- Recommendations to Move Forward

Motivation

How can we avoid this for US offshore wind?

Source: The Copenhagen Post, April 7 2010

Objectives

- Understand current best-design practices
  - What are the vulnerabilities?
  - What hasn’t been considered?
- Identify and evaluate strategies for vibration mitigation and resonance avoidance
  - What can be done to improve the design and reduce risk?
  - What does it mean for those writing standards?
- Evaluate impact of “advanced designs” on structural design
  - What are the additional risks associated with novel concepts?
  - What are the potential benefits?
### Technical Approach
- Compile and assess requirements
- Evaluate forcing mechanisms
- Evaluate resonances
- Assess structural fatigue and ultimate limit states
- Tradeoff study of resonance avoidance concepts
- Assess the impact of potential advanced turbine designs

### System Insights
- Higher resonances unimportant for this canonical wind turbine
  - Dynamic amplification falls off quickly above fundamental mode
  - Forcing mechanisms acting at high frequency have small amplitudes relative to other system sources
- Ambient forcing mechanisms important
  - Gusts & wave action are broadband - potential to excite fundamental mode
  - Important to properly parameterize ambient forces during design process
- Soft-stiff strategy vulnerable to changes in foundation properties
  - Scour reduces static stiffness and can result in excessive rigid-body motion of the support structure
  - Reduction in soil subgrade modulus (stiffness) reduces natural frequency, aligning fundamental resonance more closely with ambient sources
- Aerodynamic damping essential for suppressing fundamental mode

### Summary
- APS has performed a detailed analysis of a reference offshore wind turbine to define and evaluate the period of vibration requirements
  - A computational tool suite was developed to gain physics-based insight into the dynamics of OWT systems
  - Higher frequency resonance interactions were deemed unimportant for the 5MW reference wind turbine
  - Reliance on static foundation properties possibly inappropriate and dangerous
- A set of sensitivity studies were performed
  - Better understanding of the system
  - Roadmap potential ways to relax the period of vibration requirements, achieve resonance avoidance, and mitigate deleterious vibrations
  - Conclusions: importance of ambient forcing mechanisms, strategies to maximize aerodynamic damping
- Promising vibration mitigation and resonance avoidance strategies evaluated
  - Higher fundamental frequencies can be obtained from improved aerodynamic damping
  - Most promising include magnetic gears and breakwaters
  - Identified potential issues with novel concepts, such as floating turbines, jacketed foundations, and vertical-axis turbines

### Recommended Continued Work (1)
1. More thorough investigation of promising vibration mitigation and resonance avoidance strategies and novel technologies
   - Potential candidates include breakwaters and magnetic gears
   - Relate on industry partnerships
   - Identify potential non-technical issues, such as environmental issues and aesthetics, and assess cost-benefit
   - Identify the need for further technological development
   - Development technologies through detailed design, testing, and implementation
2. Validate suite of wind turbine related computational models and tools
   - Integrate APS improvements and insights into FAST and other existing models
   - Support those involved in standards-compliance assessment

### Recommended Continued Work (2)
3. Define more representative reference offshore wind turbine
   - 5MW NREL reference turbine has fundamental natural frequency near 1P
   - A more representative “soft-stiff” turbine would have a fundamental frequency nearer the middle of the 1P-3P range
   - Repeat period of vibration assessment for more representative reference turbine to determine whether 3P interactions become important
   - This effort would be expedited by the already-existing set of tools APS developed and used during the Phase I effort
   - Identify potential methods for mitigating 3P interactions
4. Investigate period of vibration requirements for emerging offshore wind turbine platforms
   - Floating turbines
   - Jacketed foundations
   - Utilize already-existing APS toolkit
   - Provide BOEMRE insights into the structural response and design of these systems before the technology is established
Technical Approach (1)

- Compile and assess requirements
- Evaluate forcing mechanisms
- Evaluate resonances
- Assess structural fatigue and ultimate limit states
- Tradeoff study of resonance avoidance concepts
- Assess the impact of potential advanced turbine designs

Offshore Wind Turbine System

Offshore wind turbines: complex dynamic systems subject to multiple forcing mechanisms

Technical Approach (2)

Forcing Functions
- Aerodynamic
- Hydrodynamic
- Machinery

Coupled Dynamic Response
- Resonance characteristics
- Forced response: deflections, resultant forces & moments

Requires assumptions on wind, ocean, & operating conditions

Requires assumptions on foundation & soil characteristics (e.g., monopile, stiff clay)

Coupled Response
- Requires stresses
- Strength of mats
- FEA models

Key Themes:
- Comparative view of resonance avoidance approaches
- Impact of uncertainties in soft-stiff approach

Design Impact:
- Fatigue
- Ultimate strength
- Practical concerns

Design Practices (1)

Campbell Diagram

- Classical technique for understanding potential resonance excitation
- Offshore wind turbine design practices require that 1P and 3P source frequency does not occur at support structure fundamental resonance over operating band ("soft-stiff")
- What about higher resonances and other sources?

Design Practices (2)

Campbell Diagram

Sparse

Dense

Wind Turbine Resonance Diagram

Design Practices (3)
**Design Practices (4)**

Soft-Stiff Designs Require:

- Larger, more expensive piles and towers
- More difficult installation processes

**Canonical Wind Turbine**

A canonical reference wind turbine was identified to provide context for analyses:

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<thead>
<tr>
<th>Description</th>
<th>Value</th>
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<tbody>
<tr>
<td>Tower Length (m)</td>
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<tr>
<td>Foundation Depth (m)</td>
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<tr>
<td>Water Depth (m)</td>
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<td>Pile Length (m)</td>
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<td>Tower Diameter (m)</td>
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<td>At RNA</td>
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<tr>
<td>RNA Mass (tonne)</td>
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</tbody>
</table>

**Computational Tool Development (1)**

- Key understanding of physics must be leveraged in order to brainstorm and assess potential resonance avoidance and vibration mitigation strategies
- Computational tools are needed to quantify performance of strategies
- APS has developed a suite of computational tools for offshore wind turbines
  - Rely on competencies and experience in structural dynamics, hydrodynamics, propulsor design/analysis, rotating machinery, and METOC
  - Decided against using FAST
- Benchmark against published results wherever possible
  - Resonant tower frequencies agree with FAST
  - Sensitivity to soil & foundation stiffness and damping characteristics consistent with findings of MMI

**Computational Tool Development (2)**

- **METOC Characterization**
- **Structural Dynamics Modeling**
- **Fatigue Life Estimation**

**Insight 1: Higher Resonances**

Fatigue Damage Assessment under Idealized Loading

Higher resonances negligible for fatigue

**Insight 2: Ambient Sources (1)**

Assessment Methodology

- Wave Kinematics
- Morison Equation
- Pile Force

Structural Dynamics and Strength of Materials

Fatigue Damage Assessment
Insight 2: Ambient Sources (2)

Wave Climate

- Wave excitation is extremely important for the fatigue life of the system under certain conditions
- How common are conditions that excite the system into fatigue accumulating vibrations?
- Data collected in NOAA buoy near Block Island

Wave conditions that can excite deleterious vibrations occur often in US OCS

Insight 3: Reliance on Static Properties

Reduction in subgrade modulus reduces stiffness, bringing support structure frequency inline with ambient forcing

Insight 4: Aerodynamic Damping (1)

- Aerodynamic damping
  » Important aeroelastic effect
  » As support structure vibrates, turbine sees oscillatory changes to inflow
  » Results in oscillatory change in drag that suppresses vibration (damping)!
  » What does changing level of aerodynamic damping do to system?
    » Most important for fundamental resonance
    » Rotor doesn’t move as much at higher frequency modes
    » Significant reduction in dynamic amplification

Insight 4: Aerodynamic Damping (2)

- How to maximize aerodynamic damping?
  » Increase motion at RNA
- What does changing level of aerodynamic damping do to system?
  » Most important for fundamental resonance
  » Rotor doesn’t move as much at higher frequency modes
  » Significant reduction in dynamic amplification

Strategies and Advanced Designs

- Potential strategies to mitigate deleterious vibrations and avoid resonance coincidence
  » Breakwaters to mitigate wave forcing
  » Jacketed (truss) foundation
  » Variable speed turbines
  » Floating systems
  » Design impact of advanced wind turbine designs

Gearbox-less Turbines

- 20% of the downtime is caused by gearbox failures
  » Requires an average of more than 250 hours to repair
  » Increasing problems with increasing power
- Direct-drive
  » Use low-speed/high-torque electric generator
  » Heavier, more expensive than mechanical gearbox
- Magnetic gears
  » Emerging technology
  » Potential benefits include overload protection, increased efficiency, improved acoustics, and potential for direct integration with generator

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>Mechanical Gearbox</th>
<th>Direct Drive</th>
<th>Magnetic Gear</th>
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</thead>
<tbody>
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<td>5.0</td>
<td>5.0</td>
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<tr>
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<td>45.1</td>
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<td>Total Cost, million USD</td>
<td>2.4</td>
<td>2.7</td>
<td>2.5</td>
</tr>
<tr>
<td>Total Losses, MWh</td>
<td>763</td>
<td>739</td>
<td>513</td>
</tr>
</tbody>
</table>
**Vertical Axis Turbines**

- SANDIA concludes that unsteady loads on the blades of VAWT are larger than on the blades of HAWT
  - Design is difficult but not impossible
  - Full reversal of blade loading during a rotational cycle
  - Potential advantages for offshore VAWT
    - No 3P source (tower blockage effect less pronounced)
    - Reduced requirements for tower design (blades fixed-fixed)
    - Thin atmospheric boundary reduces need for tall turbines
    - Footprint size is not as problematic an issue at sea
    - Lower center of gravity, smaller overturning moment than an equivalent HAWT implies suitability for floating OWTs
  - Generator is at the bottom, simplifying maintenance and allowing the use of big, heavy generators
  - Inherently omni-directional

**Breakwaters**

- Breakwaters are often used to protect sensitive shoreline and prevent erosion. They can be used to mitigate wave forcing on offshore wind turbines from pile-wave interactions.
- **How it works**
  - Diffracts (redistributes) wave energy
  - Steepens waves, precipitating breaking (dissipation)
  - Morison equation implies reduction in force with reduction in wave particle velocities/accelerations
  - AEGIR used to model wave-pile interactions
  - For 5-second wave, reduction of 20% possible
  - May require deep breakwater
  - Need a better handle on cost-benefit

**Jacketed Foundations**

- Significant increase in stiffness – effectively reducing length of equivalent cylindrical support structure
  - Increase in natural frequency
  - Reduction in aerodynamic damping level
  - Tradeoff between reduced damping level and proximity to ambient sources (wind gusts and wave loading)

**Ducted Turbine Designs**

- Ducted wind turbine systems
  - Also known as diffuser-augmented wind turbines
  - Duct results in larger mass flow through system
  - Allows a reduction in overall turbine diameter of up to 15% for a given power system
  - Generally higher rotation speeds may allow smaller and cheaper direct-drive systems
  - Reduces turbine mass, but potential increase in overall nacelle mass can be expected based on propeller experience

- Several companies, such as FloDesign, are pursuing ducted wind turbines that promise higher efficiencies

**Floating Turbine**

- Floating offshore wind turbines are being explored for use in deep water where traditional pile foundations are not feasible. These floating systems have significantly different period of vibration requirements.
  - Spar platform calculation
    - Shifts structural fundamental frequency to 0.54Hz from 0.25Hz
    - Adds 0.09Hz platform natural frequency
  - Additional platform-dominated resonances complicate avoidance
  - Multiple design approaches complicate general guidelines
What do we Need for Safety?

• What do we know?
  – Look at wind farm accidents
• Provide for a Safety working Culture
  – Safety Management System Template
• Provide for a Safe Structure
  – Guidance on Acceptance of Facility Design Report (stating potential acceptable Standards)

Safety Assurance

Most Companies in offshore oil and gas industry and chemical safety recognize the importance of a formal (written) documentation of the safety requirements for design, installation, and operations.

Encompassing:
  • a Safety Management System:
    – Safety Procedures for Personnel Behavior (e.g. climbing ladders),
    – Safety Operating Procedures (e.g. lockout/tagout, confined space entry
    – Assurance of Competence (Training) of Personnel (e.g. etc.),
    – Associated Procedures e.g. Marine Procedures for Jack-up Vessels on site
    – A Performance Monitoring and Auditing System
      Including Signatures by Sr. Responsible Management
  • Safety Design of Equipment

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      Including Signatures by Sr. Responsible Management
  • Safety Design of Equipment
System of Safety: Template

- Management Commitment
- Access/Egress: disembarking and embarking from boat or helicopter
- Procedures for site assessment of jack-ups
- Working at heights and climbing (including rope access)
- Working in confined spaces
- Material Handling: Lifting operations and equipment/rigging
- Electrocution: HV & MV
- Smoke and Fire
- Moving parts, stored energy
- Lone working
- Diver Safety
- Competence of personnel to safely operate the equipment
- Rescue from heights
- The following of Manufacturer’s procedures when operating the turbines

Overspeed III. Mechanical damages.
Root causes. Bad workmanship. Pitch system.

Due to human interference with the control system of the pitch system the turbine went overspeed. During this one of the blades hit the tower and the whole nacelle broke loose and fell to the ground. Damaged parts. Nacelle, 3 blades, upper section of the tower.


Damage Database

Fire Protection: Mandatory?
Lightning Protection: Mandatory?

Pioneers – some of the issues
Offshore Denmark W.D. 6-14m.
- Since 2002
- Issues with:
  - Cables
  - Lightning
  - Software & Control System (overspeed damaged blades)
  - Standstill marks (8) gearboxes
  - Transformers (insulation defect)
  - Defective Generators (production defects)
  - Quality (blades/ gears etc.)
  - Hydraulic System
  - Secondary Construction
  - Corrosion Protection
  - Terminal Strips (HR 2)

Analysis can lead to identifying
Bearing faults
Coupling Faults
Misalignment Faults
Gear Faults
Unbalance
Support Structure Faults

% Total Failure by Component Type

This is NOT your O&G Platform Risk!
- Geographically Concentrated Risk

- Structural Integrity depends on
  - Tower Strength
  - Battery Backup for Yaw Alignment
  - Control Systems
  - Communications
  - Software
  - Fatigue Resistance of Soil
  - No redundancy

2 Design Approaches
APPROACH: OMNIDIRECTIONAL
Design not sensitive to the changes in the wind direction
API RP2A

APPROACH: STANDARD
Design, which is supported by back-up power supply securing power for the yawing systems

IEC Code Solution: 6-hour Battery

Experience from India!
Tropical Cyclone 03/A destroyed
129 or 40% of the 315 wind turbines

A critical factor in the failures in India is that the grid also failed. Wind turbine manufacturers would be well advised to check that this load case has been included in their design calculations (prior to IEC Code)
Experience from Japan!

When typhoon passed through, the wind direction changes from North to Southwest for 3 hours. From these evidences, these turbines would lose yaw control, then subjected to the side attack of strong gust and broke. This experience shows the importance of wind turbine protection against power failure.

Mission of BOEMRE

“Encourage orderly, safe and environmentally responsible development”

- When is that fulfilled?
  - Blade falls off? Gearbox fails?
  - Many towers fail in one field?
  - Floating wind farms break moorings and “helter-skelter”?
  - When a hurricane knocks out multiple fields all up the East Coast?

Provide: Design of Facility

Suggested suitable standards provided where appropriate

- Primary Structures e.g. Towers and Substation, cables
- Control and Protection Systems (if power req’d for Struct.)
- Accommodation
- Fire Detection and Protection
- Flammable Inventory
- Lightning Protection
- Third Party Equipment (and control)
- Installation Construction and Commissioning Procedures
- Access onto and within the structures
- Emergency Equipment

European System of Approvals?

- IEC Code
- Eur. Accreditation: (ANSI Equivalent) gives Country Acceptance of Certifier
- Certification Bodies Advisory Committee
  - Acceptance of other Cert Body Certs
  - Country Requirements additional
- BOEMRE CVA (traditionally different - similar approach to Germany)
- BOEMRE Submissions
  - English not Metric, Location of docs.
  - ? - Eur steels, Eur welding, Eur Safety Equip. EN50308
- Electrical Standards – EU Not API, UL, IEEE
- USCG has requirements for applicability for Lifesaving/ Firefighting etc.
Adapting IEC

- Fire not dealt with – ADD As Mandatory
- Lightning is state-of-art statements – ADD As Mandatory
- Accredited Certifiers – not a system set up in US for Wind (see ANSI)
- Certification Bodies Advisory Committee – doesn’t exist in US (Turbines are GL, Riso and CIWI) – CVA is a P.E.
- Acceptance of other Cert. Body Certs – legal issues – 20 years?
- Scope of Evaluation identified by supplier/ owner Project basis – CVA.
- Extent of Blade tests- vague; What Lab are they tested in? How many? Who witnesses?
- CERTifier shall verify turbine can be transported according to design
documentation
- CERTifier has to evaluate personnel safety aspects are dealt with appropriately (too vague to certify)
- Design Certification-repeating calculations is costly: must accept Type Approval

• CVA must certify in the Facility Design
• Independent Assessment of Design

- Certification Bodies Advisory Committee – doesn’t exist in US (Turbines are GL, Riso and CIWI) – CVA is a P.E.
- Acceptance of other Cert. Body Certs – legal issues – 20 years?
- Attendance of all Stakeholders required

- CFR Guidance to Design CVA

- Independent Assessment of Design
- CVA must certify in the Facility Design

Report: that it withstands “the environmental and functional loads appropriate for the intended service life”

- Planning Criteria
- Operational Reqts
- Environmental Loads
- Load Determinations
- Stress analysis
- Material Designations

- Scope of Evaluation identified by supplier/ owner Project basis – CVA.
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Survey Activities

1. Parker with Fault
   - 1-year return period storm? - Battery Life 6 hrs? (Japanese Guidelines?)
   - Collision criteria for design?
   - Construction: a 1-year return storm (if > 1 week)?

2. Other Conditions
   - Collision criteria for design?
   - Construction: a 1-year return storm (if > 1 week)?

Submarine Cables for Windfarms

The World Offshore Wind Database, Douglas-Westwood: 192 projects with a total of 698W of capacity, 17000 turbines and US$108 billion of expenditure, including 40,000km of subsea cabling.

Vattenfall UK Offshore Power: The Ormonde Wind Farm: Construction Process For The UK’s First Full Scale 5 MW Offshore Wind Project

Ole Bigum Nielsen - Head of UK Offshore Projects

FUTURE OF OFFSHORE PROJECTS: RISKS

We are heading massive investments in coming years & we need new investors in the business.

- What do investors like?
  - Certainty
  - Confidence
  - Stability
  - Usability
  - Comfort
  - Safety
  - Assurance

- We are in control of:
  - Foundations
  - Worksites
  - Offshore Substations
  - Operations

- We are in control of:
  - Cables (confident by the insurance companies)
  - Cable installation is a big challenge for the business and is where we have to focus
  - There have been a tradition in the business for several years
  - It is the time for a new tradition
Historical Incidents with Cables

<table>
<thead>
<tr>
<th>Country</th>
<th>Item</th>
<th>Consequence</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ireland</td>
<td>Cable fault due to anchor dragging</td>
<td>1 week</td>
</tr>
<tr>
<td>UK</td>
<td>Plough overran the cable</td>
<td></td>
</tr>
<tr>
<td>UK</td>
<td>2 month installation plan took 3.5 months execution</td>
<td>1.5 month</td>
</tr>
<tr>
<td>UK</td>
<td>Cable damage at J-tube</td>
<td>3 months</td>
</tr>
<tr>
<td>Sweden</td>
<td>Currents too strong for cable anchors</td>
<td></td>
</tr>
<tr>
<td>UK</td>
<td>Cable Fault damaged 500 metre in-field cable</td>
<td>4 weeks</td>
</tr>
<tr>
<td>Denmark</td>
<td>J-tube issues caused cable issues</td>
<td></td>
</tr>
<tr>
<td>Denmark</td>
<td>Construction Vessel damaged cable $1m-5m</td>
<td></td>
</tr>
<tr>
<td>Denmark</td>
<td>Terminal Strips</td>
<td>2 months</td>
</tr>
<tr>
<td>Denmark</td>
<td>Bad weather delayed installation</td>
<td></td>
</tr>
<tr>
<td>UK</td>
<td>Burial problem where spud depressions from installation vessel on the cable path</td>
<td></td>
</tr>
<tr>
<td>Sweden</td>
<td>Installation vessel propellor hit rocks/trench filled in/weather deteriorated</td>
<td>2 months</td>
</tr>
<tr>
<td>UK</td>
<td>Cable Repair</td>
<td>5 months</td>
</tr>
<tr>
<td>Denmark</td>
<td>3 accidents with damages of subsea cables</td>
<td></td>
</tr>
<tr>
<td>UK</td>
<td>Soil sampling jackup blown off its legs</td>
<td>3 weeks +</td>
</tr>
<tr>
<td>UK</td>
<td>Installation Barge blown off location - crew rescued</td>
<td></td>
</tr>
<tr>
<td>UK</td>
<td>Transition joint failure on export cable</td>
<td>None</td>
</tr>
<tr>
<td>UK</td>
<td>Moisture ingress required cable repair</td>
<td></td>
</tr>
<tr>
<td>UK</td>
<td>Fairly major scour issues - solved</td>
<td></td>
</tr>
<tr>
<td>Belgium</td>
<td>Cable repair required</td>
<td></td>
</tr>
<tr>
<td>Sweden</td>
<td>Export cable needed to be replaced</td>
<td></td>
</tr>
</tbody>
</table>

Atlantic Wind Energy Workshop 2011
msharples@offshore-risk.net

Scour from Jack-up Leg Holes

Seabed Scour Considerations for Offshore Wind Development on the Atlantic OCS, by Thomas McNeilan and Kevin B. Smith, Fugro Atlantic

Sand Waves

During the construction of the Nuon OWEZ wind farm offshore the builders encountered sand waves up to 4 meters in height in 18 meters of water depth and these moved at the rate of 6 meters per year.

Exposing buried cable

This photo of sand interacting with waves off Hawaii, may give some visual appreciation of the issue of sand wave and movements.

Regulation

• § 30 CFR 285 the gathering, transmission and distribution cables are considered part of the Facility – 200 ft wide swath
  – Location, design, installation, testing, repair, exterior corrosion protection, inspections, and decommissioning…….
• No exclusion zone for cables (as of now)
• Cable vessels can be foreign flag
• Europe has fisherman awareness programs
  If damaged it may be owner’s risk – Is it different than pipelines?

Key steps in Planning

• Route Selection
  – Tools to Determine Site Parameters
  – Tests on the soil/
  – Navigation Risk and Burial Risk Assessments
• Installation – vessel and equipment
• Cable Protection
• Cable Design and Suitability

Cables: AC, HVAC, HVDC

<table>
<thead>
<tr>
<th>Water depth:</th>
<th>Armored size</th>
<th>Armor direction:</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>cable coil direction</td>
<td></td>
</tr>
<tr>
<td>Double armor:</td>
<td>maybe non-coiling</td>
<td></td>
</tr>
<tr>
<td>Armor:</td>
<td>Rocky areas</td>
<td></td>
</tr>
<tr>
<td>Diameter of cable:</td>
<td>must fit vessel</td>
<td></td>
</tr>
<tr>
<td>Bending radius:</td>
<td>no damage for install</td>
<td></td>
</tr>
<tr>
<td>Bending radius:</td>
<td>J-tube constraint</td>
<td></td>
</tr>
<tr>
<td>Sheath:</td>
<td>prevents moisture</td>
<td></td>
</tr>
</tbody>
</table>

Mainly Length and Power to be transmitted– determines AC, HVAC or HVDC
Other Cable Design Issues

- Ambient Temperature Range – water/land
- Burial depth
- Thermal resistivity of seabed
- Single length requirement – amount spare
- Vessel that will lay it
- Likely risk of unsupported/sharp rocks
- Likely extent of power surges
- Life of cable
- Protection method – burial/rock dump etc.

Target Cable Burial

<table>
<thead>
<tr>
<th>Threat</th>
<th>Hard Ground (clay 72kPa, rock)</th>
<th>Soft – firm soils (sand, gravel, clay 18-72kPa)</th>
<th>Very soft-soft soil (mud, silt, clay 2-18kPa)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Trawl boards, beam trawls, scallop dredges</td>
<td>&lt;0.4m</td>
<td>0.5m</td>
<td>&gt;0.5m</td>
</tr>
<tr>
<td>Hydraulic dredges</td>
<td>&lt;0.4m</td>
<td>0.6m</td>
<td>N/A</td>
</tr>
<tr>
<td>Slow net fishing anchors</td>
<td>N/A</td>
<td>2.0m</td>
<td>&gt;20m</td>
</tr>
<tr>
<td>Ship’s anchors Up to 10,000 t DWT (50% of the world fleet)</td>
<td>&lt;1.5m</td>
<td>2.1m</td>
<td>7.3m</td>
</tr>
<tr>
<td>Ship’s anchors Up to 10,000 t DWT (95% of the world fleet)</td>
<td>&lt;2.2m</td>
<td>2.9m</td>
<td>9.2m</td>
</tr>
</tbody>
</table>

Electro-Magnetic Fields (EMF)

- AC – the 3 phases cancel each other – no issue
- DC – Single line with no return line – affects Navigation: Not recommended for wind farms
- DC – parallel cable - minimal
- DC – coaxial cable – no problem

Cables and Heat

- Temperature contours HVDC Cables
- Cables and 50" pipeline - Ref Worzyk

Seismic Risk in USA

Norsok Marine Soil Investigation

<table>
<thead>
<tr>
<th>PROPERTY</th>
<th>PERTINENT SOIL PARAMETERS (S = sand, C = clay, R = rock)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Density</td>
<td>T = Tonnes/m³, k = kN/m³</td>
</tr>
<tr>
<td>Strength</td>
<td>S = Sand, C = Clay, R = Rock</td>
</tr>
<tr>
<td>Modulus</td>
<td>E = Elastic modulus, G = Shear modulus</td>
</tr>
<tr>
<td>Compressibility</td>
<td>C = Compressibility</td>
</tr>
<tr>
<td>Permeability</td>
<td>P = Permeability</td>
</tr>
<tr>
<td>Conductivity</td>
<td>E = Electrical conductivity, T = Thermal conductivity</td>
</tr>
<tr>
<td>Resistance</td>
<td>R = Resistance</td>
</tr>
<tr>
<td>Corrosion</td>
<td>C = Corrosion</td>
</tr>
<tr>
<td>Isolation</td>
<td>I = Isolation</td>
</tr>
<tr>
<td>Jetting</td>
<td>J = Jetting</td>
</tr>
<tr>
<td>Depth</td>
<td>D = Depth</td>
</tr>
<tr>
<td>Load</td>
<td>L = Load</td>
</tr>
<tr>
<td>Speed</td>
<td>S = Speed</td>
</tr>
<tr>
<td>Direction</td>
<td>D = Direction</td>
</tr>
</tbody>
</table>

Ref: Greenpeace: Offshore Wind Energy - Implementing a New Powerhouse for Europe,
Tools to Determine Route

Optimum route may not be green, straight line, but red to avoid free spans.

Multi-beam Echo sounder

Sub-Bottom Profiler + Soil Boring

Rock Layer

Sandy Layer

Navigation Risk Assessment

Threats from Fishing, Ships (anchors), Collision

- What fishing tackle?
- What size & type ship /anchors?
- What recreation vessels/ anchors?
- What military vessels/ anchors?
- What warnings of cables/ Racon?
- What approaches /weather?
- e.g. Likelihood of vessel deploying anchor – and any past history
- What signals/ AIS monitoring?
- What is on the charts?
- Any exclusion zones?

Route Selection

- Waterdepth (weight)
- Rocky shores
- Scour
- Boulders
- Instability
- Depth (Heat)
- Organic material
- Ice
- Shore Landing point
- Ships (Navigation Risk Assessment)
- Burial Ability (Test Sled)
- Obstacles
- Burial method
- Soil Strength (ease of burial vs depth)
- Soil Strength (ease of dropped objects hit).

Side Scan Sonar

Multi-beam Echo sounder

Navigation Risk Assessment

Sources of Information

- MARAD – Vessel calls at US Ports (details)
- USCG – keeps some data
- Bureau of Transportation Statistics
- Army Corps Engineers – traffic in and out of ports
- Classification Societies have anchor data
- AIS system -
Cable Protection

- Fishing
- Dropped objects

Depends on Site & Threats

- Burial – is the favorite method
  - 1 meter normal
  - 2-3 m. at harbor entrance
  - Corps of Engrs has required 15 ft
  - Rocky bottom offshore Maine so needs double armor or rock dump
- Rocky landing Blyth – rock cut in Soft bottom where Anchors can penetrate
- Pipeline crossings – need special bags
- May need concrete box at some locations

NOAA Chart Warnings

MMS - NTL 2010 – P04

Pipelines and power cables shall be identified with warning signs on each platform. The signs shall use letters not less than 10 inches in height, and the letters shall be black on a white background.

“WARNING.”
“SEAFLOOR PIPELINES AND/OR POWER CABLES” (whichever is appropriate)
“DO NOT DREDGE OR ANCHOR”
Burial Protection Index
Mole et al. 1997 SubOptic '97 Conference: Equivalent Reliability?

Rocky Terrain Offshore Maine:
Heavy Armoring required for Cable Protection

Vessel Selection is a Big Deal
Weather capability/motions for local seastate
Maneuvering - for inter-array cable
Speed to complete in weather window
Accommodation - so can stay out
Warming system /Protection – from errant vessels
Anchor handling to move along route
Marine management system
Crew experience
Transfer vessels if required
J-tube design & vessel coordination
Diver availability
Draft requirement
Equipment Load capability

Loading the Cable w/o Damage
Direction of Lay is dependent on armoring direction, and bending radius: Spare repair length to be added
Experience to ensure no damage during loading

Cable Jetting
(Courtesy of L'D Travocean, France)

Installation: Mechanical Plow
Wheel cutter for rocky sea floor

Cable trench cut into calcrite

(Courtesy of L.D. Tranvocean) [Ref Worzyk]

Germanischer Lloyd Cautions Issues

European Certifier

- Rubbing between cable / vibrating tower
- Too small a bending radius
- Pulling forces; squeezing; salt water; organic matter heating; cable; animals
- Heat e.g. small tubes on shore approach
- Possibility of cable being switched off/earthed; any tubes - earthed.
- J-tube smooth –
- Filling factor 40-60%

Post-Installation Survey: Helpful

- Exact Cable Route recorded (find for repair)
- Exact burial of any spare cable for repair
- Depth confirmed
- Repair Plan (living document + safety plan)
- Possible Re-survey after extreme events
- Cable Surveillance Records
- Fault, repair records and investigation
- Video survey after installation

Installation Methods Improve

Questions?

Offshore Risk & Technology Inc.
506 Nottingham Oaks Tr. Suite 200,
Houston, Texas 77079
Tel: 713 922 8170
Email: msharples@offshore-risk.net
or malcolm.sharples@gmail.com

Day 1 - 12 July 2011
Presentations/Technology Assessment & Resource (TA&R)
IEC Code – Minimum in Green

Figure 6: Effect of Yaw Misalignment under the 100-year Storm Conditions at a TX Offshore Site

Annotated from OTC Paper 21970 by Qing Yu, Lars Samuelsson and Pao-Lin Tan, ABS
**SEABED SCOUR CONSIDERATIONS for Offshore Wind Development**

**TA&R Study 656**

Fugro:
Tom McNeilan & Kevin Smith
Old Dominion University:
Larry Atkinson & Jose Blanco

Presentation to Atlantic Wind Energy Workshop
July 12, 2011

---

**Study Objective**

- TA&R Project 656 to evaluate Seabed Scour Considerations for offshore wind energy development on the Atlantic OCS.
- The objective of this study is to:
  - review oceanographic and seabed data from the Atlantic OCS,
  - review European OWF project experience, and
  - describe how OWF structure and cable installation may affect scour susceptibility of the seabed.
- The TA&R project 656 report intended to increase awareness that scour is an important technical consideration for the development of offshore wind resources.

---

**Sediment Mobility**

- Sediment Mobility – erosion, transport & redeposition
  - Caused by the interrelationship between the bottom currents (produced by oceanographic conditions) and the seabed and seafloor sediments that:
    - Produces the seafloor geomorphology and
    - Creates the potential for sediment movement.
  - That interrelationship varies both:
    - Spatially and
    - Temporally.
  - Subtle changes during minor storms, while large storms can produce significant changes
    - Normal conditions
    - Extreme conditions of various scales – episodic events

---

**Small Scale Example of Sediment Transport in Atlantic OCS**

Documented obliteration of sand ripples during small storm

---

**Requirements for Predicting Sediment Mobility**

- Sea Surface
  - MetOcean Data
    - Bottom Velocity
  - Wave Parameters / Current Velocity
    - Total Current Data
    - Measurements via wave buoys, current meters, etc.
- Seafloor/Sediment Data
  - Bathymetry/Relief, Seafloor Roughness, and Morphology
    - Seafloor Characteristics
    - Sediment Grain Size, Fines Content, and Geotechnical Parameters
  - In situ Testing
    - Grab Samples
    - Vane tests
    - In situ Testing
Scour

- The introduction of OWF structures can significantly alter the dynamic equilibrium at the ocean–seafloor interface
  - Introduce Obstructions - locally increase the bed stresses due to bottom currents,
  - Disturb the seafloor - reduce the resistance of the seafloor sediments to scour, and
  - Unbalance the dynamic equilibrium at the ocean-seafloor interface.

Morphology and Migratory Bedforms

May be a positive or negative influence:

- Alter flow conditions and either promote scour or protect foundation from strong flow causing scour
- Can infill scour pits, if feature migrates into scoured area
- But infilling may only be temporary as feature migrates away

Seafloor Morphology and Water depth

- Decrease in water depth can lead to higher velocity currents over seafloor features like sand ridges
- Processes that can change water depth
  - Erosion, accretion, or shifting of sand ridges and banks
  - Migrating sand waves and dunes

Scour Examples from Europe

- Scour around a mono-pile
  - Trick question: Which is earliest and which is latest survey?
  - Answer: Bottom Survey is last and shows the former scour hole being infilled by a passing sand wave

- Scour within a windfarm area
  - Note: Offshore Wind Farms cover large areas – conditions should be expected to vary within the large OWF area

- Scour due to installation activities around a monopile
  - Note: Spud can depressions have infilled but widened
  - Monopile scour has increased
Scour Examples from Europe

Scour around a monopile

Note: potential for undermined cable at exit from J-tube

Undermining >> Spanning >> Vibrations (Strumming) >> chaffing >> cable damage

Scour Examples from Europe

Scour within a windfarm

Note: Sand waves in wake of monopile are affecting nearby inner array cables

Wind Turbine

Migrating Sand Wave

Arrows below indicate areas where cables may be exposed

J-Tube Connection

Migrating Bedforms and Cable Hazards

Jet-Trenching Mechanism and Scour

Jet-trenching
- Sediments infilled in trench are in a looser state
- Modifies seafloor topography

Jet-trenching Mechanism and Scour

Overspill Deposits and Fine-grained Sediments in Suspension may be transported away from trench

Trench Surface is Lower than Surrounding Seabed Resulting in a Linear Depression (Trench Scar)

Jet-trenching Mechanism and Scour

Sediments that Deposit in Trench may be in a Looser State than Undisturbed Sediments

Summary of European Experience

- Significance of ocean dynamics sometimes underappreciated
- Scour developed quickly after the development of some OWF due to "normal" ocean dynamics and "routine" storm events
- Scour
  - Considerations often varied within an OWF
  - Scour holes around piles can reduce lateral support >> transfer load farther down the pile >> increase unsupported length of sub-structure >> increase lateral load-deflection >> change foundation period of vibration
  - Scour around piles can undermine cables. At the extreme that can compromise the integrity of the cables
  - Migrating sand waves can expose or further bury cable and supply sediment to infill scour depressions
- Once scour develops it adds significant O&M costs

Seafloor Character and Flow Velocity

Flow over uneven surface may produce vortices that can concentrate erosion in depressions or trenches, depending on the flow strength and sediment characteristics
Requirements for Scour Assessment

- Development of scour through time: Storm events (e.g., nor’easters) very significant.
- Surveys to measure lateral extent and depth of scour.

Monopile Turbine Foundation

Monopile Diameter Influences Scour Dimension

Potential Cable Damage At Spud Location

Potential Scour At Spud Location

Seafloor/Sediment Data

- Bathymetry/Topo, Bottom Roughness, and Morphology
- Sediment Grain Size, Fines Content, and Geotechnical Parameters

MetOcean Data

- Wave Parameters
- Current Velocity

Seafloor Conditions in Mid-Atlantic

Typical OW Structure site survey (1.8-km by 1.8-km)

Note: At least 3 different scales of bottom topography (geomorphology)

Implications for US Offshore Wind Development

- Sediment transport & scour are complex phenomena.
- Changes in the seafloor are due to the complex interactions between the ocean and the seafloor.
- Require integration of oceanography and geosciences.
- Occur on spatial scales that vary across a OWF.
- Both normal and event-driven considerations.
- The Atlantic OCS conditions are not uniform.
- Wave-driven phenomena and tidal forces can both be important.
- Broad knowledge is available, but site- and project-specific data are limited – BOEMRE’s Frontier Area designation is appropriate.

Recommendations

- Define spatial and temporal variation of bottom currents at (and within) the OWF site (and export cable route).
- Both normal equilibrium conditions and extreme storm conditions.
- Detailed definition of seafloor geomorphology.
- At structures and within site area.
- High quality multi-beam bathymetry is a must.
- Repeated surveys to identify movement of sand waves.
- Define sediment grain size.
- Integrated evaluations.
- Appropriate protection and avoidance.
- Plans for mitigation if scour is worse than expected.
Day 1 - 12 July 2011
Presentations/Technology Assessment & Resource (TA&R)

TA&R 656 Report

- 50 pages, 40 figures, 3 Appendices
- Table of Contents
  - Executive Summary
  - Introduction
  - Offshore Wind Farms
  - Sediment Transport and Scour
  - Potential Effects of Offshore Wind Development on Sediment Transport
  - European OWF Experience
  - Scour Susceptibility Evaluation for Two Hypothetical OW Areas
  - Pre-Design Investigation and Post-Installation Monitoring
  - Scour Avoidance, Protection and Mitigation

Thank You
**MMS TA&R 627 and 650**

**Inspection Methodologies for Offshore Wind Turbine Facilities**

**Offshore Wind Turbine Inspection Refinements**

*July 12, 2011*

---

**TA&R 627 and 650 Overview**

- **TA&R 627**
  - Develop guideline IM procedures for offshore wind turbine facilities appropriate for use in US waters
  - Address the following:
    - platform structure
    - turbine tower and nacelle
    - turbine blades

- **TA&R 650**
  - An outcome of TA&R 627 study
  - Refine inspection guidance for:
    - Turbine Blades
    - Tower Inclination measurements

---

**TA&R 627 Background**

- No existing US regulatory guidance for integrity management of offshore wind farms
- In advance of offshore turbines in US waters, BOEMRE needed guidance for effective inspection of these facilities
- Advantageous to merge existing offshore platform approaches and onshore turbine approaches

---

**Recommended Inspection Guidelines**

**Inspection Focus**

- Guidelines address:
  - Structural integrity
  - Access (i.e., walkways, platforms, etc.)
  - Reporting (e.g., checklists)
  - IM guidance

- Scope does not include:
  - Functional requirements for mechanical and electrical systems
  - Turbine operation
  - Maintenance issues
  - Items not influenced by data gathered from visual and NDT inspection techniques
  - Construction activities
  - Power generation efficiency

---

**Recommended Inspection Guidelines**

**Inspection Frequency**

- Frequencies provided are guidelines to be applied based on:
  - Facility Condition
    - Past damage and repairs
    - Modifications to original design
    - Results of inspection of similar installations
  - Consequence of failure
    - Impact to surrounding areas including waterways, fishing, etc.
**Recommended Inspection Guidelines**

**Subsea Structure**
- Critical areas include:
  - Cathodic protection systems
  - Welded connections
  - Splash zone condition
  - Areas of previous damage or repair
- Inspection approaches include:
  - Annual CP measurements
  - Regular visual survey by diver or ROV
  - Regular close visual scan of critical areas such as connections and seabed scour

**Recommended Inspection Guidelines**

**Above water structure and access systems**
- Critical areas include:
  - Tower to substructure attachment
  - Condition of stairs, landings, handrails, etc.
  - Areas of previous damage or repair
- Inspection approaches include:
  - Annual visual inspection of structure and access systems
  - Regular NDT of connection between tower and substructure

**Recommended Inspection Guidelines**

**Post-event Inspections**
- After an environmental event that is close to the design event for the facility (e.g., earthquake or hurricane) an inspection should be performed.
- Should be pre-planned with areas of highest concern (based on condition and analysis) targeted.
- Above and below water inspections necessary.

**Recommended Inspection Guidelines**

**Engineering Evaluation**
- Simply performing the recommended inspections is not enough.
- Inspection results need to be reviewed by engineers to identify trends, recommend follow-up and revise future inspection scopes as necessary.
- Ensures the cycle of integrity management is maintained.

**TA&R 650 Project Overview**
- Develop refined inspection procedures for offshore wind turbine facilities addressing:
  - Blade inspection
  - Facility inclination measurement
  - Revise inspection procedures developed for TA&R 627
- Focus on:
  - Technologically sound approaches
  - Applicable to offshore environment
  - Executable in safe manner

**Blade Inspection – Objectives**
- Evaluate existing and novel approaches to blade inspection based on:
  - Worker safety
  - Scalability (multiple sites)
  - Repeatability
  - Cost effectiveness
- Objective is to identify blade degradation prior to catastrophic failure.
### Blade Inspection – Types of Degradation

- **Manufacturing-related degradation**
  - Delaminations
  - Bond failures
  - Cracks

- **In-Service degradation**
  - Lightning
  - Leading edge erosion
  - Other impact damage

### Blade Inspection Techniques

- **Visual inspection**
  - Remote or close visual inspection of the blade surface

- **Tap test**
  - Tap sound can be related to structural condition

- **Ultrasonic testing**
  - Ultrasonic pulses determine object properties (thickness, internal flaws)

- **Thermography**
  - Observes how heat flows at the surface

- **Shearography**
  - Observing interferometric images of the structure

### Blade Inspection Access

- Aside from remote visual inspection, all of the inspection techniques require a technician to be in contact with the blade at the time of the inspection.

- Primary techniques for achieving this are:
  - Rope access
  - Suspended platform systems

- Industry has this capability and there are numerous service providers for either option.

### Inspection Refinements

- **Blade Inspections**
  - Expert consensus is that external blade damage is the most prevalent in-service damage.
  - Lightning strikes, edge erosion, etc. can generally be identified by visual inspection.

- **Internal blade damage identified based on**
  - Abnormal performance data or condition monitoring data
  - Through communications with the blade manufacturer

- **Revised guidance reflects these expectations**
  - Focus on routine visual examination during regular inspection
  - Also proactive regular close visual or NDT examination requirements regardless of whether or not other data points to such defects

### Tower Inclination Objectives

- Extreme events during service may result in a significant facility inclination that may adversely affect operations.

- Operator will need to assess inclination impact on the facility
  - Repair or replace decision
  - Operational modifications

- Objective is to identify inspection techniques that will accurately measure the inclination.
Inspection Refinements

Facility Inclination

- A variety of methods exist to measure a facility’s inclination from inexpensive level bubbles to electrical devices (tiltmeters and trim cubes)
- These can readily be used to measure inclination during regularly scheduled inspections as well as post-storm
- Important to have a baseline inclination measurement at installation
- Operator should ensure that the inclination tolerance is defined for operations and safe boarding during inspection / maintenance

TA&R 627 and 650 Summary

- Provide inspection guidance to BOEMRE and industry suitable for installations in US waters
- Refinements addressed specific areas not adequately covered during initial study
- Results include guidance document with recommended inspection
  - Frequencies
  - Techniques
  - Critical areas
- General IM guidance also provided
ABS R&D on Offshore Wind Turbines

- Develop ABS Guides and software for offshore wind turbines
- Provide technical support to ABS certification and classification projects for offshore wind turbines
- Contribute to the US and international collaborative research and development
  - BOEMRE’s TA&R Programs
  - IEA Wind Task 30 (OC4)
  - AWEA Large Wind Turbine Compliance Guidelines
  - IEC TC88

Objectives

- Study the critical design load conditions for floating wind turbines
- Identify and rank the critical technical challenges to deploying floating wind turbines on the US OCS
- Draft design guidance based on the research findings

Scope of Work

- Task 1: State of the Art Review
- Task 2: Case Study using the Existing Design Concepts and US OCS Conditions
- Task 3: Assessment of Critical Technical Areas for Floating Wind Turbine Design
- Task 4: Draft Design Guidance for Floating Wind Turbines
- Task 5: Final Report
- Workshop

Project Plan

<table>
<thead>
<tr>
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- Task 1: State of the art review
- Task 2: Case study
- Task 3: Assessment of critical technical areas
- Task 4: Draft guidance
- Task 5: Final report
- Workshop will be held on the date agreed with BOEMRE
Task 1: State of the Art Review
- Existing design experience and relevant design guidelines for floating wind turbines
- Research and development in the US and elsewhere
- Applicable software

Task 2: Case Study
- Data collection for case studies
  - Conceptual design of floating support structures
  - Metocean conditions on the US OCS
  - NREL 5MW baseline offshore wind turbine
- Case studies
  - Three types of support structures
  - Typical turbine operating conditions
  - Effect of control schemes
  - Global responses of coupled rotor-turbine-floater-mooring systems

Task 2: Case Study
Selected Conceptual Designs
- NREL TLP
- IEA-OC3 Spar
- WindFloat Semi

Task 2: Case Study
Metocean Conditions
- GoM Central Region – API INT MET
- Northern CA and ME – NOAA NDBC Buoy Data

Task 2: Case Study
Load Cases
- Operating condition – power production, start-up, shut-down and parked
- Turbine conditions – with and without fault
- Storm conditions – 10-year, 50-year and 100-year return
- Turbulent wind versus steady wind
- Wind and wave combination

Task 2: Case Study
Coupled Global Responses
**Task 3: Critical Technical Areas**

- Structures and stationkeeping systems
  - Environmental conditions
  - Load cases
  - Global performance analysis
  - Stationkeeping systems (mooring, tendon and foundation)
  - Structural design
  - Other potentially critical areas

**Tasks 4 & 5: Design Guidance & Final Report**

- Draft design guidance based on the findings from Task 1, 2 and 3
- Draft final report for BOEMRE comments
- Revision based on the feedback from the ABS internal review and BOEMRE’s comments
- Final report

**Workshop**

- Workshop with attendees from the industry, academia, government and regulatory agencies
- Workshop report
- Recommendations for future study and enhancement of draft design guideline

**TA&R 670 Design Standards for Offshore Wind Farms**

**Objectives**

- Study the governing load cases and load effects for wind turbines subjected to tropical revolving storms on the US OCS
- Review and evaluate the existing methods of calculating the breaking wave slamming loads inflicted on offshore wind turbine support structures
- Provide recommendations to support future enhancements to the relevant design criteria for offshore wind turbines

**Scope of Work & Project Planning**

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</table>
**Task 1: State of the Art Review**
- Existing design methods and standards for wind turbines subject to strong wind and wave slamming loads
- Tropical hurricane wind and wave modeling
- Wave slamming loads on offshore structures
- Applicable software

**Task 2: Tropical Hurricane Effects**
- Data collection for case studies
  - Conceptual design of a monopile, tripod and jacket
  - Hurricane metocean conditions of US OCS
- Comparative study of IEC and API wind models
- Effect of fault of yaw and pitch control
- Effect of wave and wind misalignment
- Case studies
  - Normal and abnormal turbine operating conditions
  - Three types of support structures
  - NREL 5MW baseline offshore wind turbine

**Task 2: Tropical Hurricane Effects**
**Regional Metocean Conditions**

**Load Cases**
- Normal conditions (DLC 6.1) – yaw and pitch control is functioning properly
- Abnormal conditions (DLC 6.2) – omni-directional storm wind
- 100-year and 50-year conditions
- Wind and wave combination

**Task 2: Tropical Hurricane Effects**
**Support Structures**
- Monopile
- Tripod
- Jacket

**Task 3: Breaking Wave Slamming Loads**
- Review shallow water wave theories and wave breaking mechanisms
- Review existing design, analysis and experiment methods related to breaking wave slamming
- Evaluate test data and analytical results available in the public domain
Task 3: Breaking Wave Slamming Loads

- Assess critical parameters governing the breaking wave slamming loads
- Recommendation on determining breaking wave slamming loads
  - Wave slamming coefficient
  - Breaking wave kinematics
  - Spatial and temporal distribution

Tasks 4 & 5: Recommendations & Final Report

- Draft recommendations
  - Design criteria to account for the environmental conditions in the tropic-prone areas in US waters
  - Calculation of breaking wave slamming loads
- Revision based on the feedback from the ABS internal review and BOEMRE’s review
- Final report

www.eagle.org
Offshore Wind Extreme Metocean Event Climatology for the Mid-Atlantic

TA&R Program Breakout Session
BOEMRE Atlantic Wind Energy Workshop
Herndon, VA
12 July 2011

George Hagerman
VCERC Director of Research
Virginia Tech Advanced Research Institute
900 North Glebe Road
Arlington, VA 22203
Email: hagerman@vt.edu
Phone: 757-422-2704

Presentation Outline

Task by Task overview
- Task 1A (new): Wind, wave, water level maps at 50-, 100-, and 500-year return periods (from FEMA Region III study)
- Task 1B (revised): Analysis of US Army Wave Information Studies (WIS) wind and wave hindcast for extra-tropical storm population only
- Task 2A (original): Synthetic hurricane wind and wave hindcast
- Task 2B (new): Joint storm population probability analysis of extreme wind return periods combining WIS extra-tropical hindcast with synthetic hurricane wind hindcast
- Task 3: Water level analysis – accomplished by new Task 1A
- Task 4: Wind-driven current analysis
- Task 5: Mapping to IEC Design Load Cases and other standards

Expert Group peer review workshops
- Nomination of members from industry, academia, government
- First meeting at BOEMRE in Herndon on 29 July 2011
- Second meeting at Offshore Technology Conference in May 2012

FEMA Region III Storm Surge Study

Objective 1: Identify and reconstruct historical extratropical storms in Region III
- Selection based on water levels at 7 stations
- Total of 32 historical storms 1955-2005
- Kinematic reanalysis of all wind fields
- Empirical Simulation Technique (EST) used for return period calculations
- To include sampling at 3 tidal stages

FEMA Region III Storm Surge Study

Objective 2: Develop a representative set of synthetic hurricanes
- Record of 20 hurricanes in 60 years insufficient for 50- and 500-year computations
- Synthetic storm set used to develop windfield frequencies and hurricane parameters
- Demonstrated validity with comparisons to historic data

Synthetic Hurricane Wind Hindcasting
FEMA Region III Storm Surge Study
Preliminary Validation of Mean Wind Speeds

Preliminary Validation of Significant Wave Heights

US Army Corps of Engineers Wave Information Studies, WIS (20 years of wind and wave hindcast data)

ADCIRC Mesh and WIS Grid Points
- New Jersey Wind Energy Area
- Delaware and Maryland WEAs

ADCIRC Mesh and WIS Grid Points
- Delaware and Maryland WEAs
ADCIRC Mesh and WIS Grid Points – Virginia Wind Energy Area

Wavewatch III Offshore Wind and Wave 30-Year Reanalysis (1980 through 2009) by NCEP

Measured Current Datasets

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Water Level and Wind-Driven Current Forecasts for Hurricane Earl, 03 Sep 2010

 Topics for Expert Group Peer Review and Feedback

"Reduced" Wind Speeds and Wave Heights
Topics for Expert Group
Peer Review and Feedback

Topic A: Inconsistencies among New and Evolving Standards: By unthinkingly assigning appropriate stress periods to the ULs in ASCE 10-08, GL 01/09/07, and API RP 2NE/7, an acceptable risk for the different offshore wind farm components, we propose to evaluate or measure for the use of disparate amplitudes such as “Joint Bollard” and “Composite Bollard” and instead use these parameters to the entire facility to characterize exposure and consequences for defined failure mechanisms. To bring an expert group to discuss this topic, participants would include the DOT/Marine Safety team and the WIS/WEC/7 team. A summary of results would be provided along with recommendations for actions.

Topic B: Capacity Among New and Evolving Standards: By unthinkingly assigning appropriate stress periods to the ULs in ASCE 10-08, GL 01/09/07, and API RP 2NE/7, an acceptable risk for the different offshore wind farm components, we propose to evaluate or measure for the use of disparate amplitudes such as “Joint Bollard” and “Composite Bollard” and instead use these parameters to the entire facility to characterize exposure and consequences for defined failure mechanisms. To bring an expert group to discuss this topic, participants would include the DOT/Marine Safety team and the WIS/WEC/7 team. A summary of results would be provided along with recommendations for actions.

Topic C: Area Risk vs. Point Risk: For a given extreme wind speed, its return period at a point or project site might be 250 to 500 years, but the return period over a large region might be less than 50 years. The worst Wind Energy Area of the southern Mid-Atlantic Right could have multiple projects using the same turbine model, and projects' exposure may be more appropriate for type certification, whereas point risk may be more appropriate for project certification. By practical necessity, type certification can only occur in a few categories, such as the EEC 03/04-04, Class I, II, and III, and More. To bring an expert group to discuss this topic, participants would include the DOT/Marine Safety team and the WIS/WEC/7 team. A summary of results would be provided along with recommendations for actions.

Project Schedule

In GANTT Chart below, circles are quarterly reports (by 15th day after quarter ends), diamonds are Expert Group meetings, triangles are project reports, and the square is the OTC presentation.

Thank You!

U.S. Army Corps of Engineers Wave Information Studies (WIS):
http://frf.usace.army.mil/wis2010

Any questions?

Email: hagerman@vt.edu

Day 1 - 12 July 2011
Presentations/Technology Assessment & Resource (TA&R)
IEC Design Requirements for Offshore Wind Turbines, 61400-3
Update on Ongoing Activities

J. F. Manwell, Prof.
Dept. of Mechanical and Industrial Engineering
Univ. of Massachusetts
July 12, 2011

Background
- IEC 61400-3 was issued in 2009
- It is essentially an extension of IEC 61400-1 (fundamental standard for on-shore wind turbines)
- It includes extensive consideration of metocean external design conditions
- It includes additional design load cases (DLCs), beyond those of IEC 61400-1

Summary IEC 61400-3
- Prepare preliminary design (“PD”)
- Develop structural dynamic model of PD
- Specify external conditions
- Specify load cases
- Determine structural loads and stresses
- Check that stresses are acceptable, given chosen material
- Adapt design if necessary and repeat

Structural Dynamics Model
- Structural dynamics models available for horizontal axis wind turbines
  - Examples: FAST (NREL), BLADED (Garrad-Hassan)
- New models will be needed for non-standard designs
- Preliminary design must be described in form compatible with model

External Conditions
- Wind, waves, currents most important
  - Means, extreme, probability density, wind shear, joint statistics of wind/waves, etc.
- Other conditions: temperature, lightning, icing, corrosive environment, etc.
- Actual site assessment required, at least one year recommended
- Extrapolation for return periods (50 yr)

Load Cases: Overview
- Ultimate loads/fatigue loads
- Normal conditions/unusual conditions
- Operating/non-operating
IEC 61400-3 Load Case Categories

- Power production
- Power production + fault
- Start-up
- Normal shut down
- Emergency shut-down
- Parked
- Parked + fault
- Transport, assembly, maintenance, repair

Design Load Cases

- For each category, various combinations of external and conditions are considered
  - Wind, waves, currents, ice, etc.
- Both fatigue and ultimate loads are considered

Example: Power Production DLCs

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<th>Design situation</th>
<th>DLC</th>
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<th>Waves</th>
<th>Sea currents</th>
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IEC 61400-3 Load Analyses

- Maximum strength
- Fatigue failure
- Stability analysis (e.g. buckling)
- Deflection (e.g. preventing blades from striking tower)

IEC 61400-3 Method of Analysis

- Loads predicted by design tools (e.g. computer codes)
- Method of partial safety factors
- Expected "load function (effect)," multiplied by a safety factor, must be less than the "resistance function"
- Design properties for materials from published data
- Safety factors chosen according to established practice

Ultimate Strength Analysis

- Find characteristic load effect, $F_k$, from analysis
- Find design load effect, $F_d$, using load safety factor $F_d = \gamma_f F_k$
- Find characteristic material resistance, $f_k$, from literature (or other source)
- Find design material resistance, $f_d$, using material safety factor $f_d = \frac{1}{\gamma_m} f_k$
### Recent Developments
- IEC 61400-3 is now used in most of the world
- Questions regarding 50 yr return period and metocean conditions (e.g. hurricanes)
- The US undertook a study to compare IEC 61400-3 and the API recommended practice for design of offshore platforms (API RP-2A)
- Need for 2nd ed of IEC 61400-3 recognized
- Strong interest, especially in Korea, for standard/RP for floating OWTs

### Ongoing Activities
- A maintenance team (MT-3) has been established to produce a second edition of 61400-3
- The first meeting was held in May, 2011
  - Twenty participants, 8 countries (DE, DK, ES, JP, KR, NL, UK, US)
- Parallel activity about to start for floating OWTs (MT3-2)

### Scope of 2nd ed. of IEC 61400-3
- Consideration of comments already received from national committees and updating the standard where appropriate
- Reviewing comments/suggestions from other sources, inc. EU Upwind research program
- Utilizing recent experience of the design of offshore wind turbines and their support structures

### Specific Areas of Consideration
- The new edition is expected to introduce changes to:
  - Load calculations and simulations
  - External conditions
  - Assessment of external conditions
  - Support structure and foundation design
  - The various annexes on design approaches
  - Text referring to issues treated by IEC 61400-1

### Action Items: New Material
1. More guidance on soil investigations and treatment of uncertainties
2. Remote monitoring and remote reset (safety system)
3. Design codes to be used in conjunction with 61400-3
4. Safety factors (strength / resistance)
5. Material selection, strength assessment etc.
6. Damping – esp. Monopiles
7. Wake modelling, DWM
8. New annex: Method of extrapolating extreme wave conditions (include breaking wave conditions)
9. Conditions / load cases for assessment of cyclic loading
10. Run-up guidance
11. General review of safety factors & return period
12. Use of Charnock rel.
13. Ice loading
14. Vortex induced vibration
15. Review $C_d$, $C_m$ guidance
16. Review of wind site assessment (including ETM & cyclone / hurricane)
## Action Items: Review of DLCs

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<tr>
<td>17</td>
<td>Wind-wave misalignment, all DLCs</td>
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<tr>
<td>18</td>
<td>Grid-loss periods - define minimum outage / availability</td>
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<tr>
<td>19</td>
<td>Review ice DLCs</td>
</tr>
<tr>
<td>20</td>
<td>Review SSS - provide simpler guidance</td>
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<tr>
<td>21</td>
<td>DLC1.2 - currents, methods for wind wave combination</td>
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<td>22</td>
<td>Reduce no. Stoch. Simulations with NSS (identify RNA or SS driving)</td>
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<tr>
<td>23</td>
<td>DLCx.x, embedded wave, move definition of X.Xa-c elsewhere</td>
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<td>24</td>
<td>DLC for boat impact: O&amp;M vessels</td>
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## Conclusions

- Second edition of 61400-3 now underway
- Many changes anticipated
- Opportunities for input and collaboration, especially on such issues as external design conditions, including hurricanes
- Parallel activity for floating OWTs has been initiated
Scope of Study

- **TASK 1: Standards and Practices**
  The applicability and adequacy of existing standards and practices for the design, fabrication, and installation of offshore wind turbines.

- **TASK 2: Role of Certified Verification Agents (CVAs)**
  The expected role of the CVA in identifying standards to be used and conducting onsite inspections to verify compliance with the standards.

- **TASK 3: CVA Qualifications**
  The experience level, technical skills and capabilities, and support equipment and computer hardware/software needed to be considered a qualified CVA.

Task 1

**Standards and Practices**

---

Regulations, Standards, and Guidelines for Offshore Wind

- **Regulations** are requirements promulgated by governments. Examples include the offshore wind regulations developed by Denmark, Germany and the Netherlands.

- **Standards** are documents developed by a consensus process following an established protocol. Examples include IEC 61400-1, 61400-3, 61400-22, and API RP 2A.

- **Guidelines** are documents developed by a group or company which is not subject to a vote of constituencies. Examples include the offshore wind guidelines developed by GL, DnV, and ABS.
**Findings – Task 1: Standards**

- No single set of standards exist that covers all aspects of offshore wind - design through commissioning
- Many standards and guidelines exist which collectively are suitable for offshore wind installations but with some gaps
- The BOEMRE regulations 30CFR 285 lack the clarity and specificity needed for development of offshore wind in the OCS
- The U.S. (state and federal) urgently needs a clear set of regulatory expectations to facilitate the orderly development of offshore wind

**Recommended Regulatory Approach for BOEMRE**

- Develop a set of high level **goal-based standards**
- Establish a core competency to lead the development of the goal-based standards, and review compliance.
- Pre-approve sets of guidelines and standards proposed by developers and classification societies that are compliant with the **goal-based standards**

**Comparison of Level of Risk**

Offshore wind farm pollution and human safety risks are relatively low.

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<td>Local liquefied natural gas terminal</td>
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**Risk Matrix Driven by Policy Consequences of Failures**

- The U.S. commitment to exploiting offshore wind as a key component of its renewable energy policy may drive regulators to ensure a minimum level of system reliability.

**Task 2 Role of Certified Verification Agents (CVAs)**

- A two-tier oversight process administered by BOEMRE.
  - **Lower complexity** facility plans are stamped by a professional engineer and checked by BOEMRE.
  - **Complex structures** - Certified Verification Agents (CVA) are used (e.g. deepwater, floating structures).
Scope of CVA or Third Party Review Recommendation: Task 2

The third-party review should cover the development process including:
- Design
- Fabrication and Manufacturing
- Installation

The third party review should include system components critical to survival and large scale reliability issues:
- Tower and support structure,
- Foundation,
- Blade and blade controls,
- Infield cables and connectors,
- Export cables,
- Structural and electrical systems

Standards Recommendations: Task 2 (continued)

- The Developer is responsible for proposing a comprehensive package of standards, rules, guidelines and recommended practices that conform with the goal-based standards.
- The Certified Verification Agent should review and comment to BOEMRE on the adequacy of the proposed standards.

Minimum Qualifications Recommendations Task 3

When evaluating CVAs, BOEMRE should seek organizations and individuals that have:
- Independence and objectivity
- Experience, expertise, and engineering judgment
- Experience with the environment at the project location.
- Clearly defined roles and responsibilities with adequate oversight by a PE (or international equivalent).
- An auditable quality plan for the processes and record keeping involved.

Recommendations to BOEMRE Task 3 (continued)

- Increase internal capability to oversee the development of offshore wind farms in the OCS.
- Approve CVAs on a project-specific basis.
- Disseminate lessons learned from the CVA process to promote good practices to the industry.
- Create an expert panel to provide feedback and guidance for the initial projects.
- Participate in the International Electro-technical Commission (IEC) Wind Turbine standards development

QUESTIONS
Specific Objectives – Fill Data Gaps

- In the Study Area, what are the abundance, distribution, and utilization of:
  - Bird Species (flight behavior)
  - Marine Mammals
  - Sea Turtles
- What areas are more/less suitable for renewable energy projects based on potential ecological/environmental impacts?
- Two year study (2008-2009): ~$7M

Field Studies & Data Compilation

- Three Primary Targets:
  - Avian
  - Marine Mammal
  - Sea Turtle
- Supporting Studies:
  - Oceanographic
  - Fish and Fisheries Data
  - Benthic Mapping
  - GIS & Modeling
TOTAL SURVEY EFFORT
2008-2009
Bimonthly coastal and offshore surveys
Total km 18,183
Total species:
153 (avian)
8 (marine mammals)
2 (sea turtles)

Detected species
Five federally threatened or endangered species:
• North Atlantic right whale (Eubalaena glacialis)
• Fin whale (Balaenoptera physalus)
• Humpback whale (Megaptera novaeangliae)
• Leatherback turtle (Dermochelys coriacea)
• Loggerhead turtle (Caretta caretta)

Also:
• Minke whale (Balaenoptera acutorostrata)
• Bottlenose dolphin (Tursiops truncatus)
• Short-beaked common dolphin (Delphinus delphis)
• Harbor porpoise (Phocoena phocoena)
• Harbor seal (Phoca vitulina)

Sensitivity Map
• Simple weighting of GIS layers by natural & physical resources
• More heavily shaded areas indicate greater potential for impacts
• Used for input to BOEMRE for 7. Call for Information and Nominations for Commercial Leasing for Wind Power on the Outer Continental Shelf Offshore New Jersey

Avian Radar

Photo by Tony Leukering, GMIJ

A-109
Total Bird Density

Depth, distance to shoreline and nearest shoal are significant predictors of bird spatial distribution.

Marine Mammal Density

A-110
Hurdles

- Lack of “Standard Methods” for U.S.
- NOAA Permit - Marine Mammal Protection Act & Endangered Species Act
  - Need due to “take” of protected species
- Weather - Visual surveys need to be conducted under good conditions
- Vessels - Limitations on operation (e.g., storms, availability)
- Budget

Project Significance and Issues

- DATA, DATA, DATA, DATA!
- 1 project in state waters; multiple in federal waters
- Multi $$Billion investment
- Data will help support the development of renewable energy projects
- Help assess potential impacts
- Inform NEPA & Federal Consultation process (e.g., ESA)

Findings:
Influence on Siting Decisions

- Information and data can be used for:
  - Baseline data for projects in study area
  - Design of future monitoring
  - Screening of potential sites
  - ID Areas for BOEMRE & Phase II Wind Facilities
  - Listing of species that may be impacted esp. T&E species
  - Estimate of relative scale of potential mitigation

Data Gaps/Future Studies

- Site-specific (footprint) studies - radar
- OWPEBS - template to build upon or copy
- U.S. accepted techniques/methods - allows comparison between studies and for comprehensive geospatial analysis
- Migratory nature of protected species indicates the need for regional or coast-wide studies

New Jersey Coastal Management Program’s 309 Ocean Strategy: Coastal & Marine Spatial Planning

- Develop a CMSP work plan & coordinate with the Regional Planning Body.
- Participate in national workshop(s) and CMSP simulation exercises.
- Continue to work with the federal agencies and MARCO, as necessary, to develop the stakeholder and scientific participation processes.
- Identify potential revisions to enforceable policies.
- Next phase will develop the actual plan. In addition, revisions to enforceable policies will be proposed, adopted and submitted as a program change to OCRM.

MARCO Mapping & Planning Portal
Available at http://www.midatlanticocean.org/
Day 2 - 13 July 2011
Presentations/Environmental/State Planning Panel

Nj DEP Office of Science website:
www.state.nj.us/dep/dsr/

Photo by Tony Leukering, GMI
Massachusetts Ocean Management Plan & Offshore Wind Siting

BILL WHITE
Assistant Secretary for Federal Affairs
Executive Office of Energy and Environmental Affairs

Governor Patrick’s Massachusetts Clean Energy Vision
• Most ambitious Energy Efficiency program in the U.S.
  – By 2020: 20% electricity through Energy Efficiency
  – 3x California/capita
  – Doubling of employment in EE services since 2007
  – $2 Billion Investment = $6 Billion Savings
• By 2020: Plan to Reduce GHG Emissions by 25%
• By 2020: Plan for 15% from Renewable Energy
• By 2020: 2,000 MW from Wind and 250 MW from Solar

Ocean Plan
• Prohibited area:
  – Uses, activities and facilities prohibited by Ocean Sanctuaries Act and plan
• Renewable energy areas:
  – 2 areas: Gosnold, Vineyard
  – Commercial-scale wind
• Multi-use area:
  – Siting and performance standards apply

Ocean Plan: Renewable Energy Areas
• Product of extensive assessment of compatibility with uses and resources as well as cumulative impacts:
  ✓ Buffer from development and near-coast activities
  ✓ High concentrations of marine avifauna and whales
  ✓ Water-dependent marine uses
  ✓ Regulated airspace
• 2% of entire planning area
• Per Plan, only suitable locations for wind energy at commercial scale
• Adjacent federal waters identified as areas for potential development with additional characterization

Oceans Act of 2008
• Development of integrated ocean management plan
• 15 directives, including:
  – Develop siting priorities, locations, and standards for uses, facilities, activities allowed by state law
  – Identify and protect special, sensitive, and unique estuarine and marine life and habitats
  – Foster sustainable uses
  – Support infrastructure necessary for economy and quality of life
• All state approvals must be consistent with Plan

State ocean planning area

Day 2 - 13 July 2011
Presentations/Environmental/State Planning Panel
Federal leasing for offshore wind
• BOEM issued framework for leasing OCS for offshore renewable projects in April 2009.
• Governor Patrick requested formation of Massachusetts Task Force so that state, tribal, and local elected officials to provide input.
• Beginning in November 2009, BOEM convened 8 meetings to solicit input from Task Force on a Massachusetts Request For Information (RFI).
• Engagement in federal process based on MA Ocean Management Plan

Data, Information & Outreach
• Significant data and input from MA Ocean Plan informed RFI location.
• In conjunction with BOEM & USCG, EEA convened over 35 public & stakeholder meetings.
  – Martha’s Vineyard, Nantucket, New Bedford, Boston
• MA: Extend RFI comment deadline 3 months
• Fisheries Working Group
• Habitat Working Group
• Ongoing data development

Process to date
• Stakeholder and public meetings
• Development of two issue-oriented stakeholder groups:
  – Fisheries Working Group
  – Habitat Working Group
• Review available data: fishing, habitat, marine mammals, avifauna, shipping
• As in Massachusetts Ocean Plan, consider potential compatibilities between wind energy and existing uses/natural resources
• Identify issues needing further investigation
• Identify areas recommended for not pursuing further

Marine mammals: whales

Marine avifauna: sea ducks
EEA Recommendation on RFI

- Review of data on whales, turtles, birds, etc.
- Review of data on groundfish, scallops, herring, quahog, lobster, etc.
- Review of navigation, commercial shipping, and boating data
- To reduce potential impacts on fisheries, mammals, & navigation, Commonwealth recommended an exclusion of eastern ~half of RFI Area

Next Steps

- BOEM to issue Call for Interest and Nominations and issue draft NEPA planning notice
- Task force input; working groups and stakeholder meetings
- Ongoing studies and information synthesis
  - Clean Energy Center survey:
    - Avifauna, large whales, and sea turtles
    - Mobilization and begin surveys: August/September
    - Survey Period: Fall 2011 through summer 2012
  - Commercial fishing:

EPA’s Cross-State Air Pollution Rule Will Prevent:

- Prevent up to 34,000 premature deaths,
- 1,500 nonfatal heart attacks,
- 400,000 cases of aggravated asthma,
- 1.8 million sick days/year beginning in 2014,
- $280 billion in annual health benefits.
IMAGINE

Displacing Coal with Offshore Wind
OVERVIEW

- Legislative Background and Data Collection Summary
  1) The Ocean Energy Demonstration Siting Initiative
  2) Baseline Data Collection
  3) Current Efforts and Next Steps

- Gaps, Roadblocks, Red Flags, Faint Hopes, and FOIA
  1) Data Gaps
  2) Communication Gaps
  3) What We Need...

THE OCEAN ENERGY TASK FORCE

- L.D. 1465 (P.L. 270) – Initiated siting process lead by DOC and SPO with consultation from the University of Maine and various non-governmental organizations and stakeholders
  - Directed DOC and SPO to site up to five Ocean Energy Demonstration Sites in state waters (3 NM from the coasts of the mainland and islands).

COASTAL AND MARINE SPATIAL DATA

FINAL DESIGNATION

DEEP C WIND

- Pre-deployment field studies: drop camera survey (benthic invertebrate, demersal fish), active acoustic survey (pelagic fish), 24/7 radar monitoring for flying vertebrates (bird and bats), visual surveys for marine mammals
- Baseline hydro-acoustic surveys for ambient noise
- Acoustic telemetry for tagged fish and other tagged species, with range testing using standard Vemco tags

- Surveys before and after (during) test turbine deployment (benthic invertebrates, pelagic fish, bird/bats, visual surveys for marine mammals)
- Hydro-acoustic surveys and ongoing monitoring for turbine and anchoring system noise
- Acoustic telemetry for tagged fish and other tagged species
BASELINE DATA COLLECTION

• Networked Approach
  1) Utilizing Strengths of Partners;
  2) Leveraging Financial Assets;
  3) Coordinating Partners Efforts and;
  4) Providing a Forum For Peer Review

• Current Efforts Include:
  1) Human Use Mapping
  2) Avian/Winged Mammal Studies
  3) Bathymetric Mapping
  4) Habitat Classification Coordination
  5) And Many More!

DATA/COMMUNICATIONS GAPS

• DATA GAPS
  1) Accurate Bathymetric Mosaic
  2) VTR/VMS
  3) Standardized and Reliable Methodologies
     • Taking into Account Differences In Technology

• Communications Gaps
  1) Differences between Federal Programs
  2) NOAA Revitalization
  3) State involvement in all of the previous...

NEEDS/OBSTACLES AND CONCERNS

• $$$
• Diversion of existing funds for new initiatives
• Reliable and Easily Interpreted Standards
  1) Siteing
  2) Ensure Wise Investment
• Inter-agency Communication
• State Involvement (All)
• Coordination of Federal Environmental Data Collection and Monitoring Efforts
• $$$

EFFORTS WARRANTING COORDINATION?

• Human Use Mapping – NOAA, BOEMRE, Island Institute, Gulf of Maine Research Institute, Massachusetts Ocean Partnership, etc
• Bathymetric Mapping – Maine, Massachusetts, Rhode Island, NOAA, EPA, USGS, Private Companies, etc
• Avian Work – Private Companies, USFWS, Academia, etc
• ANAPP – USFWS, NOAA, BOEMRE

NEEDS/OBSTACLES AND CONCERNS

• $$$
• Diversion of existing funds for new initiatives
• Reliable and Easily Interpreted Standards
  1) Siteing
  2) Ensure Wise Investment
• Inter-Agency Communication
• Coordination of Federal Environmental Data Collection and Monitoring Efforts
• $$$

Questions, Comments, or Concerns?

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Marine Spatial Planning For Renewable Energy

Estimates of 80 m wind speeds
AWS TrueWinds data

Mohegan Bluffs, BI – Complex Stratigraphy
**Technology Based Assessment**

**Objective:** Develop a metric based on technical challenge to power production potential to screen for sites.

\[
\text{TDI} = \frac{\text{TCI}}{\text{PPP}}
\]

where TDI – Technical Development Index  
TCI- Technical Challenge Index  
PPP- Power Production Potential

Presented in form of dimensionless values (Predicted TDI divided by lowest TDI possible in area of interest)

**Marine User Data**

Commercial and recreational fishing  
Recreational boating  
Existing licenses (leases)  
Aggregate extraction  
Conservation  
Aquaculture
Natural Resource Data

Birds
Fish and fish habitat
Marine mammals and turtles
Water and air quality
Historical and cultural resources

SAMP Research

Research Topics Include...
- Wind resources
- Marine mammals and birds
- Fisheries uses
- Physical oceanography
- Ecosystem interactions
- Sediment and benthic habitat
- Cultural resources
- Acoustics and electromagnetic effects
- Meteorology
- Engineering
- Marine transportation uses

Rhode Island Ocean Special Area Management Plan (SAMP)

Boat-based Surveys (February 2009 – May 2010)
- 8 randomly-located sawtooth line transects to estimate density
- One survey per week conducted on 2 grids
- Each 4 by 5 nm grid gets surveyed once per month

Waterfowl abundance in Narragansett Bay based on DEM mid-winter waterfowl counts

Day 2 - 13 July 2011
Presentations/Environmental/State Planning Panel
Day 2 - 13 July 2011
Presentations/Environmental/State Planning Panel

Key Findings:
- Wind turbines result in habitat loss in and around the wind farm.

Pre

Post

Figure A. Density charts of Common Scoter in the control area, pre, post, and in the study area, pre, post and post with wind farm. The density chart includes the following:

- Pre: 2010-2011
- Post: 2012-2013
- Study Area: 2014-2015

[Map or chart showing data]

Rhode Island Ocean Special Area Management Plan (SAMP)
Ocean SAMP Document

- Ecology of the Area
- Cultural and Historical Resources
- Fisheries Resources
- Recreation and Tourism
- Marine Transportation
- Marine Infrastructure
- Offshore Development Renewable Energy
- Future Uses
- Climate Change
For More Information

- http://seagrant.gso.uri.edu/oceansamp/
Project Objectives

- Develop standardized protocols for baseline assessment and monitoring for offshore wind, wave and current energy development
- Develop a conceptual framework and approach for cumulative environmental impact evaluation

Year 1

- Engage researchers, regulators and industry
  - Project Advisory Committee
  - Topic Area Advisors
- Identify potential effects where data needs to be collected & monitoring performed
  - Scale 1- Individual Device
  - Scale 2- Utility-Scale Development (~100 devices)
  - Scale 3- Several Utility-Scale Projects in a Region
- Comparative Evaluation of current monitoring techniques
  - Current U.S. monitoring in other offshore industries
  - European & Other International monitoring techniques

Year 2

- Identify techniques for standardized baseline and monitoring protocols
- Develop a ‘common language’ for data collection
  - NOAA’s Coastal & Marine Ecological Classification Standard
  - To feed into Ecological Valuation Index and Cumulative Impact Model (Obj #2)

CEQ Task Force: Proposed national priority objectives

- Ecosystem-Based Management:
  Adopt ecosystem management as a foundational principle for the comprehensive management of the ocean, our coasts, and the Great Lakes
- Coastal and Marine Spatial Planning:
  Implement comprehensive, integrated, ecosystem-based coastal and marine spatial planning and management in the United States.
- Inform Decisions and Improve Understanding:
  Increase knowledge to continually inform and improve management and policy decisions and the capacity to respond to changes and challenges. Better educate the public through formal and informal programs about the ocean, our coasts, and the Great Lakes.
- Coordinate and Support:
  Better coordinate and support Federal, State, tribal, local, and regional management of the ocean, our coasts, and the Great Lakes. Improve coordination and integration across the Federal Government, and as appropriate, engage with the international community.
Contours of Non-Dimensional TDI with Glacial Geology

**Scenarios**

- TDI with AIS > 24 counts and Exclusionary Areas removed
- TDI > 2.5 with AIS > 24 counts and Exclusionary Areas removed
- TDI with visual buffer 15km

**Example of Mapping Strategy**


**Habitat Mapping Approach**


**Siting Evaluation Model - Tier 2 Screening**

**Goal**

Habitat mapping → Classification → Ecosystem-based management
Monitoring must test hypotheses about changes induced by man (including climate change) by sampling the environment repeatedly across space and time.

• One approach:
  Replicate data by reoccupying the same sites over time. Data can be tested for changes using classical ANOVA multivariate approaches.

• A new approach (Legendre, et al., 2010. Ecology 91, pp. 262-272)
  Uses ANOVA models to detect a significant space-time interaction without replication (without occupying the same sites). This interaction indicates ecosystem change. This approach allows comparisons to be made using historical data sets, and data sets with random site selection. It may also be more cost effective than #1.

Obstacles Encountered and Remaining Gaps

• Effective approach [ as perceived by both cognizant parties and stakeholders] to coordinating Federal, State and developer baseline study efforts.

• Appropriate study scales are regional, and consensus regional approaches need to be developed.

• Need to develop a cost-effective approach to maximize study area coverage.

• Need to develop straightforward and easily understandable indices to evaluate impacts and make siting decisions.

• Need to develop cost-effective and scientifically valid monitoring programs, and a straightforward and easily understandable approach to deciding site-specific requirements of monitoring programs.
The Marine Mammal Protection Act
Incidental Take Authorization Process

Michelle Magliocca
Office of Protected Resources

The Act

Prohibits the taking of marine mammals
Unless exempted or authorized under a permit:

• Commercial fishing
• Scientific research
• Subsistence hunting in Alaska
• Measures taken to protect personal safety or property
• Incidental Take Authorizations

Sections 101(a)(5)(A) and (D)

Upon request, the Secretary (of the Department of Commerce) shall allow the incidental take (but not intentional) of small numbers of marine mammals pursuant to a specified activity (other than commercial fishing) within a specific geographic area if…

...after public comment period, the Secretary finds:

• Negligible impact
• No unmitigable adverse impact for subsistence use
• Permissible methods of taking are clear
• Mitigation and monitoring measures set forth

Authorizations

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<tr>
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<th>Letter of Authorization (LOA)</th>
<th>Incidental Harassment Authorization (IHA)</th>
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<td>101(a)(5)(A)</td>
<td>101(a)(5)(D)</td>
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<tr>
<td>What it Authorizes</td>
<td>Harassment or mortality</td>
<td>Harassment only (Level A or B)</td>
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Wind Power Considerations

• Pre-construction surveys
• Acoustic impacts during construction
• Possibility of entanglement
• Acoustic impacts during operation
• Modifications to avoid impact
Acoustic Criteria

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<tr>
<th>Criterion</th>
<th>Criterion Definition</th>
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<td>180 dBrms, re: 1 μPa</td>
<td>190 dBrms, re: 1 μPa</td>
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<tr>
<td>Level B Behavioral disruption for impulse sounds</td>
<td>160 dBrms, re: 1 μPa</td>
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<tr>
<td>Level B Behavioral disruption for continuous/non-impulse sounds</td>
<td>120 dBrms, re: 1 μPa</td>
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Application Questions

Activity
- Description, date(s), duration, and location

Marine Mammals
- Species, numbers, status, and distribution

Takes
- Type, methods, and amount

Impact
- On species, subsistence, and habitat

Mitigation

Purpose: to include the means of effecting the least practicable adverse impact

General goals:
- Avoidance/minimization of injury or death
- Reduction in takes
- Reduction in intensity of takes
- Avoidance/minimization of impacts on habitat
- Increase in probability of detecting marine mammals

Adaptive management

Monitoring

Purpose: (1) to document level of take; (2) to document effects of activity; and (3) to increase knowledge of effected species

General goals:
- Increase understanding of species
- Increase understanding of take impacts
- Increase understanding of effectiveness

Separate from mitigation monitoring

Compliance

- National Environmental Policy Act (NEPA)
- Endangered Species Act (ESA)
- National Marine Sanctuaries Act
- Magnuson-Stevens Fishery Conservation and Management Act

Contact Information

http://www.nmfs.noaa.gov/pr/permits/

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Day 2 - 13 July 2011
Presentations/Environmental/Broad Scale Habitat, Abundance & Distribution/Consultation Process
The Endangered Species Act Overview

Sec. 2: Purpose
Sec. 3: Definitions
Sec. 4: Listing, Recovery, and Monitoring
Sec. 5: Land Acquisition
Sec. 6: Cooperation with the States
Sec. 7: Interagency Cooperation (section 7 consultation)
Sec. 8: Convention Implementation [CITES]
Sec. 9: Prohibited Acts
Sec. 10: Exemptions
Sec. 11: Penalties and Enforcement

Selected Definitions

Endangered Species – Any species in danger of extinction throughout all or a significant portion of its range.

Threatened Species – Any species which is likely to become an endangered species within the foreseeable future throughout all or a significant portion of its range.

Critical Habitat – The specific areas within the geographical area occupied by the species, on which are found those physical or biological features (1) essential to the conservation, and (2) which may require special management protections.

Take – Harass, harm, pursue, hunt, shoot, wound, kill, trap, capture, or collect, or to attempt to engage in any such conduct.

Types of Section 7 Consultation

- **7(a)(1)** To further Federal conservation programs
  - Action “may affect” listed species or critical habitat
  - Federal Agency: Upon review of programs or development of conservation

- **7(a)(2)** To insure Federal Activities are not likely to jeopardize/adversely modify
  - Action “may affect” listed species or critical habitat
  - Federal agency: During proposed action approval

- **7(a)(3)** (Early Consultation) To insure Federal Activities are not likely to jeopardize/adversely modify
  - Action “may affect” listed species or critical habitat
  - Federal agency and applicant: Before submission of applications for approval of proposed action

- **7(a)(4)** (Conference) To insure Federal Activities are not likely to jeopardize/adversely modify (proposed species/critical habitat)
  - Action is “likely to jeopardize” proposed species or “destroy or adversely modify” proposed critical habitat
  - Federal agency and applicant: During proposed action approval
Section 7(a)(2) Consultation

Each Federal Agency Shall:

“...insure that any action authorized, funded or carried out is not likely to jeopardize the continued existence of listed species or destroy or adversely modify critical habitat.

• Use the best scientific and commercial data available

• Triggered by Federal actions that "may affect" a listed species and/or designated critical habitat

Information Required for Consultation (Initiation Package)

A written request for consultation and must include:

• A description of the action

• A description of the specific area affected by the action

• A description of the listed species/critical habitat that may be affected by the action

• A description of the manner in which listed species/critical habitat may be affected

• Any relevant reports (e.g., NEPA documents & others)

• Other relevant studies or available information

Biological Opinion

Results from a formal consultation – Required if an Action has unavoidable adverse effects

• Determines whether an action is likely to jeopardize the continued existence of threatened or endangered species and/or is likely to destroy or adversely modify critical habitat that has been designated for listed species.

• If incidental take is anticipated, an Incidental Take Statement is attached.

Jeopardy and Adverse Modification

“Jeopardize the continued existence of” – to engage in an action that reasonably would be expected, directly or indirectly, to reduce appreciably the likelihood of both the survival and recovery of a listed species in the wild by reducing the reproduction, numbers, or distribution of that species.

Adverse Modification – a direct or indirect alteration that appreciably diminishes the value of critical habitat for both the survival and recovery of a species.

Incidental Take Statements

• Incidental Take results from, but is not the purpose of, carrying out an otherwise legal activity conducted by a federal agency or applicant.

• If incidental

• Following the reasonable and prudent measures and terms and conditions contained in an Incidental Take Statement exempts incidental take from the section 9 prohibitions.

• If take of any listed marine mammal is anticipated, then that take must also be exempted under the MMPA.
Section 7 Assessment Structure

- Identify the "Action"
- Identify the Action Area
- Assess the "Species'" Exposure
- Assess the Risk to "Species"
- Assess the Risk to Individuals
- Assess the Risk to Populations
- Assess the "Species'" Response
- Environmental Baseline
- "Species'" Status
- Cumulative Effects
- Jeopardy/Adverse Mod Conclusion

Section 7(a)(3) Early Consultation

A Federal agency shall:

- ...consult on any prospective action at the request of, and in cooperation with, the prospective permit or license applicant if:
  - the applicant believes that listed species may be present in the area affected by his project;
  - the applicant believes that implementation of such action will likely affect listed species; and
  - Agency certifies "applicant status" for consultation purposes

Applicant's Role in the Consultation Process

If the federal agency identifies an applicant for the purposes of consultation:

The Action Agency provides the applicant an opportunity to submit information for consideration during consultation

The applicant must be informed by the action agency of the estimated length of any extension of the 180-day timeframe for preparing a BA, along with a written statement of the reasons for the extension

The timeframes for concluding consultation cannot be extended beyond 60 days without the applicant's consent

The applicant is entitled to review draft biological opinions and to provide comments;

The Services will discuss the basis of the biological determinations with the applicant and use the applicant's expertise in identifying reasonable and prudent alternatives to the action if likely jeopardy or adverse modification of critical habitat is determined; and

The applicant receives a copy of the final biological opinion
Section 7 – Interagency Cooperation

- **Section 7a(1)**
  - Directs all Federal agencies to utilize their authorities to further the purposes of the ESA by carrying out conservation programs to benefit listed species
  - Planning portion of section 7

- **Section 7a(2)**
  - Requires each Federal agency to insure that any action it authorizes, funds, or carries out is not likely to jeopardize the continued existence of listed species or destroy or adversely modify critical habitat
  - Consultation portion of section 7

Three Effect determinations

- No effect
- May Affect, Not Likely to Adversely Affect
- May Affect, Likely to Adversely Affect

If the agency determines that their action will not affect listed species or critical habitat, then no further action is needed

Section 7- Interagency Consultation

- If the agency action “may affect” a listed species or critical habitat, the agency may initiate 7(a)(2) consultation with the Service
- Private entities are affected by section 7 when their action needs Federal authorization or funding

Informal Consultation

- Process to assist action agencies in evaluating potential effects on species and habitat
- Consisting of discussions between the Federal agency, and the Services to determine if there are ways to avoid adverse effects to the listed species or critical habitat

Informal consultation

- If necessary, modifications are jointly made and the Service concurs that the action is not likely to adversely affect listed species or designated critical habitat
- Formal consultation is not required

If adverse affects are unavoidable, the Federal agency initiates formal consultation by submitting the necessary information regarding the action, listed species and/or critical habitat from the action agency:

- A description of the action;
- A description of the specific area affected by the action;
- A description of the listed species/critical habitat that may be affected;
- A description of the manner in which they may be affected;
- Any relevant reports prepared on the proposal, and;
- Other relevant studies or available information
Section 7 – Interagency Cooperation

- **Formal consultation**
  - Once initiated, the formal consultation process is carried out within 90 days
  - Within 45 days of the conclusion of formal consultation, the Service will issue a document called a Biological Opinion
  - Therefore, from the date of initiation to the issuance of a Biological Opinion, the formal consultation process can take up to 135 days
  - There are opportunities for extensions, if necessary

- **Two possible outcomes:**
  - Federal action not likely to “jeopardize” species or adversely modify critical habitat
  - Federal action likely to “jeopardize” species or adversely modify critical habitat

  - If action is not likely to jeopardize, BO includes:
    - Incidental take statement estimating amount of take
    - Reasonable and prudent measures and associated Terms and Conditions needed to minimize impacts of incidental take

  - If action is likely to jeopardize, opinion includes reasonable and prudent alternatives that avoid jeopardy or adverse modifications and are:
    - Consistent with the intended purpose of the action
    - Within authority of the Federal agency
    - Technologically and economically feasible

  - Compliance with reasonable and prudent alternatives allow the project to continue
  - In rare instances, such alternatives are not available

- **Compliance with reasonable and prudent alternatives allow the project to continue**
  - In rare instances, such alternatives are not available
**Fishery Management Council Perspective:**

Spatial Aspects of Fishery Management Plans

Michelle Bachman, New England FMC*  
Tom Hoff, Mid Atlantic FMC  
Roger Pugliese, South Atlantic FMC

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**Management authority and structure**

The Magnus Stevens Fishery Conservation and Management Act (magnus stevens 2007), delegates authority to each FMC to “Conserve and Manage” fisheries and fish habitat in the US Exclusive Economic Zone (3-200 miles) seaward of their states:

**NEFMC:** ME, NH, MA, RI, CT  
**MAFMC:** MA, RI, CT, NY  
**SAFMC:** NC, SC, GA, east FL, Key West  
**MAMFC** (NC) is in the SAFMC area but also serves the MAFMC

Council members are citizens from each state who are knowledgeable about fisheries. They serve three-year terms and are appointed by the Secretary of Commerce from lists of nominees submitted by state governors. The official responsible for marine fisheries management in each state, as well as the regional director of the National Marine Fisheries Service are also voting members. Non-voting members include representatives of USFWS, USGS, State Department, and ASMFC.

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**From a regional FMC perspective, what types of general information should be considered during wind energy siting and development?**

- Habitat Closed Areas, Mortality Closed Areas, Gear Restricted Areas, Coral HAPCs, Marine Protected Areas and Special Management Zones in the South Atlantic
- Essential Fish Habitat Designations and Habitat Areas of Particular Concern
- Distribution of fishery resources
- Distribution of fishing activities and revenues

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**Outline**

- Intro to Fishery Management Councils
- General information of interest:
  - Fishery independent data
  - Fishery dependent data
  - EFH designations
- Management programs, analytical tools, and data products related to specific fisheries or regions

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**Collaboration**

- FMCs collaborate with NMFS to develop FMPs, and NMFS implements regulations associated with FMPs
- Some FMPs jointly developed/approved by two FMCs, or, other FMC members participate on plan development committees
- Councils also collaborate with ASMFC on management of some species (e.g. Atlantic herring, Spanish mackerel, scup, black sea bass, bluefish)
- Stakeholders (industry members, recreational fishermen, NGOs) provide input via advisory panels and public meetings
- Technical work is a collaborative effort between council staffs, NMFS science centers, state resource management agencies, other federal agencies, and academic partners
- Emerging opportunities for collaboration with Ocean Observing Systems (e.g. MARACOOS, NERACOOS), regional habitat partnerships, landscape conservation partnerships, regional alliances (Governor’s Alliances, MARCO, NROC, etc.)

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**Fishery Independent Data**

Fish abundance, distribution, environmental data

- Fishery resource surveys are conducted by NMFS Science Centers, via collaborative research partnerships with states
  - SEAMAP, NEAMAP
- Also, cooperative research with industry
  - These data, used primarily for resource/stock assessment, could be used to identify better areas for wind development
  - These data are also used to support EFH designations

*Management Plans are written for species, groups of species, or ecosystem components. Some plans are joint between two councils.*

**NEFMC** – Northeast multispecies (groundfish)
- cod, skates, monkfish*, herring, deep-sea red crab

**MAFMC** – Squid/mackerel/butterfish, bluefish, spiny dogfish*, summer flounder/scup/black sea bass, surfclam/ocean quahog, tilefish

**SAFMC** – Coastal migratory pelagic*, coral, crabs, finfish and live/hard bottom habitat, dolphins/wahoo, golden crab, shrimp, snapper groupers, pelagic sargassum habitat, comprehensive ecosystem amendments supported by the fishery ecosystem plan

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**Council Data and Information for Offshore Wind**

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**Council Data and Information for Offshore Wind**

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**A-137**
Fishery Dependent Data

- Catch, Effort and Revenue

  • Fishing effort data are collected as a requirement of various FMPs:
    - Fish landings through NMFS surveys or state trip reports — required for all Council managed fisheries
    - Vessel Monitoring System data — high spatial/temporal resolution position data — required for most fisheries in NE and MA, only HMS and Rock Shrimp in SA
    - At sea observer data — detailed trip/catch information for a subset of trips
    - Dealer data — prices paid at the dock for the catch
    - Both recreational and commercial data are collected
    - Should consider fishery closed areas/seasons when evaluating the magnitude of effort in a proposed WEA

Essential Fish Habitat

- “Those waters and substrate necessary for spawning, breeding, feeding, and growth to maturity” (MSA)
- Requirements (in brief, see EFH Final Rule issued by NMFS):
  - Describe/identify and designate EFH for all managed species
  - Minimize, to extent practicable, adverse effects of fishing
  - Identify other actions to encourage the conservation and enhancement
  - Identify non-fishing impacts to EFH
- Habitat Areas of Particular Concern (HAPC)
  - An FMC may also designate HAPCs as subsets of EFH based on: Importance of the ecological function, extent to which the habitat is sensitive to human-induced degradation; to what extent development activities are, or will be, stressing the habitat type, and rarity of the habitat type.
SAFMC – Online Habitat and Ecosystem Support Tools

- South Atlantic Habitat and Ecosystem Website
- South Atlantic Habitat and Ecosystem Internet Map Server (IMS) and ArcGIS Services
- Developed in cooperation with Florida Fish and Wildlife Research Institute to support ecosystem-based resource management, habitat, species and ecosystem research, and regional collaboration

Throughout the Northeast and Southeast regions:
Ecosystem Modeling

- Ecosystem models will improve understanding of the complexity of the system and methods to evaluate the impacts of fishing and non-fishing activities
- They integrate data on fish, habitat (pelagic and benthic), and fishery operations
- Models require substantial data inputs:
  - These types of models will be used increasingly as Councils move away from single species/stock management and towards ecosystem-based approaches

Council vision for the future

- Move from single-species assessments/management to multi-species assessments/management to true ecosystem-based assessment/management
  - Develop ecosystem-based FMP amendments to address regulations needed for individual fisheries or regulations across fisheries
- Encourage and facilitate development of regional tools to understand ecosystem impacts of fishing, bycatch, predator-prey interactions, fleet mobility/dynamics and habitat impacts.
  - These tools will provide the ability to evaluate non-fishing activities and aspects of comprehensive place-based management in the region
- Continue to engage with regional marine spatial planning organizations
  - Governor's Alliances, NROC, MARCO (latter is an emerging collaboration)
- Coordinate with agencies and regional organizations to establish research priorities
  - e.g. BOEMRE

Fishery Management Councils and Offshore Wind

- Support evaluation of renewable energy as a potential important use of offshore resources
- Evaluation should be integrated into existing state and regional and possible future (NOC) marine spatial planning frameworks
- Fisheries needs to be explicitly integrated
  - EFH provisions of MSA provide commenting and consultation authority
  - Spatial management actions developed pursuant to FMCs FMPs
  - Urge BOEMRE and others to collaborate with Councils as soon as possible
- Supportive of data-collection efforts and research that may/can be associated with wind projects
- Councils provide a forum for stakeholders to provide comments

Acronyms

- ASMFC – Atlantic States Marine Fisheries Commission
- CEBA – Comprehensive Ecosystem-Based Amendment
- CHAPC – coral habitat area of particular concern (SA)
- EEZ – exclusive economic zone
- EFH – essential fish habitat
- FMC –fishery management council
- FMP – fishery management plan
- HAPC – habitat area of particular concern
- MARCO – Mid-Atlantic Regional Council on the Ocean
- NMFS – National Marine Fisheries Service
- NOC – National Ocean Council
- NROC – Northeast Regional Ocean Council
- OOS – Ocean observing system
- SASI – Swept Area Seabed Impact (model or approach)
NMFS surveys – past and present

Sofie Van Parijs
National Marine Fisheries Service
Northeast Fisheries Science Center

NOAA/NMFS surveys
1. NOAA CetMap (cetacean density and distribution mapping working group)
2. AMAPPS – Atlantic multi year multi agency effort
3. NMFS standard surveys
   - aerial surveys
   - vessel surveys
   - acoustic surveys and monitoring

CetMap project

Jan. 19, 2010 in a letter to the Council on Environmental Quality, NOAA's Dr. Jane Lubchenco committed to convening two working groups to develop a comprehensive noise budget for the oceans (Under water sound field mapping WG) AND to model marine mammal distributions and densities (Cetacean Density and distribution mapping WG).

Product driven undertaking to last 12-16 months (end products June 2012), CetMap composed of 14 scientists (mainly NOAA and external experts)

OBJECTIVE to create a comprehensive GIS-based visualization tool that will identify the single most appropriate indicator of density or distribution, based on the best available science, for a given area, time, and species. Area covered – US EEZ and beyond.

P. Halpin et al., Marine Geospatial Ecology Lab, Duke University

CetMap project

Given that the same quantity and quality of data are not available for all species, areas, and times, a hierarchal framework was developed (based on a review of existing data and available models) to prioritize the ideal methodologies to use for a given area/time/species.

1. Habitat-based density estimates
2. Stratified density estimates
3. Habitat affinity indicators
4. Presence only (no information about absence)

CetMap project

DATA GAP ANALYSIS – EAST COAST US

NEW CETACEAN DENSITY MODELS

East Coast – will be comprehensively remodeled utilizing newly available survey data
Gulf of Mexico – will be comprehensively remodeled utilizing newly available survey data
North Slope of Alaska – habitat-based density estimates will be newly modeled for the Beaufort and Chukchi sea for all species with available data.
West Coast – habitat density estimates already exist for most species/areas/times; however, multiple survey datasets are being considered for new density modeling to fill known gaps in species (e.g., harbor porpoises, gray whales, and coastal bottlenose dolphins) and seasons.
Inland Waters – many different cetacean survey datasets that have been analyzed using different methods exist for both Washington Inland Waters and Cook Inlet. WG participants are exploring the possibility of finding external experts that could assist in analyzing these data more comprehensively.
Gulf of Alaska/Bering Sea – Although participants agreed that new analysis or modeling in these areas would not be possible, CetMap will identify the most appropriate existing dataset or analysis to indicate cetacean density or distribution for given areas and times.
CetMap project
NOVEL SPATIAL METRICS FOR integrating passive acoustics and tagging data.
- Using novel methods for using other pertinent data to inform marine animal distribution and density

Example: N Atlantic right whale

AMAPPS – Western Atlantic surveys

NEFSC Long term multi year surveys for marine mammals
Aerial, ship board and passive acoustic occur year round and target endangered species relevant to each region.
We now have decade long seasonal surveys from aerial. Targeted vessel surveys with specific objectives.
Building passive acoustic capacity to improve detectability of certain species

Small Scale
43 flights

Stratified random broad scale
324 flights

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Presentations/Environmental/
Broad Scale Habitat, Abundance & Distribution/Baseline Data
Passive acoustics

Just when you think you know it all——passive acoustics shows you that you have just begun to scratch the surface.

No visual sighting of right whales over 10+ years of survey effort.
Repeated presence of right whales via acoustic monitoring over 2 years.

Blue Whales, Balaenoptera musculus
NOAA/NMFS Aerial Surveys 1998 - 2014

Fin Whales, Balaenoptera physalus
NOAA/NMFS Aerial Surveys 1997 - 2014

Killer Whales, Orcinus orca
NOAA/NMFS Aerial Surveys 1998 - 2014
NFMS NE and SE surveys

Nearly all of our visual survey data (aerial and ship board) AND some of our passive acoustic data can be found in OBIS - SEAMAP.

Please make sure that you use our best data and use ask the science centers to review it to make sure that it has been accurately represented.
**Atlantic Marine Assessment Program for Protected Species (AMAPPS)**

**Partners:** BOEMRE, NOAA National Marine Fisheries Service (NEFSC and SEFSC), US Fish and Wildlife Service, US Navy – Chief of Naval Operations

**BOEMRE Point of Contact:** Deborah Epperson

**Slides Courtesy of Lance Garrison, NOAA**

**Kimberly Skrupky, BOEMRE HQ**

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**Study Objectives**

1. Collect broad-scale data on the seasonal distribution and abundance of marine mammals (cetaceans and pinnipeds), sea turtles, and seabirds.
2. Collect similar data at finer scales at sites of particular interest.
3. Conduct tag telemetry studies of sea turtles, pinnipeds, and seabirds.
4. Explore alternative platforms and technologies to improve population assessment studies.
5. Assess the population size of surveyed species at regional scales.
6. Develop models and associated tools to translate these survey data into seasonal, spatially-explicit density estimates incorporating habitat characteristics.

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**Multi-year Study Plan**

Within a 5-year cycle conduct assessment surveys for marine mammals, sea turtles, and sea birds along the U.S. Atlantic coast.

Conduct aerial surveys over the continental shelf for marine mammals and turtles in four seasons.

Conduct summer and winter vessel surveys in oceanic waters collecting data on sea turtles, marine mammals, and sea birds.

Expand the spatial scope of migratory bird surveys conducted by USFWS.

Deploy satellite telemetry tags on sea turtles to collect data on movements and dive intervals.

Conduct tag and aerial survey studies of harbor seal and gray seal populations.

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**Multi-year Study Plan**

In addition to improved data collection efforts, enhance existing capabilities for spatial modeling and data collection.

Explore advanced data collection technologies:
- Aerial imagery tools including high-altitude, high-resolution imagery, LIDAR, photogrammetry.
- UAV Gliders to record marine mammal vocalizations, collect oceanographic data, and remotely report detections of interest.

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**Multi-year Study Plan**

In addition to improved data collection efforts, enhance existing capabilities for spatial modeling and data collection.

Integrate collected data and associated environmental data into a common database.

Develop statistical models of habitat and spatial distribution.

Implement decision support tools to allow users to query data and model products to support environmental assessments.

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**Year 1 NMFS Activities**

Aerial surveys for Marine Mammals and Turtles conducted during July-August.

Satellite telemetry tags deployed on sea turtles.

Summer vessel surveys were planned, but vessels were diverted to support DWH efforts.

Winter (Feb-March) surveys were recently completed.
**NMFS Aerial Surveys**

Broad-scale line transect surveys on NOAA Twin Otter

- Surveys flown at 600 ft, airspeed of 100 knots
- Tracklines oriented perpendicular to shoreline
- Data collected for “Distance Analysis” to estimate abundance

**Northeast US Aerial Surveys**

Surveys flown from 17 August to 26 September 2010

- Total of 9,604 km of trackline covered
- Sightings included: 373 cetacean groups (15 sp), 21 seal groups, 69 turtles, 222 other species (fish)
- Employed “circle-back” approach to correct for visibility bias

**Southeast US Aerial Surveys**

Surveys flown from 24 July to 14 August 2010

- Total of 7,944 km of trackline covered
- Sightings included: 181 cetacean groups (6 sp), 1502 turtles
- Employed two-team independent observer approach to estimate visibility bias

**Sea Turtle Tag Telemetry**

- In the southeast, tags were deployed on turtles captured during trawl studies conducted by the SCDNR
- In the northeast, tags were deployed on turtles off of New Jersey with the assistance of a commercial fishing vessel
- Both studies targeted immature loggerheads 61-97 cm length

**Sea Turtle Tag Telemetry - NE**

- 14 loggerhead turtles tagged off of New Jersey and Delaware-2010
- Tags were active through at least January, with several tags still active
- Turtles moved south of North Carolina during November-December

**Winter Aerial Surveys - SE**

- Survey flown between 7 February and 14 March 2011
- High winds throughout survey limited sampling effort to 11 flight days
- High densities of turtles seen between Cape Canaveral and Cape Hatteras
### Year 2 Planned Activities

- Seal tagging studies and aerial surveys
- Additional turtle telemetry studies in northeast waters
- Northeast and Southeast Vessel Surveys – including Bird Observers
  - *R/V Gordon Gunter and R/V Henry B. Bigelow*
  - The vessel-based surveys are currently out
- USFWS Expanded aerial surveys for waterfowl
- Repeat NE and SE summer aerial surveys
**Why does the Navy collect broad scale habitat, abundance & distribution data**

- E.O. 12114 requires all federal agencies to demonstrate leadership in the environmental stewardship requirements of NEPA, MMPA, ESA, CZMA, and related environmental legislation.
- The Navy, in collaboration with cooperating agency NOAA Fisheries Office of Protected Resources, performs NEPA and ESA analyses for all its test and training ranges, and obtains MMPA permits based on best available habitat, distribution and abundance data for marine mammals, sea turtles and other protected and endangered species.

**The Navy-NMFS Adaptive Management Process for Annual Survey Planning**

- The Final Rules that govern the unintentional taking of marine mammals incidental to Navy activities on Navy training ranges and operating areas put in place a requirement to convene a Monitoring Workshop to:
  - Review the monitoring results from the previous two years of monitoring pursuant to the rules and LOAs.
  - Consider the current science applicable to monitoring.
  - Obtain feedback and recommendations from the participants on the monitoring plans.
Scope and Objectives

Phase 1: Objective
- Characterize ambient (background) sound in areas of the OCS that are to be developed for renewable power generation

Phase 1: Scope
- One-year study to record and characterized ambient sounds levels at two BOEMRE-selected sites:
  - 1) Nantucket Sound
  - 2) Delaware Bay

Methods - Recorders

AMAR
- Geospectrum M48B or M8E hydrophones
- 24-bit resolution (low noise floor)
- 12 kHz sampling rate, (5 – 15040 Hz)
- 768 GB solid-state storage
- Float-on-a-rope style, grapple recovery

Wenz Curves
- Wenz (1962) JASA
- National Research Council (2003)
Methods for Ambient Acoustic Analysis

- **Spectral Analysis**
  - Fast Fourier Transform (FFT) on 1 s windows with 50% overlap
  - Averaged at 1 min intervals

- **Presentation of Results**
  - Quartile-distribution plots for entire duration of recording

Ambient Analysis Results

**NANTUCKET**

(October 2010 – January, 2011)

Ambient Results - Spectrogram

Meteorological Data (Buoy 44020 Oct – Jan)

- Wind Speed (kn)
- Wave Height (ft)
- Water Temp (degC)

Ambient Results – Quartile Distributions

**DELAWARE BAY**

(June – October, 2010)

(January – April, 2011)
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Presentations/Environmental/
Acoustic Monitoring Technology and Impacts

Ambient Acoustic Results - Spectrogram

Meteorological Data (Buoy 44009 Jun – Oct)

Hurricane Tracks
Hurricane Earl - 3 Sept  Hurricane Igor – 20 Sept

Ambient Results – Quartile Distributions

Ambient Acoustic Results - Spectrogram

Ambient Results – Quartile Distributions
Summary

- Baseline ambient sound levels at the two sites have been recorded and can be used for future comparisons
  - Shipping and boating are present at both sites throughout the year
  - Biological sources, especially fish, may produce sound levels that can dominate ambient levels in some frequency bands
  - These data are useful for monitoring / assessing protected and endangered species at the development sites

Additional Results (not in scope of phase 1)

- Sample detection/identification of acoustic sources
  - Shipping and Boating
  - Biological sources (including protected species)
    - Whales
    - Dolphins
    - Fish

Methods for Additional Analysis

- Manual Detection by Experienced Analyst
  - Characteristics of recorded signal
  - Additional knowledge
    - e.g., species expected to be in the area
- Automated Detection
  - Search signal for specific criteria associated with a source
  - Can be validated against manual identification

Search Criteria for Automated Detection

- Shipping Detection
  - Occurrence of at least 3 tonal signals in 3 out of 4 minutes in the frequency band between 0 – 1 kHz
- Boating Detection
  - At least 5 seconds with a minimum of 5 tones
  - Often occurring with rapid changes in frequency
- Marine Life Detection
  - Signal contour following used to determine duration, bandwidth, start and stop frequencies, and sweep rate
  - Match characteristics to defined call types

Sponsored by BOEMRE

Thanks to the captains and crews of the Big Game (Cape May, NJ) and the Minute Man (Falmouth, MA)
Ambient Acoustic Results – Band Level Plots

Four, three-month deployments:
- June–Oct
- Oct–Jan
- Jan–Apr
- Apr–Jun

Methods - Deployments

Recording Sites in Delaware Bay (69') Nantucket (55')
NDBC Buys 44020 and 44009 used for meteorological data.

Deployment Status

Jun – Oct 2010
- Delaware Bay
  - Successful AMAR recovery
  - Successful data recovery
- Nantucket
  - Unsuccessful AMAR recovery
  - Successful recovery in January
  - Found with side-scan sonar
  - Recovery line was tangled
  - Unsuccessful data recovery
  - Unit failed after deployment

Oct 2010 – Jan 2011
- Delaware Bay
  - Unsuccessful AMAR recovery
  - Will attempt recovery in April
- Nantucket
  - Successful AMAR recovery
  - Successful data recovery
Compliance Monitoring

- Operating permits require monitoring to assure that endangered whales are not “taken”
- Challenge: detect and localize endangered killer whales within 200m of a tidal turbine
- Strategies – Passive & Active Acoustics
  - Passive acoustic detection and cross-bearing location estimation using two tetrahedral arrays separated by 20m
  - Active acoustic detection and tracking using multi-beam or fixed aspect array

Killer Whale (*Orcinus orca*), or Orca

- Southern Resident Killer Whales
  - Adult Males 6-8 m long, weigh >6 tons
  - Adult Females 5-7 m, weight 3-4 tons

Active Acoustic System Considerations

- Frequency of Operation
  - Selected 200 kHz
- Marine Mammal Hearing

Sonar Pulse Duration

- Focus on pulse duration
  - A common echo sounder transmit pulse is rectangular
  - The pulse is formed by cycles of the sounder operating frequency
  - The bandwidth required to implement a rectangular pulse increases as transmit pulse duration decreases
Sonar Pulse Frequency Content in Relation to Pulse Duration

Sinc Function in Log Scale for 200 kHz 0.5 ms Duration Sonar Pulse

Cumulative integrated spectral energy (About 1% below 100 kHz)

Field Measurement, 200 kHz Echo Sounder, 500 Micro-Second Pulse, 16 m Range

Field Measurement, 200 kHz Echo Sounder, 500 Micro-Second Pulse, 200 m Range

Whales Can Probably Hear the Sonar Pulses
Behavioral Responses To Sonar

Many high-frequency (>200Khz) active sonars have off-frequency noise ‘side-bands’ that appear detectable to marine mammals.

Summary

- COTS sonars operating at 200 kHz generate sound within the hearing range of killer whales and many other marine mammals.
- Evidence is accumulating that there may be a behavioral response to sonar pulses.
- Active acoustics remains in the mix for compliance monitoring but acceptance by regulators is an issue.
- Potential upside – 200 kHz sonars may “alert” marine mammals to the presence of a turbine.
Day 2 - 13 July 2011
Presentations/Environmental/
Acoustic Monitoring Technology and Impacts

Acoustic Data Processing

BRP Scientific Workflow and Analysis

Scales of Analysis: Temporal

Scales of Analysis: Temporal

Cornell-BRP - East Coast Deployments

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Day 2 - 13 July 2011
Presentations/Environmental/
Acoustic Monitoring Technology and Impacts
Effects of EMFs from Transmission Cables on Marine Organisms

Ann Pembroke
Normandeau Associates, Inc.
Presented at
Atlantic Wind Energy Workshop
July 13, 2011

Basis of Concern
- Electrosensitivity
- Magnetosensitivity

Source of Concern
- Unshielded cable
- Shielded cables

courtesy: Scottish Natural Heritage (Gill and Bartlett 2010)

Source of Concern – Magnetic Fields
- AC Cables
  - 33 – 138 kV
  - oscillates
- DC Cables
  - 75 – 500 kV
  - directional

Geomagnetic Field Influence – NaiKun DC export cable
Without geomagnetic field With geomagnetic field

Elasmobranchs Case Study
Sandbar Shark
- Demersal, schooling, migratory
- HAPC (juveniles) in Mid-Atlantic
- Sensitive to bioelectric field
- Sensitive to DC magnetic field > geomagnetic field
Other Fishes Case Study
Sockeye Salmon

- Anadromous
- Dependence on natal rivers
- Geomagnetic cues
- Pelagic behavior
- Potential impact by DC cables near estuary mouth, but other senses come into play

Marine Mammals Case Study
Bottlenose Dolphin

- Sensitive to small changes in geomagnetic field
- Migratory, coastal
- Potential exposure to DC fields up to 50 m above cable
- Speed and agility likely to limit exposure duration

Sea Turtles Case Study
Loggerhead Turtle

- Use geomagnetic field for directional and positional orientation
- Hatchlings swim direction can be influenced by manipulation of magnetic field
- Geomagnetic orientation crucial seaward of wave break
- Reproductive adults use multiple senses to reach beach

Invertebrates Case Study
Spiny Lobster

- Benthic
- Commercially fished
- Daily homing
- Seasonal onshore-offshore migration
- Magnetosensitive
- Potentially sensitive to field up to 20 m either side DC cable

Data Gaps

- Focus of research to date has been on natural electric or magnetic stimuli
- Physiological or behavioral responses of individuals
- Extrapolation to population-level impacts speculative
- Many groups poorly studied
- Early life stages generally not studied

Acknowledgements

BOEMRE Pacific Region Contract M09PC00014
http://www.boemre.gov/omni/pacific/environmental-studies/completed-environmental-studies.htm

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- Eric Nestler, Normandeau
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- William Bailey, Exponent
- Timothy Tricas, University of Hawaii
- Andrew Gill, Cranfield University

contact: apembroke@normandeau.com
Passive Acoustic (PA) Research at NOAA/ NMFS

Dr. Sofie Van Parijs
Northeast Fisheries Science Center

PA Research at NEFSC

4 Main Research Areas

- Ocean Noise Project (2007- ongoing)
- Long term monitoring and behavior of marine mammals and fish (2007- ongoing)
- Acoustic abundance estimation of marine mammals (2007- ongoing)
- Autonomous acoustic technology (gliders) (2010 - ongoing)

OBJECTIVES

- Map ocean noise within SBNMS
- Characterize various contributing sound sources (biological and anthropogenic)
- Evaluate acoustic impact of anthropogenic activities, and effect on animal communication ranges

Ocean Noise Project (2007 - ongoing)

SBNMS Ocean Noise Project: previous analyses

- Analyzes modeled communication ranges for 89 right whales over the course of one month (April 2008)
- Summary: Calling right whales have lost 72–86% of their communication space under present-day conditions.
- One or more of the 89 calling whales in the modeling area was found to be exposed to levels of noise ≥ 120 dB by ships for 20% of the month

SBNMS Ocean Noise Project: current analyses

Expanding previous project to assess communication masking for multiple species and call types

- Right whale upcalls & gunshots
- Minke whale pulse trains
- Humpback whale social sounds & song
- Fin whale song

Integrating sound fields from multiple types of vessels

- Large vessels (carrying AIS)
- Whale watching vessels
- Fishing vessels
**OBJECTIVES**

- Understand basic acoustic occurrence, distribution and behavior of different species
- Validate PA results with respect to other monitoring platforms
- Evaluate effectiveness of PA as a tool for both monitoring & mitigation

**Detectability of Right whale mom-calf pairs**

- **Objective:** Assess calling activity of right whale mothers with their calves across different habitats

**Documenting long term occurrence of whale species**

**Movements of singing humpback whales on foraging grounds**

- Developing new tracking metrics to assess changes in behavior

**Right whale acoustic behavior**


- **AMAPPS Summer 2011:**
  - When bad weather = acoustic detection still possible
AMAPPS Summer 2011

Integration of acoustic information with visual data

Autonomous Acoustic Technology (2007 – ongoing)
Collaborative project with WHOI (M. Baumgartner & D. Frantantoni)

OBJECTIVES

• Record low and mid-frequency marine mammal vocalizations
• Detect, classify, and report vocalizations of interest in REAL TIME
• Collect oceanographic data

Real time relay of detections underway

NEFSC: Current PAM Field Projects

Characterizing Ocean Noise in the Mid-Atlantic Bight (ongoing) - conjunctive research with fossil fuel exploration

SEFSC: Current PAM Field Projects

Transmit monitoring of Southern Resident killer whales

NWFSC: Current PAM Field Projects

Remote monitoring of Southern Resident killer whales

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What next for PA

1. Finalize last stages of emerging technologies e.g. gliders
2. Make processing capacity more widely available e.g. Cornell tools
3. Develop better integrative tools for PA e.g. CetMap
4. NOAA PA archive – working with NGDC for archiving and NOPP project for establishing the data portal.
Day Two

- Open Microphone

An opportunity for participants to present any other relevant efforts that have been recently completed, or that are on-going that may have an impact on TA&R research efforts.

“Proven Technology” in New Operating Environments

Several differences in the operating environment of the Atlantic seaboard, and the areas where offshore wind turbines currently are sited have been identified, e.g. hurricanes and open-ocean breaking waves. What other issues present unique concerns for the US OCS? What can we adapt from oil and gas experience?

Marine Hydrokinetic (MHK) Devices (with special emphasis on current devices in the Gulf Stream)

FERC will be the regulatory agency for construction and operations of some MHK devices on BOEMRE leases, but if the device is not grid connected, BOEMRE will regulate its construction and operations. Design standards have not been developed for these devices. What are the key operational safety/protection of the environment concerns?

Design and Safety Standards Gaps

Several preliminary studies and on-going standards maintenance efforts have been initiated. What gaps have been identified? Are they appropriate for consideration for research under the TA&R program funding?

Regulating Worker Safety

The risks to offshore oil and gas workers and terrestrial wind farm workers will be discussed with the goal of determining the key issues of regulating renewable energy worker safety on the US OCS.

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January 7, 2011 China: Three workers have been killed while installing and testing a wind turbine in northern China. One of the three workers suffered an electric shock in the nacelle. The other two workers were badly injured from the resulting fire and died later in hospital.

April 22, 2011 - NJ Shuts Down Onshore Wind Turbine Program After Major Malfunction - All three blades break free of newly installed turbine in what is labeled an “abnormal occurrence”

April 14, 2011 - As a damaged wind turbine lays on the ground behind Western Reserve High School where it fell from its tower Sunday afternoon, the district’s two other electricity-generating units sit idle while officials with the company that built them try to determine why this one collapsed.

April 2011 - US Department of Labor’s OSHA cites wind farm servicing company for 6 willful safety violations after worker suffers burns in wind tower.

April 2010: IPSWICH: Two men who broke into a substation and watched in horror as a father-of-two was electrocuted have admitted to two charges of burglary. Johnathan Ehlert, was killed after sustaining fatal burns.

July 2010: Ross County OH: A man was electrocuted in an Ohio co-op substation. Investigators say he died trying to steal copper wire.

March 2011: McDowell County NC - What started as a plan to steal copper wire from the Duke Power substation ended in the death of a 19-year-old authorities say was electrocuted.
Recent documents submitted to BOEMRE have revealed that offshore wind turbines may contain substances that present hazards that are not obvious, e.g. ethylene glycol contained in a dampering system. What other unknown hazards are there? How do we work around IP issues?

OSHA to fine LM Wind Power $136,500

In two days in October, inside of wind-turbine blade No. 106, the amount of a hazardous substance called styrene reached 1,889 parts per million and then 2,195 parts per million, triggering air-quality alarms at LM Wind Power in Grand Forks. Workers were inside the confines of the giant blade, but a supervisor failed to get them out, according to the U.S. Occupational Safety and Health Administration. Styrene is a hazardous chemical used in fiberglass production and the maximum exposure OSHA allows is 600 parts per million.
Worker Safety for Offshore Wind Energy Projects

John Cushing
Bureau of Ocean Energy Management, Regulation and Enforcement (BOEMRE)
13 July 2011

Existing Regulations

- 30 CFR 285.810 – Safety Management System:
  a) How you will ensure safety of workers
  b) Remote monitoring, control, and shut down
  c) Emergency response procedures
  d) Fire suppression equipment, if needed
  e) How you will test SMS
  f) How you will train workers

Industry “Best Practices”

- 33 CFR Subchapter N, “Outer Continental Shelf Activities”:
  • USCG regs applicable to offshore oil & gas platforms on OCS.
  • Includes requirements for manned and unmanned platforms.
  • Addresses workplace safety & health, design & equipment, lifesaving, firefighting, operations, etc.
  • Being updated with more comprehensive requirements.
- EN 50308, “Wind turbines – Protective measures – Requirements for design, operation and maintenance”:
  • European standard, refers to other European standards.
  • Addresses access & escape, working areas, climbing, guards, lighting, noise, emergency stop, power disconnect, fire protection, manuals, safety instructions & emergency procedures, etc.

BOEMRE Contacts

- John Cushing: Safety & Enforcement Branch, 703-787-1737, John.Cushing@boemre.gov
- Lori Medley: Engineering & Research Branch, 703-787-1915, Lori.Medley@boemre.gov
Day 2 - 13 July 2011
Presentations/Technology Assessment and Resource Program

**Getting there**
Wind power is about 30 years ahead of MHK; wave and tidal power are about 10-15 years of open-ocean current MHK. A useful framework for progress is...

<table>
<thead>
<tr>
<th>Technology Readiness Levels</th>
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<tbody>
<tr>
<td>Research</td>
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<tr>
<td>Feasibility</td>
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<tr>
<td>Discovery</td>
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<tr>
<td>Proof of Concept</td>
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<td>Laboratory Validation</td>
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**Comprehensive System Approach**
- Industry Technology
  - Development Assistance
  - Testing and Optimization
  - Standards Development
  - Environmental Assessment
  - Resource Characterization and Modeling
  - Regulatory and Policy Input
  - Public Outreach
  - Education Programs and Workforce Training

**Test Capabilities**
Small-scale Offshore Test Berth
Surface-deploy systems with rotors as large as 3.5m radius or 100kW peak power production.
- BOEMRE interim Policy lease in process.
- Implementing of EA development at BOEMRE for IP lease.
- Future 238 Research Lease under consideration and review.

**Other SNMREC Value**
- Research and Development:
  - Intelligent Monitoring and SCADA Systems
  - Device Performance Measurement Suite
  - Turbulence Characterization

**Beginnings**
Computer-controlled, 20kW class dynamometer: generator and intelligent monitoring system testing is underway.
- Instrumented mooring and telemetry buoy, sea-tested and ready for summer deployment in the Florida Current. Experimental turbine system ~50% complete.
Another challenge

Assuming the economics work out, we must ask: Can energy recovery on these scales be done in the context of environmental stewardship?

The answer involves two related perspectives:
- environmental concerns specific to the Florida Straits,
- environmental benefits of implementing renewable energy recovery.

The balance of these will determine the future of marine renewable energy in Florida.

Aerial Surveys

- Assess sea turtle individual and species distribution that might be affected by interaction with devices
- Monthly surveys being conducted with currently accepted protocol – human observers
- Developing technology package: video record and post-processing capability
- NOAA collaboration

Environmental Milestones

- 14-month time series of Florida Current velocity profile;
- Offshore observatory being developed (ADCPs, CODAR)
- First simulations of current as perturbed by energy extraction;
- Benthic survey of operations area complete;
- Aerial surveys for sea turtles and marine mammals in progress, including automated video recognition system.
Birds and Bats Breakout Session

Wednesday July 13, 2011

Session Objective

- To present information on current and planned research efforts and immediate information needs – follow up to recent FWS workshop
- Presentation/panel and facilitated discussion

Presentation Summary

- Summary of Marine Bird Science and Offshore Wind Workshop – Melanie Steinkamp (FWS)
  - Summary of current knowledge on distribution and abundance of marine birds in the North Atlantic
  - Identify and prioritize future scientific research and monitoring

- Current Research Efforts
  - Dr. Caleb Gordon (Normandeau)
    - Endangered Bird Species Risk Assessment - potential for interactions between endangered and candidate bird species and wind facility operations on the Atlantic OCS
  - Acoustic/Thermographic Offshore Monitoring System
    - monitoring of spatiotemporal abundance of marine birds on the AOCS
  - Aerial High-definition Imaging Pilot Study - pilot study of aerial high-definition surveys for birds, marine mammals and sea turtles on the AOCS

- Current Research Efforts (cont’d)
  - Dr. Allan O’Connell (USGS)
  - Dr. Richard Veit (CSI/SUNY)
    - Results from ships of opportunity cruises and examples of persistent aggregations or ‘hotspots’
    - Ongoing BOEMRE funded studies and future activities
  - Dr. James Woehr (BOEMRE)
  - Steve Pelletier (CWB Stantec)
    - Ongoing offshore bat research in Gulf of Maine and data needs

- Research Needs
  - David Bigger (BOEMRE)
    - Maps showing species spatial and temporal abundance and distribution
      - Hot spots and cold spots
      - Persistent aggregations
      - Migration routes
    - What environmental or oceanographic features drive distributions?
    - Guideline development for avian surveys
    - Identify priority species
    - Species risk – how are they vulnerable?
**Bats – Data Needs**

- What species are offshore and when are they there?
- Regional use
- Annual variability
- Species at risk
- Flight characterization (foraging, migration, breeding)
- Distance to shore gradient
- Turnover rates
- Influence of white nose syndrome on behavior and populations
- Standardization of data collection
  - What are the metrics/answers needed to make decisions?
  - Also needed for birds

**Birds – Decision Support Tool**

- Risk Model/Flavored Bird Distribution and Abundance Map – BEST BIRD MAP
  - Where are the birds?
  - What birds are there?
  - How many are there?
  - What is the passage rate?
  - Vulnerability/exposure (including behavioral factors e.g., flight altitude, attraction, etc.)
  - What are dive times?
  - Need to link habitat information to species distribution and abundance

**Birds – Data Needs for Best Bird Map**

- Distribution and Abundance Data
  - Use existing information
  - Fill survey gaps (South Atlantic Bight, Gulf Stream, T&E species)
  - Study nocturnal movement patterns
  - Study migration patterns for little known species
  - Develop predictive models - where we expect to find birds given a set of variables or characteristics
    - Develop modeled distribution to encompass data deficient areas
    - Includes covariables affecting distribution and abundance (e.g., physical environmental features, behavior, prey distribution, etc.)

**Birds – Other Needs**

- Pre-development monitoring at colonies (e.g., meal delivery rates) - pre- vs. post-construction monitoring
- Post-breeding birds (juveniles)
  - Where are they congregating post fledging/pre-migration?
- Effects of turbines/structures on environmental conditions that influence bird distribution and abundance (attraction, eddies)
- Permanent FTE - data manager for seabird database
- Improved data sharing

---

**Developing the Best Bird Map – Next Steps**

- Get the most out of existing data
  - metadata
  - remove artifacts
  - develop data quality estimates
- Structured Decision Making (SDM) workshop for sensitivity analysis (identify species vulnerabilities, risks, and priority species)
- Predicted distribution and abundance
- Weight distribution and abundance by risk (model output e.g., color coded map)
Immediate Information Needs

David Bigger
Avian Biologist
Office of Alternative Energy Programs
Bureau of Ocean Energy Management, Regulation and Enforcement
July 13, 2011

Key Stages of Renewable Energy Program*

Planning and Analysis

Lease or Grant

Site Assessment

Commercial Development

* Engage intergovernmental task forces, stakeholders, and public throughout

Regional Environmental Assessment

- Feb 2011: Announced WEAs and launched Environmental Assessment (EA)
- EA will evaluate potential impacts of leasing, site assessment and characterization activities off DE, MD, NJ, and VA
- WEAs identified following outreach, collaboration through Interagency Task Forces; may be modified through evaluation process and by EA analysis
- Draft EA released this week for a 30-day public comment period

Lease Site Assessment Stage

- Lease provides a 5-year period to collect site-specific data:
  - Informs preparation of the lessee’s construction and operations plan (COP)
  - May include archaeological, biological, geophysical, geotechnical, shallow hazard and other site characterization surveys
  - BOEMRE conducts environmental and technical reviews of the lessee’s site assessment plan (SAP)
- Submitted for planned bottom-founded data collection facilities (e.g., meteorological towers or meteorological buoys)

Planning and Analysis Stage

- Engage intergovernmental task force, stakeholders, and public
- Publish planning notices
- Request for Interest (RFI)
- Call for Information and Nominations (Call)
- Announce Area Identification (Wind Energy Areas)
- Conduct environmental compliance and consultation

Lease or Grant Stage

- Engage intergovernmental task force, stakeholders, and public
- Publish notices
  - Request for Competitive Interest
  - Determination of No Competitive Interest (Noncompetitive)
  - Proposed and Final Sale Notices (Competitive)
- Issue leases or grants
  - Negotiate lease or grant (noncompetitive)
  - Hold lease or grant auction (competitive)
Lease Construction and Operations Stage

- Lease provides a 25-year period to construct and generate electricity.
- Lessee submits construction and operations plan (COP) that describes:
  - Overall site investigation results (includes physical and biological survey results)
  - Offshore and onshore support
  - Any proposed mitigation and monitoring and lease stipulation compliance
  - Design, fabrication, installation, and operations concepts
  - Decommissioning and site clearance concepts
- BOEMRE prepares an EIS and conducts environmental & consultation and technical reviews.
- After 25 years of operation, lease expiration occurs and decommissioning is required unless a renewal is granted.

Information needs

- Maps showing species spatial and temporal abundance and distribution
  - Hot spots and cold spots
  - Persistent aggregations
  - Migration routes
  - What environmental or oceanographic features drive these distributions?

Immediate Information Needs

<table>
<thead>
<tr>
<th>Key stage</th>
<th>Information need</th>
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<tbody>
<tr>
<td>Planning and Analysis</td>
<td>- Maps of species distribution &amp; abundance</td>
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<tr>
<td></td>
<td>- Identification of priority species</td>
</tr>
<tr>
<td>Lease or Grant</td>
<td>- Estimated number of surveys</td>
</tr>
<tr>
<td>Site Assessment</td>
<td>- Maps of species distribution &amp; abundance (updated)</td>
</tr>
<tr>
<td>Commercial Development</td>
<td>- Risk assessment for priority species</td>
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</table>
Workshop Goals and Objectives

Objectives:
1. Get everyone up to speed on what we know now (studies past 3-5 years)
2. Determine the data needs within the context of the decisions that have to be made
3. ID data gaps
4. Prioritize science needs

Workshop Materials

- Much prep work ahead of time
- Used seabird database of historic (and most recent) seabird data compiled by USGS.
- Created seabird distribution and abundance maps to stimulate discussions
- Asked all PI’s doing work in the Atlantic on seabirds to provide data.
  - Dist and Abund from historic database
  - NJ and RI study results
  - Results of listed spp study (piping plover, least tern, red knot)
  - Cape Wind Studies
  - Tracking Studies
**Focal Species**

- Audubon's Shearwater
- Cory's Shearwater
- Greater Shearwater
- Northern Fulmar
- Northern Gannet
- Common Murre
- Dovkie
- Great Black-backed Gull
- Razorbill
- White-tailed Tropicbird
- Black-capped Petrel
- Loons
- Phalaropes
- Roseate Tern
- Scoters
- Cormorants
- Long-tailed Ducks
- Common Eider

**Discussion –**

- Data adequacy, hot spots (persistent aggregations) and cold spots
- Data artifacts

**Breakout Sessions**

- “What do we know now? Can we identify areas that minimize overlap between birds and wind structures?
  - identifying “hot spots” and “cold spots,”
  - risk assessment, sensitivity analyses, and cumulative impacts.
- How do we define “persistent aggregations”?
- What is our confidence level with our existing data?

**Hot and cold spots**

- Working definition at the workshop:
  - Hot spot is consistent aggregation
  - Cold spot was little consistent aggregation
  - Need scientifically valid definition
  - Are hot spots vulnerable to wind development?
  - ID places where fewer birds will be encountered – not zero birds and not just vulnerable species or fewer possible encounters.
- Hot spots and cold spots can be stable or temporal
- Interested in the intersection of both habitat and species. We have species and area-driven questions to address simultaneously. All yield slightly different types of information.
Information Issues

- To reduce the overall information needed, focus on species at risk, periods of vulnerability, and the nature of the vulnerability (migration, foraging behavior, etc.)
- Design studies around these variables because cannot bring the risk down to zero
- Current information is highly variable in quantity and quality for some species
- Clear consensus on need for prioritized matrix of information and gaps

Disparity in quantity and quality of data by species and location

- More info on some species. For example, we have data on individual movements for some species groups.
- Very little information in the southeast Atlantic.
- Quality of the data varies for species.
- Need to consider the quality and type of information needed when determining gaps.

Cumulative Impacts and Sensitivity Analyses

- Cumulative impacts – What is the impact from all effects, not just direct take (e.g., displacement from foraging or energetic effects)
- Requires a risk assessment
- Need to determine the effects of turbines on the environment. Eddies created? Attraction?
- Other vulnerabilities based on species status and behaviors?
- Consensus on the need to conduct sensitivity analyses based on species status and behaviors.

Breakout

- What are the key factors influencing site selection. Why are the birds there?
- Identify these factors and the data describing them.
- Confidence levels with the data?

Factors

- Presence/Absence
  - Areas of aggregation – seasonal patterns, how long, why there, persistence (bird days)?
  - Migratory pathways – diurnal movements
  - Colonies – static aggregations
  - Molting
  - Roosting

- Physical characteristics – includes features influencing prey availability
  - Upwelling, tides, currents
  - Oceanographic – gyre, gulfstream
  - Bays – large rivers
  - Water temp, salinity, chlorophyll, zooplankton
  - Depth/substrate, bathymetry
  - Distance from shore/colonies
  - Islands

Factors

Vulnerability – related to
- Behavior – flight altitude, avoidance, displacement, attraction/creation of forage opportunities
- Weather

Status
- Declining population/conservation concern
- T&E
- State-listed
- Shoal feeding (habitat obligate)
- Regional responsibility (% pop)
- Nuisance species
Day 2 - 13 July 2011
Presentations/Birds and Bats

Factors
Biology, Ecology, Behavior
- Migratory altitude and pathway
- Foraging behavior
- Weather patterns – affect risk
- Seasonal effects
- Overwintering areas
- Productivity/forage base
- Risk – transit hwy, commuter routes, flight height

Anthropogenic
- Commercial and recreational fisheries

Factors
Species groups – Which species to focus on for potential impacts – includes collision, displacement and avoidance. Weather is major potential factor
- Gannets and fish eating birds that may forage within the rotor swept zone
- Alcids and seaducks, loons – bottom feeders that may be displaced
- Terns and gulls – making daily foraging trips to/from breeding grounds

Breakout
Groups asked to assess the quality of the data available to define persistent aggregations or cold spots
- Data quality varies.
- Little information for the SE Atlantic and Gulf of Mexico
- Information varies by species, region, and proximity to shore
- No information on nocturnal movements/patterns

Data Quality
- Available data was reviewed within the following categories:
  - Distance from shore (nm)
    - Within 3 miles of coastline
    - Between 3 and 25 miles offshore
    - 25 miles to 200 miles
    - Greater than 200 miles
  - Seasonal (summer, winter and migration)
  - Region
    - Gulf of Maine, Hudson Canyon to Cape Cod, Mid-Atlantic and South Atlantic
  - Data quality – from 1 (poor, low confidence) to 5 (excellent, high confidence)

Data Gaps
Data gaps: (not in order of priority)
1. The southern Atlantic (south Atlantic Bight) and Gulf Stream have incomplete data (very little). We need all data here (baseline, movement patterns, etc) (diurnal and nocturnal)
2. Nocturnal use/movement patterns (everywhere). This includes foraging routes, and daily commuting routes from either colonies or roosts and seasonally.
3. Migratory routes, including songbirds
4. Fine scale nearshore information
5. Bird prey data – Hydro-acoustic or other data on bird prey collected simultaneously with surveys
6. Integration of radar with other seabird data.

PROCESS FOR IDENTIFYING PERSISTENT AGGREGATIONS and INTERPRETING THEM
2. Map PAs
3. Full-time data manager needed (permanent).
4. ID data gaps at different scales - Describe how to fill. Be specific.
   E.g., Southern Atlantic
5. Fill South Atlantic data gap and nearshore data gap coast wide.
6. Species gaps: ID them - T and F species needs, other species such as white-winged scoter, other sea ducks, goose, eiders, brant, goldeneye.
7. Create updated species maps/correct and give to science community for review of PAs
8. Consider long-term monitoring needs – clearly define why the monitoring is needed – what questions is it answering, what model is it to be used in, etc. Or in and at identified PAs.
9. Develop recommendations for how to interpret and apply PA maps.
Data Gaps
7. Small boat surveys of targeted areas: Gulf Stream off Cape Hatteras, Stellwagen Bank, WEAs
8. Pre-development monitoring at colonies, including meal delivery rates
9. Post-breeding birds – (juveniles) where are they commuting? What are the patterns after they leave breeding colonies but before they migrate? How do these behaviors influence risk? Take into account season and age of the bird.
10. Survey of Gulf Stream (ES) – e.g., Roseate Tern, Cahow, Fea’s Petrel, Zino’s Petrel, Herald Petrel

Science Needs
- Maps
  - Scale is critical; resolution is too coarse at regional scale; Need nearshore data
    - Areas with “no birds” – no transects?
  - Need to identify data artifacts
  - Data confidence layer
  - Metadata
  - Database Manager – permanent FTE

Science Needs
- Matrix on science needs according to risk. Published in Ibis 2006 (European study). Use this as framework to develop prioritized matrix of information and gaps.
- Clearinghouse of all data – including prey data, etc. There is a huge need for a body(ies) (permanent FTE) to coordinate these data sets. Data needed to update predictive models as well as for siting.
- Metadata needs to go into all data collected and stored.
- Nocturnal movements – technology to accomplish this?

Next Steps
- Predictive modeling to tell us where we’d expect to find birds given a set of variables or characteristics (use tactics).
- Create the best possible bird map by taking out the data artifacts such as trawlers, apply predictive models, ID data gaps, and put in migrants.
- Weight the areas that show up as either high use or low use areas (hot and cold spots) by the species we might find there (sensitivity analysis). Start with “cold spots”?
- Finally, we need to weight this map by the actual risk for harmful interactions (flight height, avoidancer, displacement, etc.)
- Explore using SDM to ID alternative wind sites for a state (DE?). Requires critical “thinkers” to set objectives to ID practical/management-oriented models.
- Prioritize list of science needs developed via survey monkey or some other tool.
- Implement priority research and monitoring needs.
**BOEMRE Research on Birds on the Atlantic OCS**

1) Compendium of Avian Information and Comprehensive GIS Geodatabase (USGS-PWRC)

- Information collected over 4 decades from all available sources is being compiled, synthesized and incorporated into a comprehensive GIS Geodatabase.

2) Potential for Interactions Between Endangered and Candidate Bird Species and Wind Facility Operations on the Atlantic OCS (Pandion Systems, Inc. – now Normandeau Associates)

- Development of a probabilistic collision risk model based on observed avoidance behavior.
- The use of the Avian Knowledge Network data to predict whether piping plovers are "coast huggers" or "streetwalkers" over the OCS.
- Development of a new technology combining acoustic microphones and thermographic imagery to detect and identify species of birds offshore in daylight or darkness and in any weather conditions.

3) Automated Analysis of Bird Vocalization Recordings (Cornell University)

- Software developed to automate the analysis of bird vocalizations digitally recorded offshore.

4) Pilot Study of Aerial High-Definition Imagery Surveys for Seabirds, Marine Mammals, and Sea Turtles on the Atlantic OCS (Pandion Systems, Inc. – now Normandeau Associates)

- To minimize error and disturbance to birds below the aircraft.
- To determine the most effective means to monitor seabirds, marine mammals and sea turtles using aircraft surveys on the OCS.
- To include testing the effect of flight altitudes and camera combinations on transect widths and image resolution.
- To recommend a sampling design and provide a cost estimate.

5) Acoustic/Thermographic Monitoring of Temporal and Spatial Abundance of Birds Near Structures on the Atlantic OCS (Pandion Systems, Inc. – now Normandeau Associates)

- A combination acoustic/thermographic detection device that can verify recorded vocalizations to species via thermal imagery simultaneous with the recordings.
- Will provide information on circadian, seasonal, annual, and weather-related variations in bird species presence near OCS structures in daylight and darkness and all weather conditions.
- 2011 deployment will be at Frying Pan Shoals Lighthouse and University of Delaware – Lewes wind turbine.
6) Movements of Long-tailed Ducks Using Satellite Telemetry (Massachusetts Audubon)
- To determine nocturnal locations, roost site fidelity, and movements of Long-tailed Ducks in Nantucket Sound.
- Uses surgically-implanted satellite transmitters

7) Surveying for Marine Birds in the Northwest Atlantic (USFWS-ACJV)
- Bird observers on different NOAA cruises
- Inter-agency agreements with USFWS (ACJV) and NOAA

8) Spring and Fall Migration Corridors and Winter Aggregations of Scoters, Northern Gannets, and Red-throated Loons Between Long Island Sound and the Carolina Outer Banks (probably USFWS-SDJV and USGS-PWRC)
- Will use both surgically implanted and experimental externally-attached, solar-powered satellite transmitters on birds captured from the Outer Banks/Pamlico Sound to Chesapeake Bay

9) Movements of Common Terns and American Oystercatchers around and near Nantucket Sound (probably private contractor)
- 50 Common Terns and 15 American Oystercatchers will be affixed with VHF transmitters
- An array of VHF Receivers will be located around Nantucket Sound and down the coast to Block Island and Long Island (the E-Z Pass technology)
Emerging Results and Technologies for Offshore Wind Wildlife Studies

Caleb Gordon, Ph. D.
Principal Ornithologist, Normandeau Associates (formerly Pandion Systems)

Three BOEMRE Initiatives to Advance Offshore Wildlife Knowledge Baseline

Current research and development projects by Normandeau Associates for the Bureau of Ocean Energy Management, Regulation, and Enforcement (USDOI-BOEMRE)

1. Endangered Bird Species Risk Assessment on AOCs
   BOEMRE contract M8BP20001, “Potential for interactions between endangered and candidate bird species and wind facility operations on the Atlantic OCS”

2. Acoustic/Thermographic Offshore Monitoring System
   BOEMRE contract M8PC20001, “Acoustic monitoring of spatiotemporal abundance of birds on the Atlantic Outer Continental Shelf”

3. Aerial High-definition Imaging Pilot Study
   BOEMRE contract M8PC20009, “Pilot study of aerial high-definition surveys for birds, marine mammals and sea turtles on the Atlantic Outer Continental Shelf”

Project Team

Normandeau tech staff
Christian Neuman (Director)
Caleb Gordon (PI, lead PI)
James Neuman
Greg Forney
Ian Baldwin
Chris Rips

BOEMRE tech direction
Jim Weathers (COR)

Internal co-Pi
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Larry Miles, Consaves Wildlife Foundation
Lucy Vilestra, US Coast Guard Academy
William Warren-Hicks, Ecoadd, Inc.

Scientific Review Group
Eric Smith, Virginia Tech University
Richard Pablikay, Independent consultant
David Mirinachi, New Jersey Audubon Society

Project Advisors
Anne Reex, USFWS
Susi Kim Dempster, USFWS
Annette Scherer, USFWS
Michael Amram, USFWS
Maria Tut, USFWS
Scott Johnston, USFWS
Caleb Ganger, USFWS
Allan O’Connor, USGS
Andrew-Ellott, USGS

Project Objectives

1) “to evaluate the potential for the three endangered, threatened, and candidate species of interest to be impacted by wind facilities located on the Outer Continental Shelf (OCS)”

2) “to determine the best methods to evaluate locations of future wind facilities to minimize risks to the species.”

Avian Risk Assessment Basic Framework

Phase I: Problem Formulation
Stressors and Receptors, Conceptual Risk Model

Phase II: Exposure Characterization

Phase III: Effects Characterization

Phase IV: Risk Characterization

Results Summary 1: Bird mortality-behavior studies at a coastal wind turbine in Buzzards Bay,
Results Summary 1: Bird mortality-behavior studies at a coastal wind turbine in Buzzards Bay, MA

Mortality monitoring results (Vlietstra et al. in review, JFO):

- Collision mortality = 0-5 birds/MW/yr (3 years of carcass searches with bias-correction expts)
- No Roseate or Common Tern mortality (high COTE activity, low ROST activity at site)
- Some evidence of behavioral avoidance of rotor by terns
  - Higher passage rate when rotor stopped
  - Density decrease near rotor

Collision Risk Modeling (Warren-Hicks et al. in review, JWM):

- New collision risk model based on Tucker-Hatch models, but incorporating behavioral avoidance provides biologically realistic tool for offshore collision risk modeling
- Application to Buzzards Bay Roseate Tern shows results similar to those of Cape Wind (Hatch) model

Results Summary 2: Tracking Intercontinental Migration Paths of Red Knots using light-sensitive Geolocators

- 250 LSDL placed on captured REKN
- 11 recovered one year later from recaptured birds
- Both AOCS migratory subpopulations sampled

Results Summary 3: Comprehensive Geospatial Analysis Using Avian Knowledge Network Data

Coastal Data Analysis

Hypothetical Migration Patterns

Red Knot Spring and Fall Concentrations
Day 2 - 13 July 2011
Presentations/Birds and Bats

Results Summary 3: Comprehensive Geospatial Analysis Using Avian Knowledge Network Data

<table>
<thead>
<tr>
<th>Piping Plover Data for coastal New Jersey (AKX)</th>
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<tbody>
<tr>
<td>Total</td>
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<tr>
<td>March</td>
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<td>October</td>
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<tr>
<th>Hypothetical Coastal Migratory Concentration</th>
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Overall Results Summary

- Exposure, therefore risk, is low for all three focal species, primarily because they spend little time on AOCs.
- Red Knot macro-scale exposure on AOCs is limited to semi-annual migratory flights, and could occur anywhere for either migratory subpopulation, but may be concentrated s. of MA in fall, further south in spring.
- Atlantic-breeding Piping Plover exposure on AOCs is limited to semi-annual migratory flights, and could occur anywhere, as migratory flights are probably long-distance, non-stop, and not necessarily coast-following.
- NW Atlantic-breeding Roseate Tern exposure on AOCs is semi-annual (migration) except near breeding colonies. Available data suggest that meso-scale (flight altitude) and micro-scale (behavioral avoidance capacity) exposure is low.
- Many unknowns still exist (migratory flight altitude, susceptibility factors, weather effects) yet low macroscale exposure caps possible risk at a low level

Three BOEMRE Initiatives to Advance Offshore Wildlife Knowledge Baseline

Current research and development projects by Normandeau Associates for the Bureau of Ocean Energy Management, Regulation, and Enforcement (USDOI-BOEMRE)

1. Endangered Bird Species Risk Assessment on AOCs

BOEMRE contract M08PC20060, "Potential for interactions between endangered and candidate bird species and wind facility operations on the Atlantic OCS"

2. Acoustic/Thermographic Offshore Monitoring System

BOEMRE contract M100PG0101, "Acoustic monitoring of spatiotemporal abundance of birds on the Atlantic Outer Continental Shelf" (ATOM)

3. Aerial High-definition Imaging Pilot Study

BOEMRE contract M100PG0319, "Aerial study of aerial high-definition surveys for tile, marine mammals and sea turtles on the Atlantic Outer Continental Shelf"

Acoustic/Thermographic Offshore Monitoring System (ATOM)

- Objective
  - Gather species-specific data on birds and bats flying at rotor swept altitudes at proposed offshore wind facility locations
  - Day and night
  - Throughout the seasons
  - Cost-effective

- Scope
  - Design/develop ATOM, deploy in US waters to gather 1-3 years of data

- Key Partners
  - Cornell Laboratory of Ornithology (bird sound ID)
  - IA tech, Inc. (microphone array design, range testing)
  - Previous BOEMRE research project partners, including M. Desholme

Acoustic/Thermographic Offshore Monitoring System (ATOM)
Acoustic/Thermographic Offshore Monitoring System (ATOM)

ATOM Predicted Detection Beams

Three BOEMRE Initiatives to Advance Offshore Wildlife Knowledge Baseline

Current research and development projects by Normandeau Associates for the Bureau of Ocean Energy Management, Regulation, and Enforcement (USDOI-BOEMRE)

1. Endangered Bird Species Risk Assessment on AOCS
   BOEMRE contract M08PC20060, "Potential for interactions between endangered and candidate bird species and wind facility operations on the Atlantic OCS"

2. Acoustic/Thermographic Offshore Monitoring System
   BOEMRE contract M10PC00101, "Acoustic monitoring of spatiotemporal abundance of birds on the Atlantic Outer Continental Shelf"

3. Aerial High-definition Imaging Pilot Study
   BOEMRE contract M10PC00099, "Pilot study of aerial high-definition surveys for birds, marine mammals and sea turtles on the Atlantic Outer Continental Shelf."

Aerial High-definition Imaging Pilot Study

• Objective
  Determine optimal technology and methodology for conducting high-definition aerial ocean wildlife surveys in the U.S.
  - Birds, marine mammals, and sea turtles
  - Cover a very large area in a very short time
  - Cost-effective and safe

• Scope
  Conduct pilot studies, evaluate image-gathering tech. configurations, develop large area survey protocol

• Key Partners
  Boulder Imaging
  IA tech, inc. (unmanned aircraft)
  Gemini Renewables
  British Trust for Ornithology
  AIS observers
  ECOES, inc.
  Pinnacle 1 Aviation

Advantages of high definition imaging relative to visual observer surveys

• Images archived, data are "repeatable", not subject to unknown observer bias
• Higher altitude flight doesn’t alter results by disturbing wildlife
• Higher altitude flight is safer (safer still with unmanned system)
• Faster flight, larger survey beam allow more cost-effective sampling of large areas

Aerial High-definition Imaging Pilot Study

• COWRIE zone 5 (East Anglia), July 2009, survey area shown transposed onto AOCS (in white) (HiDef Aerial Surveying Ltd, 2009)
  - 40 m image width
  - 10% sampling, 400m transect separation
  - 2316 m² survey area
  - 610 meter flight altitude
  - 174 mph airspeed

• Survey time: 3 days

Day 2 - 13 July 2011
Presentations/Birds and Bats
Experimental Design

<table>
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<tr>
<th>Treatment Factor</th>
<th>Treatments</th>
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<td>Aircraft</td>
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<td>Camera Type</td>
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<td>Light Polarization</td>
<td>With, Without</td>
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<td>Angle</td>
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<td>Altitude</td>
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<tr>
<td>Gyroscopic Stabilization</td>
<td>With, Without</td>
</tr>
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Image taken from 600m height, 1.5 cm resolution and stabilized  
Image taken from 1000m height, 2.5 cm resolution, unstabilized  
600m, 1.3 cm resolution
Day 2 - 13 July 2011
Presentations/Birds and Bats

Royal Tern from 600m at 2cm resolution, unstabilized

Immature Northern Gannet, 1000m camera altitude, 2.5cm resolution

Bottlenose Dolphins 425m altitude, 3cm resolution, 44° angle

Glare (importance of camera angle)

Roseate, Arctic and Common Tern image resolutions adjusted with Photoshop

Loggerhead Turtle, 1200m, 3cm resolution

Logggerhead Turtle, 600m, 1.5cm resolution

Leatherback Turtle (submerged), 450m, 1cm resolution

© J&J Holmes
© Copyright Go2Moon, Alaska
© Max Skwarna

Image Resolution

0.5cm resolution

1cm resolution

2cm resolution

A-188
Importance of Flight Altitude % individuals within RSZ

<table>
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<tr>
<th>Flight Altitude</th>
<th>NJDEP 2010</th>
<th>Paton et al. 2010</th>
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<tbody>
<tr>
<td>Very Low</td>
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<tr>
<td>Low</td>
<td>6.9%</td>
<td>3%</td>
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<tr>
<td>Medium</td>
<td>6.8%</td>
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<td>High</td>
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| Subantarctica
Seabird Survey and Observation Database & Hierarchical Models for Estimating Seabird Distributions in the U.S. Atlantic

Allan F. O'Connell1, Beth Gardner1,2, Andrew T. Gilbert1,3

1. USGS Patuxent Wildlife Research Center
2. North Carolina State University
3. Biodiversity Research Institute

History

- Evaluate seabird distribution for offshore development.
- No centralized repository of seabird data for the U.S. Atlantic.
- USGS/USFWS funding to catalog seabird datasets in 2005.
- Additional FWS funds to compile and standardize data into a single database in 2006.
- MMS (BOEMRE) added funds to continue work and add modeling component in 2008.

Methods

- Develop a catalog of seabird survey and observation datasets
- Acquire seabird and biophysical data (e.g., bathymetry, SST, chlorophyll) for modeling
- Standardize seabird data for modeling
- Match seabird data with biophysical data
- Conduct hierarchical modeling
- Predict species distributions

Seabird Dataset Catalog

- Created a catalog of seabird datasets
- Record information about datasets and information they contain (metadata catalog)
  - Coverage area
  - Abstract
  - Dates
  - Data type (digital, analog, text file, GIS)

Example seabird surveys

<table>
<thead>
<tr>
<th>Dataset</th>
<th>Years of surveys</th>
<th>Region of survey</th>
</tr>
</thead>
<tbody>
<tr>
<td>Manomet Center for Conservation Sciences</td>
<td>1978-1980</td>
<td>Gulf of Maine, Mid-Atlantic Bight</td>
</tr>
<tr>
<td>Cetacean and Seabird Assessment Program</td>
<td>1980-1988</td>
<td>Gulf of Maine, Mid-Atlantic Bight</td>
</tr>
<tr>
<td>Georgia pelagic surveys</td>
<td>1982-1990</td>
<td>South Atlantic Bight</td>
</tr>
<tr>
<td>Southeast Fisheries Science Center surveys</td>
<td>1992,1996,1999</td>
<td>South Atlantic Bight</td>
</tr>
<tr>
<td>Winter Survey of the Mid-Atlantic</td>
<td>2001-2005</td>
<td>Mid-Atlantic Bight</td>
</tr>
<tr>
<td>Cape Wind, Mass Audubon</td>
<td>2002-2008</td>
<td>Nantucket Sound</td>
</tr>
<tr>
<td>North Carolina shelf—trophic predators</td>
<td>2004-2005</td>
<td>Offshore North Carolina</td>
</tr>
<tr>
<td>Bar Harbor whale watch</td>
<td>2005-2006</td>
<td>Offshore Mount Desert Island, ME</td>
</tr>
<tr>
<td>NOAA Ecosystem Monitoring Survey</td>
<td>2007-2010</td>
<td>Gulf of Maine, Mid-Atlantic Bight</td>
</tr>
<tr>
<td>NOAA Herring Acoustic Survey</td>
<td>2008-2010</td>
<td>Gulf of Maine, Mid-Atlantic Bight</td>
</tr>
</tbody>
</table>

Data standardization

- Create master observation dataset
  - Create standard species lists
  - Create common data fields (date, time, observation ID, effort ID, etc.)
- Create effort dataset when possible and link to species observations
  - presence AND absence data
  - facilitates error detection
Survey effort
- Standardized survey effort to account for both discrete-time and continuous-transect surveys.
- Color schemes represent a standardized range of the number of surveys conducted in each grid cell in 5 minute equivalents.
  - Discrete time transects: 5 minute equivalents = # of 5 minute periods of survey
  - Continuous time transects: 5 minute equivalents = 0.8333 nautical mile survey segments (the distance traveled by a ship traveling 10 knots for 5 minutes)

Seabird occurrence data
- >400,000 observations have been accumulated from 70 datasets
- >270,000 seabird observation from U.S. Atlantic waters (>100k from Canada in PIROP)
- Data spans the 1900’s, most collected from 1978 through November 2010
- Data collected using a mix of scientific and non-scientific methods

Relational seabird database
- Postgresql 8.4 (PostGIS) database
- Fully relational database, efficient in design
- Very quick access and querying
- Geometry information can be stored directly in the database in open standards formats
- Allows complex geometry queries
- Can be mapped directly with some GIS products (not ArcGIS 9.3 but in 10 you can map data, but not edit it from the db directly)

Modeling
- ~ 70 sea bird species in the database that are typically found in the Atlantic
  - 10-15 of particular interest
- Modeling exercises
  - Broad species distribution mapping
  - Community occupancy modeling
  - Seaducks
  - SEANET

Spatial Poisson Regression
- Poisson observation model (commonly used for count data) with explicit spatial correlation and covariates
where $y_{ij}$ is the observation at grid cell $i$ during survey $j$ in year $t$

The log-linear full model is:

$$\log(\lambda_{ij}) = \log(\text{effort}_{ij}) + a + a_2[\text{Month}_{ij}] + \beta_1 \cdot \text{SST}_{ij} + \beta_2 \cdot \text{Chloro}_{ij} + \beta_3 \cdot \text{NAO}_t + Z_i$$

### Shortcomings

- General lack of sea bird data collected in a rigorous way across broad areas
- Data are combined over many years from various survey types
- Detection of individuals, or even species, cannot be accounted for with such data

### Results – GRSH

#### Summer

#### Winter

### Occupancy Models

- If we look at areas with repeated aerial surveys, we can estimate detection and species richness through the use of site-occupancy models
- This allows us to understand the probability of detecting a species given that it is present
- We expect that detection is very different amongst species
Species Richness

Detectability

Summary

- Detection different by species
- Detection varied by Julian date for all species
- Occupancy was different by species and with more data, we can model by season or date as well
- More data to improve models at the broad scale
- Detection of species by different survey types is important to estimating occupancy and hence abundance
- More work to be done in combining such information to improve our understanding of sea bird dynamics

Seaduck Surveys

Seaduck Surveys

Results: Species Ranges

Additional Results

- Observed significant spatial (north-south) gradient in the distributions of all species
- Identified large scale climatic influence with NAO significant for all species counts
  - Relationship varied between species
- Detected stationarity in distributions due to the significant year effect
**Implications for climate change**

- 3 of 5 species distributions are changing annually in response to NAO and other factors.
- Research suggests that climate change may affect the NAO and SST in unpredictable ways (e.g., longer periods of high years).
- Take home: climatic and weather variables appear to affect the distribution and abundance of sea ducks, in complicated and variable ways.

**SEANET Data**

- Volunteers walk stretches of beach and record the number of deceased birds.
- 120 beaches surveyed.
- 3183 total surveys.
- Beach length varied from 0.23 to 28.8 km.

**Surveys**

**Model**

- Zero-inflated Poisson model.
- Included:
  - Beach orientation (N, S, E, W).
  - Sea surface temperature.
  - Month and Month$^2$.
  - Wind U and Wind V.
- Used beach length as an offset term.

**Summary and Looking Ahead**

- Determine environmental covariates affecting beached bird counts and create an initial baseline for future studies.
- Next steps:
  - Look at species specific data for 2008 onward.
  - Examine other potential covariates.
  - Provide suggestions for sampling design.

**Future Plans for Database**

- Transfer data to FWS servers for public accessibility.
- Create metadata files to allow filtering of sensitive data.
- Create web accessible front end.
- Develop tools for exploring data.
- Work with other regions to incorporate additional datasets.
  - SEANET data to be incorporated next.
  - Create connection to OBIS for data sharing availability among other online data access sites.
Future Plans for Modeling

- USGS/PWRC
- NC State
- NOAA
- Tufts
- BRI
At-Sea Distributions of Pelagic Seabirds off the East Coast of the United States, 2010
A Preliminary Report to BOEMRE

Richard R. Veit
Timothy P. White
Marie-Caroline Martin

Biology Department:
College of Staten Island:
City University of New York
2800 Victory Boulevard
Staten Island, NY 10309

Melanie J. Steinkamp
USFWS
Melanie_Steinkamp@fws.gov

So 19 cruises so far
Summer 2007-February 2011

4 Ecomon per year
1-2 Herring per year
3 whoi cruises

Hotspots
Combining shipboard data with large spatio-temporal databases
Spatial association between hotspots of baleen whales and demographic patterns of Antarctic krill *Euphausia superba* suggests size-dependent predation

Jarrod A. Santora1, 2, *, Christian S. Reiss3, Valerde J. Loeb4, Richard R. Veit4

1Biological Institute for Advanced Ecosystem Research, Big Rock T151, Bodega, California 94923, USA
2Antarctic Ecosystem Research Division, Southwest Fisheries Science Center, 204 Ely St. #203, La Jolla, California 92037, USA
3Nico’s Loos Shut Loans, B70 3003 Loos Leasing Road, Nico’s Loos, California 90080 USA
4Biological Institute, College of Medicine, University of New York, 2880 Wilbert Road, Medford Island,
Historical Comparisons

Manomet Bird Observatory Data

1970s-1980s

Table 2. Densities of dominant species recorded in 2010 (birds/km²). Density estimates for 1970s-1980s (from Powers 1983) given in italics.

<table>
<thead>
<tr>
<th>Species</th>
<th>2010 Year 1</th>
<th>2010 Year 2</th>
<th>1970s-1980s Year 1</th>
<th>1970s-1980s Year 2</th>
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</thead>
<tbody>
<tr>
<td>Northern Fulmar</td>
<td>2.4 (7.5)</td>
<td>1.6 (3.8)</td>
<td>0 (0)</td>
<td>8.9 (1.5)</td>
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<tr>
<td>Greater Shearwater</td>
<td>0 (0)</td>
<td>6.8 (1.5)</td>
<td>7.3 (2.75)</td>
<td>5.7 (7.5)</td>
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<tr>
<td>Wilson's Storm-petrel</td>
<td>0</td>
<td>4.4 (3.9)</td>
<td>1.59</td>
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<tr>
<td>Northern Gannet</td>
<td>1.4 (1.0)</td>
<td>0.28 (1.75)</td>
<td>0.29 (0.25)</td>
<td>6.3 (1.25)</td>
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<tr>
<td>Herring Gull</td>
<td>2.6 (3.75)</td>
<td>0.50 (1.5)</td>
<td>1.7 (0.75)</td>
<td>2.3 (8.5)</td>
</tr>
<tr>
<td>Dovekie</td>
<td>0.36 (1.0)</td>
<td>0.09 (1.0)</td>
<td>0 (0)</td>
<td>8.1 (0)</td>
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</tbody>
</table>

Figure 1. The distribution of white-sided dolph (Lagenorhynchus acutus) sightings throughout the study area, 1980-1988.
Climate Change

Need to know this for interpretation of current data
Day 2 - 13 July 2011
Presentations/Birds and Bats

Spearman r = 0.41
p = 0.002

Spearman r = -0.43
p = 0.0012
Summary

1.) Hotspots are evident and persistent
2.) Changes evident 1970s-present
3.) Changing climate has impacted birds
Ongoing Offshore Bat Studies in the Gulf of Maine

Atlantic Wind Energy Workshop
Herndon, Virginia
July 13, 2011

Terrestrial Studies
Onshore post-construction studies indicate turbines pose direct and indirect mortality risks to bats.

Terrestrial Trends - example
These studies help us better understand species:
- Biology
- Range
- Migratory Patterns
- Activity Trends

Energy Shift to Offshore Sites

Offshore Bats
Are they really out there?
Historic Coastal Observations

Highland Lighthouse (Miller 1897); Truro, MA

Historic Island Observations

Lighthouse counts (Merriam 1887) at Mt. Desert Rock, ME

Historic Mariner Observations

Griffin 1940 summarizes multiple observations aboard ships at sea.

*A flock of unidentified bats alighted on a ship 10 miles off the Delaware River*
– Allen 1923

*a red bat taken aboard a ship 240 miles east of Cape Cod*
– Nichols 1913

*a large number of bats, estimated at 200, was seen flying about the ship*
– Carter 1950

*4-5 miles offshore of Sandy Hook [Long Island] in search of Petrels, observed a number of small bats flying near the surface headed for shore. Believed to be Silver-haired bats.*
– Murphy and Nichols 1950

Recent Offshore Studies

Offshore Island Study; Cryan 2007

40-year fall migration observations of hoary bats at SE Farallon Island revealed seasonal arrival/departure trends and correlations with low winds, moon phase, and cloud cover.

Recent Coastal/Offshore Studies

• Mist netting; T. Kunz. Boston Univ. 1990, Cape Cod, MA
  ~253 MYSE of 275 total captures

• Acoustic Surveys; Tetra Tech 2009, Block Island, RI
  - Acoustic surveys from 2 weather buoys
  - April - November
  - “Zero to very few” bats detected

• Ti camera/vertical radar; Geo-Marine Inc 2008, NJ
  - barge mounted 1.5-2 km offshore
  - 520 hours over 56 nights (March, April, May, October)
  - 45 bat detections

Limited observations; all prior to 1970
• 12 ship reports of bats
• 3 flocks of >100 bats
• All tree (red, silver-haired) bats in fall

Day 2 - 13 July 2011
Presentations/Birds and Bats
Offshore Studies in Europe

- Ahlén et al. 2009 – Behavior of Scandinavian bats during migration and foraging at sea.

European Observations to Date

- Bats behave differently offshore than on onshore (Ahlén 2007, 2009).
- Prey includes flying/surface insects and surface crustaceans (Ahlén 2007, 2009).
- Bats echolocate offshore using lower frequencies and longer pulse intervals (Ahlén 2009).
- Bats typically migrate <10m above sea level (Ahlén 2007, 2009).
- Bats rise rapidly when foraging near vertical objects (e.g., ships, lighthouses, turbines) (Ahlén 2009).

Offshore Survey Challenges

- Weather/Seas - Safety
- Access & deployment challenges
  - Limited access, maintenance
  - Remote data access via modem
- High Funding/Investment Costs
- Government & Private Stakeholders
- Night time Observations
  - Limited tools

Offshore Survey Methods

- Boats
- Buoys
- Turbines
- Lighthouses
- Islands

Offshore Survey Methods

Direct Observation / Portable Incandescent Spotlights

2009 – 2010 Stantec Studies
Questions

1. Are bats offshore?
   - How many?
   - What species?
   - When/Where?
   - What behavior?

2. What are potential implications of offshore wind development on bats?

Objectives

- Test effectiveness of acoustic survey equipment and methods to document offshore bat activity
- Assess presence of bats in a variety of offshore locations
- Describe general patterns of bat activity offshore
  - Activity levels
  - Species composition
  - Seasonal trends in activity
  - Nightly timing of activity
- Determine inter-annual variability in bat activity patterns offshore by repeating surveys

Methods

- Dual AnaBat SD1 Detectors
- Weatherproofed, solar-powered units
- GML1 Remote Access
- Mid-July to late November
- Island/lighthouse accessibility dictated deployment options

Deployment Examples

2009 Survey Sites

2010 Survey Sites
Collaborating Organizations

Results

• Remote acoustic detectors effective for long-term detection and monitoring of northeast bat species
• Bats detected at all 2009 and 2010 survey sites
• Peak movement periods detected
• Bats detected until mid-November
• Resident and migratory species documented at most sites

<table>
<thead>
<tr>
<th>Year</th>
<th>Geographic Area</th>
<th># Survey Sites</th>
<th>Survey Period</th>
<th>Survey Effort</th>
<th># Recorded Call Sequences</th>
</tr>
</thead>
<tbody>
<tr>
<td>2009</td>
<td>~125 miles</td>
<td>12</td>
<td>7/28 – 11/30</td>
<td>948 nights</td>
<td>26187</td>
</tr>
<tr>
<td>2010</td>
<td>~170 miles</td>
<td>7</td>
<td>7/13 – 11/30</td>
<td>526 nights</td>
<td>26768</td>
</tr>
</tbody>
</table>

*Detectors still deployed at 3 offshore sites (~300 potential survey nights of data)

Results

• Overall decline in monthly activity between July and November
Day 2 - 13 July 2011
Presentations/Birds and Bats

Species Composition

- Petit Manan Island
- Frenchboro
- Halfway Rock
- Owl's Head

- BBSH = big brown/silver-haired bat
- EPFU = big brown bat
- LACI = hoary bat
- LANO = silver-haired bat
- MYSP = Myotis sp.
- LABO = eastern red bat
- RBTB = eastern red bat/tri-colored bat

Seguin Island?

- 40,049 call sequences
- 76% of all recorded call sequences
- High Risk Location?

Offshore habitats inevitably altered

Species Composition

- Islands only, Seguin removed
- N=32,775 ID'd call sequences

Migratory Patterns?

- Night of
- Sites with Detections

Mt. Desert Rock

Mt. Desert Rock

A-208
What's Next?
2011 Survey Efforts

NERCOOS Buoy AO1
- Offshore New Gloucester, MA
- Deployed June 2011

Research Priorities
• Further analyze patterns of presence/absence and activity levels on a species-specific level
• Expand studies regionally
• Include additional buoys (IOOS system)
• Extend seasonal periods
• Include multiple year observations

Some Obvious Questions
• How far offshore will bats typically range?
• What species/gender composition?
• When and how often? Under what conditions?
• Are there peak or extended movement periods?
• Funneled or broad-front movements?
• Do terrestrial observations apply offshore?
• Do Europe’s observations apply here?
• How do we assess potential mortality?

Resolving Unknowns
Understanding offshore bat behavior and risks of offshore activities requires:
• Variety of observational tools/survey platforms for remote conditions;
• Coordinated regional approach, beyond single site assessments;
• Multi-seasonal studies; and
• Greater collaboration b/n developers, scientists, and agencies.

What Can We Learn From Onshore Studies?

Can Pre-Construction Data Predict Risk?
To a bat, is this…
Summary Observations to Date

- Variety of species extend offshore but more frequently silver-haired, hoary, eastern red bats, and *Myotis* spp.
- Bats may be vulnerable to offshore wind activities
- Planned regional, multi-seasonal surveys will serve to define issues and develop potential resolutions.

Thank You
Workshop Goals

- Provide an update of recent research (environmental, social sciences) since the 2007 RE Workshop
- Identify key data needs and prioritize research gaps
- Develop partnerships and identify potential synergies for future studies

Objectives: To assist BOEMRE and its federal partners in the environmental and technical reviews of WEAs and the evaluation of new projects

Plenary – Federal Panel

**Summary:**
- 12 Agencies presented
- Several with key regulatory responsibilities over offshore wind projects
  - 8 agencies with mandated regulatory authority
  - Others have input and interest (responsible agencies)
- Ongoing coordination to expand upon existing framework to create guidance documents, as applicable
- Coordination through task forces and levels of communication are more prevalent now than ever before

Plenary – Federal Panel

**Outcomes:**
- This workshop provided the starting point to continue this coordination and communication
- Other workshops and information transfer meetings (ITMs) are appropriate settings to continue coordination and communication

Environmental Breakout Sessions

**Objective:** Within a smaller forum, focus on biological and habitat concerns related to Environmental Monitoring and Baselines Studies
- 6 panels convening over a two-day period

Information Management and Data Sharing Products Panel

**Summary:**
- Topics: ESID, Habitat Mapping, Sonar Mapping, Space Use Conflicts, MARCO and NROC Data Portals, OBIS-SEAMAP, Multipurpose Marine Cadastre (MMC)
- Numerous Portals for spatial data dissemination
- E.O. requires all Federal agencies to make their data available to other agencies
- Ongoing data harvesting is currently making data available for use
Summary:

- Presented current and ongoing projects, including both individual wind projects and offshore transmission backbone.
- Presented site-specific survey methods, and the applicability of the results to the regulatory process.
- Perspective from developers – provided insight into the challenges and obstacles faced thus far.

**Developers Panel**

**Needs/Obstacles:**

- Timeline for permitting is a big risk for developers; developers looking for an efficient and established/known timeline from the agencies.
- Established timelines would encourage more interest.
- Permitting requirements are perceived as extensive and unclear, may be prohibitive for many developers.
- Need for consistency within federal agencies between offices.

**State Planning and Information**

**Summary:**

- States conducted baseline studies to determine wind areas to site offshore wind energy (NJ, MA, ME, RI), and development of environmental protocols (RI).
- Each approach varies, based on existing information and specific goals outlined in the states’ CMPs.
- Coastal Marine Spatial Planning (CMSP) puts into state’s hands, a developing process.
- State determinations of “local” resources of critical importance (requiring protection) are key.

**State Planning and Information**

**Needs/Obstacles:**

- Data are more regional in nature, limited site-specific data.
- Large quantity of data to process.
- Lack of standard survey methods.
- Lack of data quality guidelines (QA/QC).
- Reliable data standards will ensure that investors are making wise decisions by siting a wind project within areas identified using baseline data.
- Ensure redundancy is not occurring.

**Broad Scale Habitat, Abundance, and Distribution—Consultation Process**

**Summary:**

- Agencies discussed their mandates relative to wind energy.
- NMFS and USFWS consultation processes relevant to T/E and protected species.
- Developer’s options – informal mechanism, “seat at the table.”
Acoustic data processing

- Quantity of data collected

Consultation Process

Broad Scale Habitat, Abundance, and Distribution

Summary:

- FMCs – spokesmen for the stakeholders – i.e., fishery interests
- FMCs role outlined – gather and analyze data; no data collection; recommend
- EFH and HAPC areas in collaboration with NMFS
- FMC programs of interest to BOEMRE – SARI (sweep area seabed impact approach)
- NMFS – overview of ongoing marine mammal survey efforts (ship, aerial, PAM); search for the best density and distribution indicators
- EMF and impacts to marine species, case studies

Baseline Data

Summary:

- Data sharing between stakeholders and agencies to be able to assess and identify impacts to fisheries (one stop shop)
- Other survey technologies being investigated – HD video and photo, AUV, UAV, marine mammal tagging
- Need more information on risk to assess remaining data gaps
- Need to compile existing protocols and study results for project-specific surveys

Baseline Data

Summary:

- Ambient noise measurements, with capability to identify species-specific vocalizations
- Active acoustics – benefits, limitations
- Acoustic data processing – quantity of data collected, culling into a useful format
- EMF and impacts to marine species, case studies
- NMFS Ocean Noise Project – validating PAM methods against other survey methods; documenting occurrence, etc.

Further clarify responsibility assignments between various agencies and the developers (regional research vs. site-specific surveys)

If existing data are to be used, are they adequate? Need a mechanism to determine data quality, adequacy – how much is enough?

What species are at risk? Are impact thresholds for individual resources known? Threshold for sensitivity, when does impact occur? Cumulative effects?

For migrating or highly mobile resources, what is an acceptable scale for surveys? Regional vs. site-specific

Database management, maintenance, storage & archival, as well as data cataloguing

Baseline Data

Summary:

- NMFS data variability (CetMap) – prioritization: habitat based density, stratified density, habitat affinity, presence only
- EMF and impacts to marine species, case studies
- NMFS – overview of ongoing marine mammal survey efforts (ship, aerial, PAM); search for the best density and distribution indicators

Baseline Data

Summary:

- Need to begin consultation early
- Joint guidance for data collection between BOEMRE, NMFS, USFWS
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Baseline Data

Summary:

- Other survey technologies being investigated – HD video and photo, AUV, UAV, marine mammal tagging
- Need more information on risk to assess remaining data gaps
- Need to compile existing protocols and study results for project-specific surveys

Baseline Data

Summary:

- Summary:
  - Data management can be challenging (non-homogenous, differing formats, data volume)
  - Impacts of EMF: DC vs. AC transmission to marine species; sensitive Atlantic species characterized? Species at risk – slow moving, benthic? Potential data deficiencies?
  - Data processing capability – make it more available, better ways to process the data, data processing standards
  - Tools available to integrate acoustic data into spatial models?
Workshop Goals – What Did We Achieve?

- Provide an update of recent research (environmental, social sciences) since the 2007 RE Workshop
- Identify key data needs and prioritize research gaps
  - Understand agency roles and responsibilities
  - Data sources reasonably well defined, identified, but issues with data adequacy, cataloguing – precludes data gap id
  - Regulatory process framework in place, but the data specifics and data needs remain in flux
  - Data gaps difficult to identify – sensitive species, ability to identify impacts limited

- Develop partnerships and identify potential synergies for future studies
  - Excellent forum to bring together regulators, industry, and researchers
  - Great opportunity for individuals to acquire knowledge re: advances in regulations, new research results, new projects
  - Information is key to potential partnerships and synergies
  - Continuation of formalized working groups
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Socio-Economic Workgroup Summary
John Primo, PhD, Session Coordinator, BOEMRE
David Blaha, Facilitator, ERM

It's A Crowded Sea
- Commercial Fishing
- Shipping
- Tribes
- Recreational Users
- Sand & Gravel Extraction
- Tourism (e.g., whale watching)
- Military Activities/Coast Guard
- Other Vessel Traffic
- Offshore Wind

Potential Social-Economic Conflicts
- Commercial fishing
- Recreational fishing
- Port access
- Navigation and safety
- Marine archaeology and history
- Tribal uses
- Visual resources
- DoD/Coast Guard usage
- Property values

Social-Economic Track
- Four Sessions
  - Cultural and Historic Resources
  - Multi-Use Issues/Space-Use Conflicts
  - Public Perceptions, Legal Studies, Visual Impacts, and Tourism
  - Economic Impact, Regulatory, Policy, Stakeholder Issues and Infrastructure
- Collaborative Approach – no presentations

Priority Research Needs
- Cultural Landscapes
  - Includes tribal and working marine landscapes
  - Collect and map historic/current socio-cultural landscape data using participatory tribal (indigenous) and community mapping techniques
  - Collect marine cultural heritage landscape “context” from tribal oral histories/mariner’s folklore
- Submerged Ancient Tribal Sites
  - Standardize methodologies/guidelines for identifying submerged ancient landforms and tribal sites
  - Conduct research on submerged tribal sites leading to the development of a tribally-sensitive predictive model
Priority Research Needs

- Multiple Uses of Ocean Space
  - Research and characterize current multiple uses of the ocean
  - Evaluate and identify lessons learned from international offshore wind experience with accommodating multi-users

- Economic Impact Modeling
  - Adapt current economic models in a contextually appropriate and transparent way to more accurately assess socio-economic effects of offshore wind (e.g., jobs, property values)
  - Better understand where economic benefits may occur (e.g., locally, regionally, domestically, internationally)

- Public Perceptions and Understanding
  - Need to better understand what the public knows and doesn't know about offshore wind
  - Research, characterize and compare the cultural models of key stakeholder groups
  - Research public perceptions and the cultural models and values that influence those perceptions

Special thanks to our

- Panelists
- Moderators
- Session Participants
Session Objective
- To present information on current and planned research efforts and immediate information needs – follow up to recent FWS workshop
- Presentation/panel and facilitated discussion

Presentation Summary
- Summary of Marine Bird Science and Offshore Wind Workshop – Melanie Steinkamp (FWS)
  - Summary of current knowledge on distribution and abundance of marine birds in the North Atlantic
  - Identify and prioritize future scientific research and monitoring

Presentation Summary
- Current Research Efforts
  - Dr. Caleb Gordon (Normandeau)
    - Endangered Bird Species Risk Assessment - potential for interactions between endangered and candidate bird species and wind facility operations on the Atlantic OCS
    - Acoustic/Thermographic Offshore Monitoring System - monitoring of spatiotemporal abundance of marine birds on the AOCs
  - Aerial High-definition Imaging Pilot Study - pilot study of aerial high-definition surveys for birds, marine mammals and sea turtles on the AOCs

Presentation Summary
- Current Research Efforts (cont’d)
  - Dr. Allan O’Connell (USGS)
  - Dr. Richard Veit (CSI/SUNY)
    - Results from ships of opportunity cruises and examples of persistent aggregations or ‘hotspots’
    - Ongoing BOEMRE funded studies and future activities
  - Dr. James Woehr (BOEMRE)
    - Ongoing BOEMRE funded studies and future activities
  - Steve Pelletier (CWB Stantec)
    - Ongoing offshore bat research in Gulf of Maine and data needs

Presentation Summary
- Research Needs
  - David Bigger (BOEMRE)
    - Maps showing species spatial and temporal abundance and distribution
    - Hot spots and cold spots
    - Persistent aggregations
    - Migration routes
    - What environmental or oceanographic features drive distributions?
    - Guideline development for avian surveys
    - Identify priority species
    - Species risk – how are they vulnerable?
Bats – Data Needs

- What species are offshore and when are they there?
- Regional use
- Annual variability
- Species at risk
- Flight characterization (foraging, migration, breeding)
- Distance to shore gradient
- Turnover rates
- Influence of white nose syndrome on behavior and populations
- Standardization of data collection
  - What are the metrics/answers needed to make decisions?
  - Also needed for birds

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Bats – Decision Support Tool

- Risk Model/Flavored Bird Distribution and Abundance Map – BEST BIRD MAP
  - Where are the birds?
  - What birds are there?
  - How many are there?
  - What is the passage rate?
  - Vulnerability/exposure (including behavioral factors e.g., flight altitude, attraction, etc.)
  - What are dive times?
  - Need to link habitat information to species distribution and abundance

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Birds – Data Needs

- Distribution and Abundance Data
  - Use existing information
  - Fill survey gaps (South Atlantic Bight, Gulf Stream, T&E species)
  - Study nocturnal movement patterns
  - Study migration patterns for little known species
  - Develop predictive models - where we expect to find birds given a set of variables or characteristics
    - Develop modeled distribution to encompass data deficient areas
    - Includes covariables affecting distribution and abundance (e.g., physical environmental features, behavior, prey distribution, etc.)

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Birds – Decision Support Tool

- Sensitivity Analysis
  - Identify species vulnerabilities to offshore wind development behavior environmental conservation status
  - Prioritize species based on vulnerability

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Developing the Best Bird Map – Next Steps

- Get the most out of existing data
  - metadata
  - remove artifacts
  - develop data quality estimates
- Structured Decision Making (SDM) workshop for sensitivity analysis (identify species vulnerabilities, risks, and priority species)
- Predicted distribution and abundance
- Weight distribution and abundance by risk (model output e.g., color coded map)

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Birds - Other Needs

- Pre-development monitoring at colonies (e.g., meal delivery rates) - pre- vs. post-construction monitoring
- Post-breeding birds (juveniles)
  - Where are they congregating post fledging/pre-migration?
- Effects of turbines/structures on environmental conditions that influence bird distribution and abundance (attraction, eddies)
- Permanent FTE - data manager for seabird database
- Improved data sharing

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Day 3 - 14 July 2011
Presentations/Summaries

A-218
Day 3 - 14 July 2011
Presentations/Summaries

Technology Assessment and Resource (TA&R) Program

Renewable Energy Studies
Moderator: Lori Medley (BOEMRE)
Facilitator: Dan White (CSA)

TA&R Program
Meeting Objectives

• Provide an Update on TA&R Projects
• Identify Key Data Needs and Research Gaps
• Develop Potential Research Topics

TA&R Program
Review of Renewable Energy Studies

The following TA&R studies (completed or in progress) were reviewed. In addition updates were provided on IEC TC 88 and the TRB “Structural Integrity of Offshore Wind Turbines” report and the FAU MHK Current Project.

The PowerPoint presentations and discussion will be included in the final report.

• TA&R 634 “Mitigation of Underwater Pile Driving Noise During Offshore Construction”
• TA&R 651 “Evaluate the Effect of Turbine Period of Vibration Requirements on Structural Design Parameters”
• TA&R 633 “Wind Farm/Turbine Accidents and the Applicability to Risks to Personnel and Property on the OCS, and Design Standards to Ensure Structural Safety, Reliability, and Survivability of Offshore Wind Farms on the OCS”

TA&R Program

• TA&R 672 “Offshore Electrical Cable Burial for Wind Farms: State of the Art; Standards and Guidance; Acceptable Burial Depths and Separation Distances; and Sand Wave Effects”
• TA&R 656 “Sealed Scour Considerations”
• TA&R 672 “Assess/Develop Inspection Methodologies for Offshore Wind Turbine Facilities” and TA&R 650 “Offshore Wind Turbine Inspection Refinements”
• TA&R 669 “Floating Wind Turbines” and TA&R 670 “Design Standards for Offshore Wind Farms”
• TA&R 672 “Development of an Integrated Extreme Wind, Wave, Current, and Water Level Climatology to Support Standards-Based Design of Offshore Wind Projects”

Key Data Needs & Research Gaps Identified & Prioritized

1. KDN Wind Turbine Condition Monitoring for Safety and Inspection
2. RG MHK Mooring Space and Use Conflicts
3. RG Gulf Stream/OCS Mooring Issues
4. KDN Example Formats/Template/Go-Rys
5. RG Fatigue Design Methodologies and Design Criteria
6. RG Study of Fundamental/Structural Soil Conditions Requirements
7. KDN Audit Standards/Procedures Template
8. KDN Incident Reporting and Lessons Learned for development of Safety Management Systems
9. RG Design Guideline for Stationkeeping Systems of Floating Wind Turbines
10. RG Managing Risk for Multiple Uses of Wind and MHK projects

Potential Research Topics Key Data Needs

Wind Turbine Condition Monitoring for Safety and Inspection.
Structural monitoring is not currently required, therefore:

• Develop Structural monitoring requirements as contrasted to monitoring output and efficiency.
• Identify opportunities to add onboard monitoring to optimize or reduce inspection requirements, measure fleet-wide response of structural systems, and determine response to structure over time to project practical design and life extension of structures/project.
• Identify instrument available state of the art technology options.
• Determine how data should be interpreted/used?
• Determine what levels initiate action – What Action?
• Determine how data should be collected: real time; some regular interval; after extreme event; or black box?
Potential Research Topics

Key Data Needs Cont.

Example Formats/Templates/Go-By
- Develop Safety Management Plan (example)
- Develop Facility Design Report template consistent with regulatory requirements
- Develop Fabrication and Installation Report template consistent with regulatory requirements

Audit Standards/Procedures Template
Develop Safety Management System Criteria for Audit of systems/facilities (turbines and cables) to support Industry system integrity management & Audit Checklists for regulators.

Incident Reporting and Lessons Learned for Development of Safety Management Systems
High failure rates have occurred over time with concerns over timely/accurate/complete reporting. Need timely feedback to the industry.

Potential Research Topics

Research Gaps Cont.

Study of Fundamental/Structural Soil Conditions Requirements
- Lateral load deformation predictions based on methodology used for oil and gas API-RP 2A unverified for large diameter relatively short monopiles.
- Industry needs improvement in the ability to predict the long term performance and response of foundations.

Design Guideline for Stationkeeping Systems of Floating Wind Turbines
- Study simulation methods for the design of stationkeeping systems of floating wind turbine and identify critical design parameters for various types of stationkeeping systems (mooring, tendon, anchor, etc.) of floating wind turbines.
- Recommend a design guideline for stationkeeping systems of floating wind turbines.
- Initiate/Cooperate in international Studies to Support IEC Standard Development, particularly differences between offshore floating wind and MHK.

Managing Risk for Multiple Uses of Wind and MHK Projects
- Project developer risk for damage to vessel or injury to personnel.
- Vessel operator risk for damage to project facilities.
- Exclusion zone requirements (turbine vs. electric service platform).
- Surveillance/deterrent technology evaluation.

Potential Research Topics

Research Gaps

MHK Mooring Space and Use Conflicts
- Estimate density of proposed systems as function of device type
- Evaluate proposed mooring systems for installation practicality and safety
- Identify marine mammal entanglement potential
- Identify fisheries conflicts by gear type and mooring type

Gulf Stream/OCS Mooring Issues
- Evaluate mooring load and power transmission requirements and systems
- Analyze station keeping alternatives for optimizing device capacity factor
- Develop model inputs/outputs relative to Guidelines API RP 2SK and other applicable class rules

Fatigue Design Methodologies and Design Criteria
- Study fatigue design methodologies applicable to complex fixed and floating offshore wind turbine support structures
- Recommend a rational, practical fatigue design method for offshore wind turbine support structures
- Evaluate fatigue design criteria for offshore wind turbine support structures

Managing Risk for Multiple Uses of Wind and MHK Projects
- Project developer risk for damage to vessel or injury to personnel.
- Vessel operator risk for damage to project facilities.
- Exclusion zone requirements (turbine vs. electric service platform).
- Surveillance/deterrent technology evaluation.

Potential Research Topics

Research Gaps Cont.
The National Oceanographic Partnership Program (NOPP)

Overview of Presentation

- What is NOPP?
- Funding Process and Criteria
- NOPP Research
- How can you be involved?

What is NOPP?
Long-term interagency, inter-sector collaboration motivated by common needs

The NOPP Approach
Identify areas of ocean science research and education that are important to two or more agencies, and that would most benefit from a partnership approach

Value Proposition
Working together achieves more, and does so more efficiently, than working alone

NOPP Legislation
The 1997 Defense Authorization Act (Public Law 104-201) established the National Oceanographic Partnership Program (NOPP) for two purposes:

1. To promote national goals of assuring national security, advancing economic development, protecting quality of life, and strengthening science education and communication through improved knowledge of the ocean; and

2. To coordinate and strengthen oceanographic efforts in support of those goals by:
   a) Identifying and carrying out partnerships among federal agencies, academia, industry, and other members of the oceanographic scientific community in the areas of data, resources, education, and communication, and
   b) Reporting annually to Congress on the Program.

Why is Partnering Important?

1) Address critical national priorities that cannot be accomplished by a single agency or sector;
2) Address priority issues that bridge the mandates of individual federal agencies;
3) Contribute to the cutting edge or forefront of interdisciplinary and inter-sector science and technology;
4) Help ensure that institutional resources are invested and leveraged wisely, while planning for the future; and
5) Provide the necessary flexibility for supporting new, emerging issues that may not yet be part of a “mandate” but are of interest and value to many.

Partnership Activities
NOPP facilitates coordination through:

- Interagency discussion forums
- Targeted interdisciplinary workshops
- Funding of inter-sector, collaborative research projects
NOPP Funding Process

Research topics developed by agencies.

Written reviews submitted for each proposal by panelists.

Proposal processing by lead agency and NOPP Office.

Written reviews submitted for each proposal by program managers.

Proposal discussion and scoring made by panel.

Review of panel scores by agency program managers.

Funding agreements, selection and announcement of funded projects.

Proposal Review Criteria

Proposals are reviewed based on:
• Relevance of the proposed research to NOPP objectives;
• Overall scientific and technical merits of the proposal;
• Level of support of critical research objectives or operational goals;
• Quality of proposed partnerships;
• The offeror’s capabilities, related experience, and facilities that are critical to the proposal objectives;
• The long-term commitment of the partners to the proposed objectives;
• The qualifications and experience of the proposed PI and key personnel; and
• Reasonableness of cost.

NOPP Funding Criteria

Two or more agencies collaborate on the funding announcement. This collaboration can include in-kind support.

For Proposers - Team efforts are required among two of the three sectors: academia, industry (including NGOs), and government (including State and Local).

NOPP Research

Between 1997 and 2010, $312.4 million** was spent on 163 research projects.

NOPP Projects

Examples of the diverse range of NOPP-funded research topics include:
• Long Term Impacts of Deployments of Tags on Whales
• Atlantic Deepwater Canyons
• Offshore Renewable Energy
• Acoustic Technologies to Monitor Aquatic Organisms
• Autonomous Sensors for Measurement of Chemical & Biological Properties of Ocean
• Many others!

FY10 & FY11 NOPP Funding Topics

FY10
• Improving Attachments of Electronic Data Loggers to Cetaceans
• Developing Environmental Protocols and Monitoring to Support Ocean Renewable Energy and Stewardship
• Exploration and Research of Mid-Atlantic Deepwater Hard Bottom Habitats and Shipwrecks with Emphasis on Canyons and Coral Communities

FY11
• Marine Mammal Detection and Monitoring
• Implementation of the U.S. Integrated Ocean Observing System
How you can find out about our activities and opportunities!

- Visit our website: [www.nopp.org](http://www.nopp.org)
- Attend an Interagency Working Group on Ocean Partnerships meeting- 2nd Friday of each month
- Join our listserve and receive announcements via email

Questions?

Reference Slides

Collaboration Example

Understanding and Predicting Changes in the Workforce for Ocean Sciences, Technology, and Operations

- Research partners include the Marine Advanced Technology Education Center, Naval Postgraduate School, Texas A&M, Scripps Inst. of Oceanography, Marine Technology Society, Rutgers University and ROV Technologies, Inc.
- Funding partners include NOAA, ONR, MMS, and NASA

A core principle in NOPP collaborations has been cross-sector researcher partnerships and multiple agency funding partnerships.

Collaboration Example #2

An Ocean Observing System for Large-Scale Monitoring and Mapping of Noise Throughout the Stellwagen Bank National Marine Sanctuary

- Research partners include Cornell University, Marine Acoustics Inc. and NOAA
- Funding partners include MMS, ExxonMobile, and Shell

Two private industry members (Shell Oil and the Joint Industry Programme) helped to fund 11 projects in 2007 in areas of Coastal Effects of an Ice Diminished Arctic and Marine Mammals

Collaboration Example #3

The Archaeological and Biological Analysis of World War II Shipwrecks in the Gulf of Mexico: A Pilot Study of the Artificial Reef Effect in Deepwater

Field Studies conducted on NOAA vessel with ROV, July 2004
Six sites to depth of 1,981 m
Collaboration Example #4
The Argo Project: Global Ocean Observations for Understanding and Prediction of Climate Variability

Research partners include:
• Scripps Institution of Oceanography,
• University of Washington,
• Woods Hole Oceanographic Institution,
• University of Hawaii,
• NOAA Pacific Marine Environmental Laboratory, and
• NOAA Atlantic Oceanographic and Meteorological Laboratory.
**SPEAKER/PRESENTER BIOSKETCHES**

Listed by Session and Presentation Order

**PLENARY SESSION**

*Director Bromwich*

Michael R. Bromwich is the Director of the Bureau of Ocean Energy Management, Regulation and Enforcement and has served in that position since June 21, 2010. He was asked by President Obama and Interior Secretary Ken Salazar to lead reforms that will strengthen oversight and regulation of offshore oil and gas development and oversee the fundamental restructuring of the former Minerals Management Service, which was responsible for overseeing oil and gas development on the Outer Continental Shelf.

*Maureen Bornholdt*

Bureau of Ocean Energy Management, Regulation and Enforcement
Program Manager, Office of Offshore Alternative Energy Programs
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*Christopher G. Hart, Ph.D.*

Offshore Wind Manager
U.S. Department of Energy Wind and Hydropower Technologies

Dr. Christopher G. Hart graduated from the United States Naval Academy with a degree in Naval Architecture, Ocean, and Marine Engineering and immediately accepted a commission as a Special Operations Officer in the U.S. Navy. After ten years of Active Duty, during which he saw combat deployments in Operations Iraqi and Enduring Freedom, Dr. Hart began his graduate school studies at the University of Michigan. In the ensuing 44 months, Dr. Hart earned a PhD and MSE in Naval Architecture and Marine Engineering, along with an MBA. Dr Hart has served as the Offshore Wind Manager at the United States Department of Energy (DOE) since June, 2010. During his tenure at DOE he has worked to create an offshore wind energy industry in the United States by building a team of innovative, committed civil servants and contractors, authoring the National Offshore Wind Strategy, and allocating nearly $80M of program funds.

*Maureen Kaplan, Ph.D.*

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Dr. Maureen Kaplan is a Vice President in Eastern Research Group’s in the Economics and Regulatory Analysis section. For the past six years, she has supported BOEMRE in socioeconomic analyses for energy operations in OCS regions. She managed the analysis and identification of infrastructure components relative to offshore wind, wave, and ocean energy projects in Atlantic and Pacific OCS regions; examined infrastructure supporting offshore oil and gas operations in the Gulf of Mexico; developed a Gulf-wide methodology for estimating the jobs and revenues associated with coastal travel, tourism, and recreation; prepared an in-depth analysis of the jobs in the offshore oil services industry and a geographic distribution of those jobs, and other projects. She looks forward to participating in this exciting collaboration.
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Mr. Joel Whitman is CEO of Global Marine Energy, Inc. an American-owned company recently founded as part of the strategic expansion for GMSL, to address the growing demand for offshore power cable installation expertise in North America. He also serves as the Director Corporate Strategy, Marketing and Communications for Global Marine Systems Limited, the world’s largest independent provider of submarine cable installation and related engineering services, and a pioneer in the field of subsea cabling since the mid-1800’s. Mr. Whitman joined Global Marine in 2005 and has worked alongside his colleagues to solidify the company position in its core markets, such as Telecommunications and to diversify the business into new and emerging markets.

Timothy Konnert
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Mr. Timothy Konnert is a fish biologist who has worked in the Federal Energy Regulatory Commission’s Division of Hydropower Licensing for almost 9 years. For the last 5 years he has played an integral role on the Commission’s Marine and Hydrokinetic Energy Team in alleviating some of the regulatory barriers for the hydrokinetic industry, including the development of the hydrokinetic pilot project licensing procedures. Mr. Konnert is currently the Commission’s project coordinator for three of the four active hydrokinetic pilot project licensing proceedings on the U.S. east coast.

David Cottingham
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Dr. Walter Barnhardt is a marine geologist working on basic scientific problems that have societal and management implications. His research focuses on the geology of continental shelf and coastal environments, and understanding the processes that control sediment transport and vulnerability to change. Since 1988, he has led numerous seafloor mapping surveys along the U.S. East and West Coasts and in the Hawaiian islands. Currently he is the Director of the USGS Woods Hole Science Center in Woods Hole, Massachusetts. He supervises approximately 100 marine scientists, technologists, and
support staff who explore and study many aspects of the underwater areas between shorelines and the deep ocean as part of the USGS Coastal and Marine Geology Program.

Sarah A. Quinn, J.D.
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Ms. Sarah A. Quinn is the External Renewable Energy Specialist for the National Park Service (NPS) Washington Office. She is tasked with providing policy support to the parks, regional offices, and directorate and with helping coordinate with agency partners to facilitate smart siting and design. Previously, Ms. Quinn worked for the Bureau of Land Management California State Office where she was a renewable energy program and environmental coordinator. She was also detailed at the Regional Solicitor’s Office to resolve legal questions related to processing renewable energy applications. Sarah joined federal service as a Presidential Management Fellow. In addition to her renewable energy background, she is an attorney and member of the Colorado Bar.

Emily Lindow
Senior Policy Advisor to the Assistant Administrator
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Ms. Emily Lindow is the Senior Policy Advisor to the Assistant Administrator at NOAA Fisheries Service (NMFS). She has the lead for the NMFS energy policy portfolio, which includes offshore oil and gas, liquefied natural gas, conventional hydropower, offshore wind, marine hydrokinetic energy, and coastal nuclear energy. Ms. Lindow has substantial energy and environmental policy experience, having served as the Senior Policy Advisor to the Secretary of Commerce and the NOAA under Secretary, as well as working for the Senate Commerce Committee. She recently served as a Senior Analyst for environmental, regulatory, and Arctic issues at the National Commission on the BP Deepwater Horizon Oil Spill and Offshore Drilling. Ms. Lindow has Master of Environmental Management degree from Duke University and a Master of Arts degree in International Relations from Johns Hopkins School for Advanced International Studies.

John H. Page, Jr.
Federal Aviation Administration
Supervisor, Wind Turbine Evaluations
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Mr. John H. Page, Jr., Supervisor for wind turbine evaluations at the Federal Aviation Administration Headquarters, Obstruction Evaluation Group, is responsible for the oversight of wind turbine evaluations and their impact on the National Airspace System, as well as the development of policies and procedures related to evaluation of wind turbines. Prior to beginning his work in the Obstruction Evaluation Group John served as the Lead, Air Traffic Specialist for Unmanned Aircraft Systems (UAS) NextGen and Futures Integration and as a subject matter expert in the FAA’s Air Traffic Organization UAS Group. Prior to coming to work for the FAA Mr. Page served in the United States Army as an Air Traffic Controller (ATC). He held positions of varying levels of responsibility including ATC Facility Manager, Squadron Logistics Officer, Installation Operations Officer, ATC Human Resource Manager, and
Department of the Army Regional Representative Noncommissioned Officer to the FAA Western-Pacific Region. Mr. Page retired from the Army in February 2007 with 22 years of service.

He has a Bachelor of Applied Science Degree in Technology and Resource Management from Troy University and is currently pursuing his Master of Aeronautical Science Degree in Aeronautical Management from Embry-Riddle Aeronautical University. He is a graduate of the FAA’s Program for Emerging Leaders, a member of the Sergeant Audie Murphy Leadership Club, and a recipient of the Army Aviation Association Order of Saint Michael Award for outstanding service to the aviation community. He is married to the former Rena Messer of Kerrville, Texas they have two children and reside in Stafford, Virginia.

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Mr. Jim Haggerty is the Regulatory Program Manager for the North Atlantic Division Office of the U.S. Army Corps of Engineers located in Brooklyn, New York. He has been with the North Atlantic Division since September 2001, initially as the Administrative Appeals Review Officer before ascending to the Program Manager position in April 2006. He began his career with the Corps in March 1985 as a Regulatory project manager in the New York District office. As Program Manager he is responsible for overseeing the administration of the Regulatory Program by district offices in New England, New York, Philadelphia, Baltimore and Norfolk, Virginia. He graduated from Polytechnic Institute of New York University in May 1979 with a B.S. degree in Meteorology & Oceanography.

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Mr. George H. Detweiler, Jr., retired from the U. S. Coast Guard with over 20 years service. He returned to the Coast Guard as a marine transportation specialist in the Marine Transportation Systems Management Directorate at USCG Headquarters. His major projects have included conducting port access route studies, creating ships’ routing measures, conducting tribal consultations, and reviewing offshore renewable energy installations (OREIs) proposals. Mr. Detweiler has worked on the Cape Wind project and has been a panelist at the recently completed EnergyOcean International Conference and Exhibition in Portland, Maine, and the last AWEA conference in Atlantic City, New Jersey.

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Ms. Susan E. Bromm has been employed by the U.S. EPA since 1980 in various positions involving many aspects of domestic and international environmental protection. She is currently the Director of the Office of Federal Activities (OFA) at EPA headquarters in Washington, DC, responsible for EPA’s activities implementing the National Environmental Policy Act and for EPA’s international enforcement capacity building programs. Prior to moving to OFA in March 2008, Ms. Bromm directed the waste remediation enforcement office, establishing policy for compelling private parties to clean up old and abandoned toxic waste sites under the billion dollar Superfund program and the RCRA corrective action program. She also led efforts to implement the liability reforms contained in the Small Business Liability Relief and Brownfields law. Previous to working in the Office of Site Remediation Enforcement, Ms. Bromm directed the RCRA enforcement program, establishing national policy on waste enforcement, penalties and site clean-up. From 1980 to 1988, Ms. Bromm held a variety of positions with responsibility for developing hazardous waste regulations and setting hazardous waste facility permitting policies. Ms. Bromm is an attorney and a graduate of Georgetown University Law Center. Her undergraduate degree is from the State University of New York at Albany. She is a member of the District of Columbia bar and the American Law Institute.

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Dr. Thomas McCulloch is Senior Program Analyst and Senior Archaeologist with the Advisory Council on Historic Preservation's Office of Federal Agency Programs. He has been with the Council about 24 years. Dr. McCulloch’s primary focus is working with Federal agencies with strong archaeological, land-managing, and scientific responsibilities to ensure effective compliance with the National Historic Preservation Act. He has responsibilities for the Army Corps of Engineers (non-regulatory), the Department of Energy, NASA, NOAA, BOEMRE, and the Bureau of Reclamation. He is the staff liaison with the ACHP’s Archaeology Task Force and Subcommittee, which has recently revised the ACHP’s human remains policy, developed a new archaeology and heritage tourism policy statement, and developed new interactive archaeology guidance on the ACHP’s website. Dr. McCulloch also regularly teaches the ACHP’s introductory and advanced training courses.

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Dr. Mary Boatman is an oceanographer in the Environmental Sciences Branch of the Environmental Division in Herndon, Virginia. She is currently on a two year detail to the National Ocean Council as an Ocean Policy Advisor.
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Mr. Keld Madsen has six years of professional geospatial consulting services experience with AMEC Environment & Infrastructure and holds a M.S. in Planning and Land Management from Aalborg University, Denmark. He currently serves as the GeoSpatial Services Group Manager and is a member of the Information Management Department. His experience covers a wide range of geospatial service related functions including database development, GIS analysis, map production, raster creation and analysis, GIS implementations and application development support. He has provided technical and management assistance as well as on-site training to West Virginia University GIS Technical Center. Prior to current focus on the ESID project Keld Madsen was the project manager for FEMA Map Modernization in the State of Kentucky overseeing an engineering/GIS team on multi-year, multi-county map modernization (DFIRM) projects. He has been responsible for project deliverables, schedules, QA/QC, H&H analyses oversight, development and production of DFIRM panels, DFIRM databases, and Flood Insurance Studies.

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Mr. Chris Caldow is Chief of NOAA's Biogeography Branch, based in Silver Spring, Maryland. The Branch specializes in integrating and synthesizing spatial information into decision tools for managers of marine and estuarine ecosystems. Mr. Caldow is a Marine Biologist by training, with a strong research interest in the application of biogeographic principles to broad management issues such as Coastal and Marine Spatial Planning. His educational background includes an M.S. in Biology from the University of Houston, and B.S. in Aquatic Biology at the University of California, Santa Barbara. Mr. Caldow came to NOAA as a Knauss Marine Policy Fellow in 2000, and has been with the Biogeography Branch since then. The Biogeography Branch is part of the Center for Coastal Monitoring and Assessment (CCMA), one of NOS' National Centers for Coastal Ocean Science (NCCOS).

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Dr. Brian Calder is a Research Associate Professor at, and Associate Director of, the Center for Coastal and Ocean Mapping and NOAA-UNH Joint Hydrographic Center (CCOM/JHC) at the University of New Hampshire. He graduated M.Eng (with Merit) and Ph.D in Electrical & Electronic Engineering from Heriot-Watt University in Edinburgh, Scotland in 1994 and 1997 respectively, but became an accidental hydrographer after joining CCOM/JHC in 2000. His research interests have primarily revolved around
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**John Weiss**

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Mr. John Weiss, a Senior Associate at IEc, has nearly 20 years of experience as a consultant to public agencies and private entities. His work spans a range of environmental and energy-related issues, from the assessment of costs and benefits of offshore renewable energy, to the development of a model for assessing the environmental and social costs attributable to offshore oil and gas development, to the analysis of the efficacy of a state tax credit as a catalyst for investment in renewable energy and energy conservation projects. Mr. Weiss re-joined IEc in 2005, having previously worked at the firm from 1994-2000. From 2001-2004, he was an Associate Director at Cambridge Energy Research Associates (CERA) where he developed and communicated strategic insights to a global energy industry clientele, with a focus on emerging technologies and the potential impacts of emerging public policies. Mr. Weiss is a graduate of Brown University and the Massachusetts Institute of Technology.

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Ms. Laura McKay has been with the Virginia Coastal Zone Management Program since 1988 and has served as its Program Manager since 1994. The Virginia CZM Program is a network of state natural resource agencies and coastal city and county governments that implement Virginia’s laws and policies to protect and restore coastal ecosystems and economies. As Program Manager, Ms. McKay initiated multiple-year land acquisition, habitat restoration and ecotourism projects as well as several Special Area Management Plans (SAMPs). She serves on the Management Board of the Mid-Atlantic Regional Council on the Ocean (MARCO) and as the Leader of its Coastal and Marine Spatial Planning Action Team. In that capacity she initiated the development of MARCO’s Mapping and Planning Portal in fall 2009. Ms. McKay has a Bachelor’s degree in Environmental Studies from Smith College and a Master’s of Public Administration from the Rockefeller School of Public Affairs at the State University of New York at Albany.

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As Director of Marine Planning Programs for the Massachusetts Ocean Partnership, Mr. Nicholas Napoli leads MOP’s programs to advance science based and stakeholder informed ocean planning. In this capacity, he manages over a dozen projects including the development of statewide and regional data and information networks, the characterization of key ocean uses and industries, the development of models and other analysis and software tools to support decision making, and the development of environmental and socioeconomic indicators to measure progress.
Mr. John Weber has 13 years of experience in the environmental field, focusing on coastal and ocean management issues. He is currently the CMSP Managing Director for the Northeast Regional Ocean Council, a partnership of New England states and federal agencies collaborating on ocean management issues, where he is providing strategic direction for the Northeast response to the National Ocean Policy, particularly the Coastal and Marine Spatial Planning Framework. He recently served as the Ocean Program Manager for the Massachusetts Office of Coastal Zone Management, where he managed the development and implementation of the Massachusetts Ocean Management Plan, completed in late 2009. Mr. Weber’s previous private- and public-sector experience included review of urban waterfront development and planning activities, dredging, coastal erosion, and wetland restoration projects. Mr. Weber has a B.S. in Coastal Geology from Long Island University and an M.S. in Marine Resource Management from Oregon State University.

Patrick Halpin is an Associate Professor of Marine Geospatial Ecology and Director of the Geospatial Analysis Program at the Nicholas School of the Environment, Duke University Marine Lab. Prof. Halpin’s research focuses on marine geospatial analysis, ecological applications of geographic information systems and remote sensing; and marine conservation and ecosystem-based management. Prof. Halpin leads the Marine Geospatial Ecology Lab at Duke University and sits on a number of international scientific and conservation program steering committees. The Marine Geospatial Ecology lab leads the development of marine information’s systems such as OBIS-SEAMAP (http://seamap.env.duke.edu) and marine animal habitat and density modeling systems (http://serdp.env.duke.edu).

Ms. Christine Taylor has been the Lead Physical Scientist for The Bureau of Ocean Energy, Regulation and Enforcement’s (BOEMRE) Mapping and Boundary Branch, and the co-lead on the Multipurpose Marine Cadastre project for a little over 2 years. In addition to her work on the MMC, she focuses on mapping projects related to renewable energy siting and oil and gas lease sale areas and participates in a number of interagency working groups aimed at promoting GIS data and project sharing, including the National Ocean Council’s Interagency Information Management System - CMSP Data Portal Working Group. Prior to her employment with BOEMRE Christine served as the GIS Coordinator for NOAA’s National Marine Sanctuary Program. She has over 20 years experience working as a GIS professional.
She holds a M.S. in Environmental Science and Planning from Johns Hopkins University and a B.S. in Geography and Environmental Planning from Towson University.

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Mr. Brian Smith is a Coastal Ecologist at the National Oceanic and Atmospheric Administration’s Coastal Services Center. His focus is coastal and marine spatial planning implementation in addition to development and application of the Multipurpose Marine Cadastre. An experienced facilitator of collaborative projects, he has over 10 years of experience working with partners to conserve coastal resources.

Prior to his current position, Mr. Smith worked as a Research Coordinator for the Great Bay National Estuarine Research Reserve and as a Regional Biologist for Ducks Unlimited. He holds an M.S. in Fisheries Biology and a dual B.S. in Environmental and Forest Biology and Resources Management from the State University of New York, College of Environmental Science and Forestry.

**Jim Lanard**

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Mr. Jim Lanard is President of the Offshore Wind Development Coalition, which was recently formed by seven offshore wind developers and includes the American Wind Energy Association as one of its founding members. The Offshore Wind Development Coalition serves as an advocate for offshore wind developers and their supply chain partners before federal legislative and regulatory bodies.

Prior to his current position, Mr. Lanard was Managing Director of Deepwater Wind, where he was involved in the company’s offshore wind development initiatives in Rhode Island, New Jersey, New York and Massachusetts and supported the company’s strategic planning, policy development and regulatory affairs efforts. He also worked at Bluewater Wind for several years, leading Bluewater’s strategic planning and advocacy initiatives.

Mr. Lanard has worked in the environmental and energy sectors for his entire career. He has been executive director of two non-governmental environmental groups, Chief of Staff to a Member of the U.S. House of Representatives, Director of Environmental Programs and Government Relations for The Walt Disney Company’s Disney’s America project, and partner in an energy and environmental consulting firm. Mr. Lanard is a member of the New Jersey, Pennsylvania and Florida Bars and is also a former adjunct assistant professor at Rutgers University and Drexel University.
Ms. Aileen Kenney is the Director of Permitting at Deepwater Wind, a leading offshore wind developer. She is responsible for overseeing the permitting of Deepwater Wind’s portfolio which includes projects off the coast of Rhode Island, New Jersey, New York and Massachusetts. Ms. Kenney has worked on the permitting of wind and other energy projects in the United States and abroad for over 11 years. Prior to joining Deepwater Wind, she was the National Director of Wind Energy at Tetra Tech EC, Inc. During her time with Tetra Tech, their wind energy program was responsible for permitting over 335 projects representing over 20,000 MW of installed capacity. She co-managed preparation of the Wind Energy Siting Handbook for the American Wind Energy Association, published in 2008. Ms. Kenney received her B.A. and M.A. in Environmental Science & Policy from Clark University.

Ms. Laurie Jodziewicz (jaws-a-wits) is Director of Permitting at NRG Bluewater Wind. She has been in the renewable energy industry since 1998, most recently at the American Wind Energy Association (AWEA). For six years at AWEA she managed project siting, wildlife, and offshore wind policy issues before industry organizations, government agencies, environmental groups and the media. Prior to her involvement with wind she gained experience in a number of energy organizations spanning the solar, distributed generation and natural gas industries.

Ms. Kris Ohleth is the Director of Permitting for the Atlantic Wind Connection backbone transmission project. Her past positions include Policy Manager for Coastal and Marine Spatial Planning issues for Ocean Conservancy and the Director of Environmental Affairs for both Deepwater Wind and Bluewater Wind. Ms. Ohleth worked as a research technician and editor for the National Marine Fisheries Service in Woods Hole, Massachusetts and as a communication coordinator for The Nature Conservancy. She earned an undergraduate degree from Rutgers University and a master’s degree from the University of Rhode Island in Coastal and Ocean Policy. She is on the Board of the US Offshore Wind Collaborative, the New Jersey Environmental Lobby, and is the Chair of the New York/New Jersey Chair of the Women of Wind Energy.
ENVIRONMENTAL BREAKOUT:
MONITORING AND BASELINE STUDIES

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Ms. Jennifer Ewald has been working in the field of Marine Science for 15 years, as a Project Manager she is operationally experienced deploying over 200 oceanographic moorings in coastal Atlantic, Pacific and Alaska waters for NOAA, the Prince William Sound Science Center and State of Alaska specializing in current measurements and acoustics. Her passion for evaluating technology to improve methods of data collection, quality analysis and assessing user needs to most effectively produce accurate and relative results to the public, resource managers, emergency responders, researchers and policy makers lead to her recognition by the Department of Commerce with a Bronze Medal Award for the modernization of the National Current Observation Program (NOAA) in 2008. She received a degree in Marine Science from Coastal Carolina University in 1999 and delivered a Master’s Thesis on coastal circulation in Narragansett Bay at the University of Rhode Island in 2001. Ms. Ewald joined the Environmental Studies Program in May 2010, focusing on the coordination of renewable energy research within the agency and with external partnerships.

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Mr. Brian J. Balcom is a Senior Scientist in CSA International, Inc.’s (CSA’s) Western Regional Office located in Salinas (Monterey County), California. He is a benthic ecologist with nearly 30 years of experience in biological baseline studies and assessments of the potential effects of man's activities on the marine environment. With CSA since 1981, Mr. Balcom has provided marine biological technical expertise, environmental impact assessment (EIA) capabilities, and management oversight on numerous multidisciplinary assessments of proposed activities in federal and state waters (e.g., oil and gas exploration, development and abandonment activities, and liquefied natural gas [LNG] terminal and pipeline installation and operation). He has managed EIAs for compliance with the National Environmental Protection Act (NEPA) and Council on Environmental Quality (CEQ), and protective regulations including the Endangered Species Act (ESA), Marine Mammal Protection Act (MMPA), and California Environmental Quality Act (CEQA). Mr. Balcom has prepared assessments related to noise effects on marine mammals and sea turtles, with an emphasis on endangered and threatened species.
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Dr. Gary A. Buchanan was project manager for the Ocean/Wind Power Ecological Baseline Studies, a two year study of avian, marine mammal and sea turtle species in the offshore waters of New Jersey. He is the Manager of the Office of Science for the New Jersey Department of Environmental Protection (NJDEP), oversees multidisciplinary research and science-based technical support, and is responsible for the coordination and administration of the NJDEP Science Advisory Board. He has degrees in biology and environmental science with a focus on aquatic ecology, marine/estuarine ecology, and ecotoxicology. With more than 28 years of experience, he has conducted a variety of field, laboratory and research projects involving water quality, natural resources, ecology, ecotoxicology, environmental toxicology, ecological risk assessment, and hazardous waste site investigations. He has managed technical groups which have conducted numerous ecological and environmental investigations at sites across the United States.

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Mr. Bill White serves as the Assistant Secretary for Federal Affairs in Governor Patrick’s Energy and Environmental Affairs Office in Massachusetts. In this role, Mr. White leads the state’s efforts on the federal leasing process for offshore wind development. He has played a key role in securing Federal permits for the historic Cape Wind project and attaining federal funding for the Massachusetts Wind Technology Testing Center, the largest wind blade test facility in the world. Previously, Mr. White worked at the Harvard Kennedy School where he directed the John F. Kennedy Jr. Forum. During the 90s, Mr. White served as a Special Assistant to the President in the Clinton White House and worked at the U.S. Department of State. During the Gulf War, Mr. White helped organize the international media center in post-liberated Kuwait. He is a graduate of Boston College (B.S.) and Harvard Kennedy School (MPA). Mr. White lives with his wife and two kids in his hometown of Milton, Massachusetts.

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In his capacity as a planner at the Maine Coastal Program, Mr. Matt Nixon’s duties involve spatial analysis, data collection and collection effort coordination, coastal public access policy development, and coastal and marine spatial planning policy development and implementation. He was involved in the state’s efforts to site three ocean energy test areas in Maine state waters and is currently coordinating the data and spatial analysis piece for Maine’s next evolution of CMSP. Prior to his work in Maine, Mr. Nixon worked for the U.S. EPA, Atlantic Ecology Division where he focused on database structure
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**Grover Fugate**

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Mr. Grover Fugate is Executive Director of the Rhode Island Coastal Resources Management Council (CRMC). In his role over a 25 year period, Mr. Fugate has been responsible for overseeing the development of all policies and programs for the state’s coastal program. Currently, he is serving as project manager of the Rhode Island Ocean Special Area Management Plan (SAMP), the CRMC’s seventh such regulatory program. The SAMP will provide management of a variety of existing and new uses in state ocean waters and focuses in part on providing guidance for the development of offshore renewable energy resources. Due to his leadership with the model Ocean SAMP project, Mr. Fugate has earned many significant awards, including the prestigious Susan Snow-Cotter Award for Excellence in Ocean and Coastal Resource Management from the National Oceanic and Atmospheric Administration (NOAA). He has also been presented with several Sea Grant Awards including, the 2008 Sea Grant Life Time Achievement Award for coastal management. Mr. Fugate is the author of a number of academic journal articles on coastal and natural resources management issues and is a adjunct faculty member at the Marine Affairs Program at the University of Rhode Island and also a guest lecturer at Brown University and Roger Williams University.

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Ms. Michelle Carnevale is a Coastal Manager at the University of Rhode Island’s Coastal Resources Center. She currently conducts research and outreach on offshore renewable energy development in support of the National Oceanographic Partnership Program (NOPP) Project “Developing Environmental Protocols and Modeling Tools to Support Ocean Renewable Energy and Stewardship” (Project Number: M10PS00152) and the Ocean Special Area Management Plan (SAMP), an ecosystem-based marine spatial planning project. Specifically, her research has examined offshore renewable resources, technology, and the environmental effects of its development. In addition, Ms. Carnevale has been heavily involved in the creation of a regulatory framework for offshore renewable energy to be used at the state level in Rhode Island. Ms. Carnevale joined the Coastal Resources Center in 2009, after receiving a Master’s degree in Marine Affairs and a Master's in Business Administration from the University of Rhode Island, where her graduate research focused on offshore renewable energy development in New England. She also holds a B.S. in Marine Ecology from Cornell University.
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Dr. John King's current research interests include geomagnetism and paleomagnetism, environmental magnetism, sedimentology, paleoclimatic studies, sediment core logging, coastal and marine habitat and ecosystem studies, trace metal geochemistry, pollution studies. Dr. King teaches a graduate course in Environmental Magnetism and High-Resolution Quaternary Climate Studies, as well as graduate courses in Geological Oceanography and Introduction to Marine Pollution. Dr. King has given numerous talks and presentations to the general public on global and local impacts of climate change. Dr. King received his Ph.D. in geology from the University of Minnesota.

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Ms. Michelle Magliocca works in the Office of Protected Resources and is the point of contact for all renewable energy activities that may require an incidental take authorization under the Marine Mammal Protection Act. She received a Master of Environmental Management from Duke University.

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Ms. Julie Slacum has been a Fish and Wildlife Biologist with the U.S. Fish and Wildlife Service, Chesapeake Bay Field Office since 1999. For the first ten years of her career she worked for the Coastal Program on habitat restoration projects for endangered species and migratory birds. Most of this work involved invasive species control. Ms. Slacum worked on multiple invasive species policy issues, the largest and most controversial one being the proposed introduction of a non-native oyster to the Chesapeake Bay. She also coordinated an eight state regional panel on aquatic invasive species for several years. In 2009, she became the Endangered Species and Conservation Planning Division Chief. In that position, she supervises eleven employees that evaluate and review project related impacts on Service trust resources (threatened and endangered species, migratory birds, interjurisdictional fisheries, refuges) under the Endangered Species Act, Fish and Wildlife Coordination Act, Bald and Golden Eagle...
Protection Act, Migratory Bird Treaty Act, and Sikes Act. Before she started employment with the Service, she received a dual B.S. Degree in Biology and Environmental Science from Salisbury State University and University of Maryland Eastern Shore. She then went to receive a M.S. in Fisheries through the University of Maryland Marine, Estuarine, and Environmental Sciences program.

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Ms. Kim Skrupky is a Marine Biologist for BOEMRE. She has nine years of experience, specializing in acoustic effects on marine mammals, sea turtles, and fish. Ms. Skrupky writes and reviews environmental analyses to comply with the National Environmental Policy Act, Marine Mammal Protection Act, and Endangered Species Act and participates in the environmental studies program as BOEMRE sponsors research on marine mammals, sea turtles, and fish.

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Dr. Thomas Hoff, Senior Ecologist, has worked for the Mid-Atlantic Fishery Management Council for nearly 30 years. He has been responsible for or worked on each of the Council’s Fishery Management Plans and has been the lead for habitat and ecosystem efforts. Prior to working for the Council he spent six years with two environmental consulting firms working on the Hudson River. He has a B.S. (Zoology) and M.S. (Ecology) from The Pennsylvania State University and a Ph.D. (Marine Sciences) from the University of Delaware.

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Dr. Sofie Van Parijs has worked on passive acoustic research from the poles to the Tropics for over 17 years. She has undergraduate and masters degrees from Cambridge University, U.K. and a Ph.D. from Aberdeen University, UK. She worked as a postdoctoral scientist at the Norwegian Polar Institute, James Cook University in Australia and Cornell University before moving to the Northeast Fisheries Science Center (NMFS/NOAA) in 2004. At NMFS she is the program leader for large whale and passive acoustic research within the Protected Species Branch. She has published over 40 papers in international journals and represents NMFS in a wide range of fora within the U.S. and internationally. Her expertise in marine bio-acoustics has addressed questions on behavioral ecology, distribution, abundance, long term monitoring, mitigation and effects of ocean noise on marine mammals. This has given her extensive experience collecting data with archival, real time acoustic recorders and autonomous vehicles.
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Dr. Robin Fitch has worked for the Department of the Navy as the Director of Marine Resources and at Sea Policy since 2006, where her work has focused primarily on policy analysis and science application regarding military activities and environmental sustainability in the marine environment. Dr. Fitch served in the Navy as an unrestricted line officer from 1980 through 2010 in both the active and reserve components. She holds a B.S. and M.S. in Biology, an M.A. in Education, and a Ph.D. (ABD) in Environmental Science and Policy from George Mason University.

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Dr. David Zeddies is a Senior Scientist with JASCO Applied Sciences. He has a Ph.D. in Neuroscience from Northwestern University in Evanston, Illinois; and, is also trained as an engineer, with a BSME from the University of Illinois in Champaign-Urbana. Dr. Zeddoes has published refereed articles on auditory neurophysiology, sound source localization by fish, and the impacts of intense sounds on fish hearing. Dr. Zeddies academic and professional work includes methods of acoustic measurement and assessment of risk due to anthropogenic sounds on marine life.

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Mr. Tom Carlson has been active in research of active and passive acoustics for over 30 years. Passive acoustic research includes the effect of impulsive sounds generated by pile driving on fish, detection, classification, and localization of vocalization marine mammals, broad band noise measurement at prospective marine hydrokinetic sites, and instrumentation and software for the acquisition, processing, and analysis of underwater noise. Active acoustic research includes target strength models and measurements for fish and marine mammals and the development of micro-transmitters for acoustic telemetry.
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Dr. Peter J. Dugan is a research scientist with a background in electrical engineering and advanced computing. As a research scientist, Dr. Dugan spent 16 years in industry working for Hughes Aircraft Company and Lockheed Martin. He has authored several U.S. patents and trade secrets plus a host of professional peer-reviewed articles and presentations. His current research includes advanced methods for detection and classification using passive acoustic data and is the Principal Investigator, along with Dr. Christopher Clark, for the ONR Grant for Detection, Classification and Localization, awarded 2011. Dr. Dugan is currently the Director of Applied Science and Engineering at the Cornell Lab of Ornithology, Bioacoustics Research Program where his team works on animal vocalization recording and analysis hardware and software to promote conservation efforts.

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Ms. Michelle Bachman has worked as a Fishery Analyst for the New England Fishery Management Council in Newburyport, Massachusetts since 2008. NEFMC, which is one of eight regional councils established by the Magnuson Stevens Fishery Conservation and Management Act, manages fishery resources in federal waters off Maine, New Hampshire, Massachusetts, Rhode Island, and Connecticut. Michelle’s focus is on issues related to Essential Fish Habitat, including designation, evaluation of fishery impacts, and development of measures to minimize fishery impacts. In addition, Ms. Bachman works on issues related to deep-sea corals and marine spatial planning. She provides staff support for the Council’s Habitat, MPA, and Ecosystem Committee, and chairs the Habitat Plan Development Team. Ms. Bachman has an undergraduate degree in Biology and Environmental Studies from Tufts University, and a master’s degree in Living Marine Resource Science and Management from the University of Massachusetts Dartmouth.

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Ms. Ann Pembroke is Vice President and Technical Director of the Marine Sciences group at Normandeau Associates. With an M.S. from the University of Delaware in Marine Studies, her career focus has been on impact assessment of marine development. Initially specializing in plankton resources, she has worked her way through the food web and has addressed impacts to benthos, fish, and marine
mammals. Her experience spans major port development, dredging, deepwater ports, pipelines, transmission cables, and offshore wind projects.

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Mr. Roger Pugliese, Senior Fishery Biologist with the South Atlantic Fishery Management Council has, over 25 years, facilitated development of Fishery Management Plans ranging from South Atlantic Red Drum to Atlantic Dolphin and Wahoo to habitat plans for Coral and Live Bottom Habitat and Pelagic Sargassum. He is responsible for the Council's Spatial GIS, Essential Fish Habitat and broader habitat conservation and ecosystem coordination efforts including the development of the Council’s Habitat Plan and the Fishery Ecosystem Plan which supports Comprehensive Ecosystem-Based Management Amendments. To facilitate regional ecosystem coordination, he also serves on the Southeast Coastal and Ocean Observing Regional Association Board of Directors, is a member of the South Atlantic Landscape Conservation Cooperative Steering Committee, Chairs the South Atlantic Committee for the Southeast Area Monitoring and Assessment Program and is a member of the Governor’s South Atlantic Alliance Executive Planning Team, the Southeast Aquatic Resources Partnership and the South Atlantic Regional Research Plan Development Team.
SOCIAL ECONOMIC BREAKOUT:
ASSESSMENT DRIVEN ISSUES

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Dr. Brian Jordan is the Federal Preservation Officer and Headquarters Archaeologist for the Department of the Interior’s Bureau of Ocean Energy Management, Regulation, and Enforcement (BOEMRE). Prior to joining BOEMRE, Dr. Jordan was the assistant state underwater archaeologist for Maryland, working for the Maryland Historical Trust. In Maryland, he built up the remote-sensing and data processing capabilities of the Maryland Maritime Archaeology Program. Other government experience included building and overseeing the cultural and historical resources component of NOAA’s National Marine Protected Areas Center. In his career as a marine archaeologist, Dr. Jordan has participated in and conducted marine archaeology surveys and excavations in numerous countries on four continents, including Turkey, Denmark, Portugal, and Morocco. He also worked with and advised institutes and government representatives of several countries on the survey, excavation, and management of submerged cultural resources. Past research focused on environmental factors affecting the preservation of wooden shipwrecks in the marine environment.

David Blaha

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Mr. David Blaha has over 29 years’ International Environmental, Social and Health Impact Assessment experience primarily in the energy, mining and metals, military, and transportation sectors. His particular energy experience includes hydropower, windpower, natural gas pipelines and LNG (including onshore and offshore Deepwater Ports). He is an expert on the regulatory/procedural requirement of NEPA, Section 7 of the Endangered Species Act, Section 106 of the Natural Historic Preservation Act and Executive Orders for wetlands, floodplains, and environmental justice in the U.S. He specializes in assessing/permitting large (often >$1 billion) infrastructure projects.
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Mr. David Robinson, M.A., R.P.A., is an underwater archaeological consultant and the director of the New Bedford, Massachusetts-based Fathom Research, LLC's Marine Archaeological Services Division. He has worked in the submerged cultural resource management field since 1991, during which time he has directed archaeological projects throughout New England, the Great Lakes and Lake Champlain, the Mid-Atlantic, the Deep South, and in the Gulf of Mexico. Since 2001, Mr. Robinson has performed multi-disciplinary investigations to assess and identify both historic and prehistoric submerged cultural resources in support of the environmental permitting review for seven different offshore renewable energy projects in the Mid-Atlantic and New England regions. Most recently, he was an invited presenter during a symposium on modeling surviving prehistoric landforms on the Outer Continental Shelf at the BOEMRE's 2011 Information Transfer Meeting, and is a co-author of the 2011 BOEMRE-funded study - *Prehistoric Site Potential and Historic Shipwrecks on the Atlantic Outer Continental Shelf*.

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Mr. Doug Harris is the Preservationist for Ceremonial Landscapes & Deputy THPO for the Narragansett Indian Tribal Historic Preservation Office. The state of Rhode Island is the ancestral core of "Narragansett Countrye."

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Mr. Dave Ball is the Regional Historic Preservation Officer for the Pacific OCS office of the Bureau of Ocean Energy Management, Regulation and Enforcement (BOEMRE). He also serves as the BOEMRE Diving Safety Officer. Since joining BOEMRE in 1999, Mr. Ball has been involved with documenting a number of historic shipwrecks on the Atlantic and Gulf of Mexico Outer Continental Shelf (OCS). He has directed terrestrial and underwater projects throughout the United States and is currently responsible for archaeological and cultural heritage resources on the Pacific OCS. Mr. Ball received his Master of Arts degree in Anthropology from Florida State University in 1998 and is an elected member of the Advisory Council on Underwater Archaeology Board of Directors.
**John Jensen, Ph.D.**

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Dr. John Jensen is a faculty member Maritime Studies and Ocean Policy at the Woods Hole-based Sea Education Association and Adjunct Assistant Professor of History and Nautical Archaeology at the University of Rhode Island. He is an applied historian and archaeologist whose current research focuses on maritime landscapes and cultural heritage management. He is a member of the National Marine Protected Area System's Cultural Heritage Heritage Working Group, and a contributor to the recent Rhode Island Ocean Special Area Management Plan. He has more than twenty years of experience working in cultural heritage management at the state and federal levels and his regions of expertise include the Atlantic coast, the Great Lakes, and Alaska.

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**Susan Abbott-Jamieson, PhD**

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Dr. Susan Abbott-Jamieson is President of Abbott-Jamieson Consulting, Ltd., Adjunct Professor of Anthropology at the University of Maryland, and Associate Professor Emerita at the University of Kentucky. From 2002-2011 she served as Lead Social Scientist, Office of Science and Technology, NOAA’s National Marine Fisheries Service, guiding the development of the agency’s sociocultural analysis program to improve the agency's ability to meet its mission-related social science research requirements. She is an applied anthropologist whose current work focuses on the continued development of NOAA Fisheries’ Voices from the Fisheries Project (http://www.st.nmfs.noaa.gov/voicesfromthefisheries/) and NOAA’s Deepwater Horizon Oral History Project with the University of Southern Mississippi. Dr. Abbott-Jamieson has more than thirty years research experience in communities whose economies are dominated by natural resource extraction. Her regions of expertise include East Africa, Southern Appalachian coal mining communities, and U.S. fishing communities.

**Jeremy Firestone, Ph.D.**

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Dr. Jeremy Firestone, Professor, College of Earth, Ocean, and Environment and Director, Center for Carbon-free Power Integration, University of Delaware. He has a J.D. from University of Michigan and Ph.D., Public Policy Analysis, from University of North Carolina. Firestone helped organize the first American Wind Energy Association (AWEA) Offshore Wind Power Workshop; was Conference Chair, 2010 Philadelphia Offshore Wind Forum; and has made presentations on wind power at events sponsored by NREL-IEA, NYSERDA, DOE-DOI, Cornell University, Williams College, University of Hawaii, European Offshore Wind Conference, AWEA WINDPOWER and other venues. He served on the
Dr. Porter Hoagland is a Senior Research Specialist at the Marine Policy Center of the Woods Hole Oceanographic Institution specializing in the application of methods from economics and policy analysis to problems in ocean and coastal management. He holds a Ph.D. and an M.M.P. in Marine Policy from the University of Delaware, an M.P.A. in Public Administration from Harvard University, and a B.S. in Biology from Hobart College. His main research interests include the spatial and temporal allocation of resources and uses (marine spatial planning and ocean zoning), the design of institutions for ocean management, and the characterization of appropriate policy instruments for rationalizing human uses of the ocean. His recent work focuses on the siting of renewable energy in the ocean, marine natural hazards, including shoreline change and harmful algal blooms, the conservation and management of marine fisheries and aquaculture, and the economic valuation of large marine ecosystems.

Dr. Kevin St. Martin is an associate professor of Geography at Rutgers, the State University of New Jersey. His research concerns the development and institutionalization of economic and environmental discourse. His current work examines the case of the regulation and remapping of the marine environment and its relationship to the sustainability of community economies and local environments. His work has been published in Antipode, Environment and Planning A, the Annals of the Association of American Geographers, as well as other journals and edited volumes. Author preprints of his articles can be found at http://geography.rutgers.edu.

Dr. Amardeep Dhanju is an Ocean Policy Analyst in the Environmental Studies Program at the Bureau of Ocean Energy Management, Regulation, and Enforcement (BOEMRE). He is coordinating the National Ocean Policy initiative with a focus on Coastal and Marine Spatial Planning (CMSP). Dr. Dhanju is also engaged with social science issues related to offshore renewable energy regulation at the Bureau. Dr. Dhanju graduated with a Ph.D. in Marine Policy from University of Delaware in 2010. His dissertation focused on policy and regulatory issues related to offshore wind power development in the
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Mr. Ben Hoen is a researcher at Lawrence Berkeley National Laboratory, concentrating primarily on the investigation of individual and community responses to a number of different renewable energy sources, such as large scale wind and residential solar. In 2009, Mr. Hoen completed a multi-year study investigating the effects that nearby wind facilities have on surrounding property values, and since has continued this work as part of a team investigating noise and annoyance issues surrounding existing wind facilities in the U.S. He is co-authors on a number of LBNL report’s and journal articles and is asked to speak frequently on the subject of renewable energy and public acceptance. He holds a Bachelor degree in Finance and General Business, and a Master of Science Degree in Environmental Policy.

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Over the course of the past 30 years, Ms. Barbara Hill has held a variety of management positions within non-profit organizations focused on renewable energy, land preservation and affordable housing. From 2001 to 2005 she served as the Project Manager for Offshore Wind with the Massachusetts Technology Collaborative, Renewable Energy Trust, the state's development agency for clean energy and the innovation economy. She is a founding initiator of the CLEAN campaign, a collaborative of grassroots led organizations working for a new national energy policy advocating CLEAN's Call to Action. Ms. Hill is also a 2008 Senior Fellow with the Breakthrough Institute and serves on the Board of Directors of the U.S. Offshore Wind Collaborative.

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Mr. Gary Norton is Program Manager for Wind and Water Power at Sentech Inc, now part of SRA International. In this capacity, he provides technical and programmatic support for the U.S. Department of Energy’s (DOE) Wind Program and was instrumental in developing the agency’s strategy for Offshore Wind Energy. Mr. Norton’s experience in wind energy dates back to developing the first utility interface turbines and installing the world’s first wind farms in California in the early 1980’s. In his varied career he has also provided fail-safe power stations at remote pipeline valves for major multinationals such as Chevron and Exxon, conducted renewable energy field tests at the South Pole for the National Science
Foundation, and managed community infrastructure projects in Indonesia and Haiti for the U.S. Agency for International Development.

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Mr. Matthew B.C. Unger has been working in the energy field for the past 8 years evaluating and optimizing the design, performance, economics, and operations of both conventional and renewable energy assets. Mr. Unger received his Bachelor of Science in Integrated Science and Technology with concentrations in Energy, Business Technology, Manufacturing, Measurement, and Transportation and is pursuing his Masters in Electrical Engineering while employed as an Energy Research Specialist with the Center for Energy and the Global Environment at the Advanced Research Institute of Virginia Polytechnic Institute and State University. Most recently Mr. Unger has been working as a member of the Virginia Coastal Energy Research Consortium, a public-private-university partnership exploring the potential energy supply alternatives for Virginia from offshore wind energy. This work has included a detailed feasibility assessment of offshore wind power for Virginia.

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TECHNOLOGY ASSESSMENT AND RESOURCE PROGRAM: RENEWABLE ENERGY STUDIES

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Mr. Daniel G. White has 36 years professional experience in the ocean industry in both engineering and management positions since graduating in 1974 with a B.S. in Ocean Engineering from Florida Atlantic University. He has worked for the U.S. Navy, the private sector, and academia (Harbor Branch Oceanographic Institution). He is the publisher of Ocean News & Technology magazine and founded the EnergyOcean conference. Mr. White has founded or co-founded seven successful ocean technology companies that were involved in engineering and the development of state-of-the-art products manufactured for the ocean industry. He was accepted to law school in 1979 to pursue patent law as it related to ocean technology. In 1998, Mr. White was elected the Board of Directors of the Marine Technology Society (MTS) and served as Director of Publications for four consecutive years.

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Mr. Dwight Davis is a Principal Program Manager at Applied Physical Sciences, Corp. He received his M.S.E. in Mechanical Engineering at The Catholic University of America in 1991, and his B.S. in Physics at the College of William and Mary in 1983. He manages projects addressing pile driving noise and structural vibration for offshore wind turbines, and other projects in structural and underwater acoustics. He also manages programs to develop and transition networked radar sensors for perimeter security and border surveillance, and other software and hardware system development efforts. He was the test director for a program to develop very small and low power radar nodes. He executed many noise and vibration control projects supporting the U.S. Navy and other clients, addressing shipboard structure-borne, radiated, airborne, and sonar self-noise via design models, measurements, and modeling technique development. He wrote acoustic sections of ship specifications, and reviewed noise related documentation.
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Dr. Malcom Sharples is President of Offshore Risk & Technology Consulting for the last 10 years – which deals with work in the area of risk analysis, accident investigation of offshore rigs, safety management system, and research in various areas of offshore equipment including wind farms. Assignments have included developing plans for offshore oil companies in the arctic, and developing innovative techniques for spotting areas of high consequence potential accidents. Dr. Sharples has been engaged by BOEMRE in research work on wind farms with a view to providing advice on regulatory requirements. Prior to starting his own consultancy, he was Vice-President of the American Bureau of Shipping, and prior to that he was President of Noble Denton & Associates Inc. marine surveyors for insurance interests, having been one of the original founding associates in 1972. He serves on the Board of Directors of Keppel Offshore & Marine in Singapore which has over 20 active shipyards and on the Board of the Offshore Energy Center (offshore drilling rig museum and educational outreach center), in Galveston. Dr. Sharples is a Fellow of SNAME, a longtime member of the Marine Technology Society and the Society of Petroleum Engineering and is a practicing Professional Engineer in Texas, and in Ontario Canada where he graduated from the University of Western Ontario. He holds a Doctorate from University of Cambridge.

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Mr. Tom McNeilan is a Registered Professional Engineer with degrees in Civil Engineering and Geotechnical Engineering. His 37 years of professional experience has focused on the siting, design, installation, and performance of offshore energy structures and large coastal infrastructure. He directs Fugro’s marine engineering and survey practice for offshore renewable energy along the U.S. east coast and in the Great Lakes regions. Mr. McNeilan has been the project manager for offshore wind off the U.S. east coast and the United Kingdom; offshore oil and gas developments along the U.S west and east coasts, the Gulf of Mexico, and Alaska, as well as offshore northern Europe, the Middle East, India, and southeast Asia; deep-water and near-shore LNG terminals; and many large coastal infrastructure projects. Mr. McNeilan was the principal in charge of the BOEMRE-funded research on the influence of seafloor scour on offshore wind turbines.

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Mr. Robert Sheppard is a Technical Manager with Energo Engineering in Houston, Texas, an engineering consulting firm specializing in advanced analysis, integrity management, and risk and reliability. He has over twenty years of experience in structural engineering with a focus on assessment and repair of offshore structures and structural integrity management. Mr. Sheppard is an active participant in the American Wind Energy Association’s (AWEA) effort to develop standards for the U.S. offshore wind
industry, serving as the leader for the offshore safety, operations and decommissioning subcommittee. He has led projects for the BOEMRE to develop guidelines for the inspection of offshore wind turbine facilities including the substructure, tower, nacelle and blades. Mr. Sheppard earned a B.S. in Civil Engineering from Rice University and an M.S. in Structural Engineering from the University of California Berkeley, and he is a registered Civil Engineer in California and Texas.

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Dr. Qing Yu has held various positions within ABS and is currently a Managing Principal Engineer in ABS Corporate Technology where he is responsible for the R&D relating to offshore renewable energy. Prior to joining ABS in 2003, he held a faculty position of Naval Architecture at Shanghai Jiao Tong University, China. He has also worked as a subsea riser engineer at a major consultancy firm in Houston. Dr. Yu has fifteen years of experience with offshore and ship structures. His experience on other more specialized areas includes composite materials, mooring global analysis and structural reliability. He has published over twenty technical papers. Dr. Yu received his Ph.D. in Mechanical Engineering from Rensselaer Polytechnic Institute (RPI) in Troy, New York and his M.S. and B.S. in Naval Architecture from Shanghai Jiao Tong University.

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Mr. George Hagerman has more than 30 years experience researching renewable ocean energy systems, including offshore wind power, wave power, tidal current energy, and ocean thermal energy conversion (OTEC). His research focus areas are resource assessment, metocean extreme event analysis, site characterization, and energy cost modeling.

Mr. Hagerman is a research faculty member at the Virginia Tech Advanced Research Institute in Arlington, Virginia, and Director of Offshore Wind Research for the Virginia Coastal Energy Research Consortium, where he has coordinated the work at five universities to support a feasibility-level reference baseline design and cost estimate for a hypothetical offshore wind project off Virginia, to be compared with new-build fossil fuel generation.

Mr. Hagerman has been invited to brief federal and state regulatory agencies, and to testify before legislative committees of the U.S. Congress and the Virginia General Assembly. In 2009, the Minerals Management Service recognized his service with an Offshore Leadership Award.

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Prof. James F. Manwell graduated from Amherst College with a B.A. in biophysics and from the University of Massachusetts with an M.S. in Electrical and Computer Engineering and a Ph.D. in Mechanical Engineering. He is presently a Professor of Mechanical Engineering and the Director of the University of Massachusetts Wind Energy Center. Prof. Manwell has been working in field of wind energy for over 30 years. His research interests have focused on assessment of the wind resource and wind turbine external design conditions, hybrid power system design, energy storage and offshore wind energy. He is an author of a textbook on wind energy: Wind Energy Explained: Theory, Design and Application. He was the US representative to the International Electrotechnical Commission’s program to develop design standards for offshore wind turbines (IEC 61400-3), served on International Science Panel on Renewable Energies, has worked with the International Energy Agency on a variety of wind energy issues and helped bring a large wind turbine blade test facility to Massachusetts. He is presently a member of the IEC maintenance team (TC 88 MT3) which is developing a second edition of the offshore wind turbine design standard.

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Mr. Walt Musial is a Principal Engineer and the Manager of Offshore Wind and Ocean Power Systems at National Renewable Energy Laboratory (NREL) where he has worked for 23 years. He initiated the offshore wind energy research program at NREL in 2003 and has written several papers, reports and articles on offshore wind energy. For over seven years he has been the primary technical contact to the Department of Energy on offshore wind. Recently, Mr. Musial served on a committee to the National Academy of Science which wrote a report titled “Structural Integrity of Offshore Wind Turbines” which was published in 2011. Before NREL, Mr. Musial was employed in the commercial wind energy industry in California. He studied Mechanical Engineering at the University of Massachusetts at Amherst, where he earned his Bachelor’s and Master’s Degrees and specialized in all aspects of renewable energy and energy conversion with a focus on wind energy. He has over 50 publications and one patent.
BIRD, BATS AND OFFSHORE WIND DEVELOPMENT:
REMAINING INFORMATION GAPS

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Dr. David Bigger is an avian biologist in the Office of Alternative Energy Programs. He serves as the program’s lead for renewable energy studies on the Atlantic OCS and as the staff lead for the Atlantic Offshore Wind Consortium’s Data and Science Work Group. Dr. Bigger has over 12 years of professional experience with endangered species and natural resource management. Prior to joining the Department of Interior, Dr. Bigger was a Senior Scientist in the private sector where he directed the development of a habitat conservation plan’s scientific research program for a threatened species, designed and managed an inland population monitoring program to assess the effectiveness of conservation strategies, and explored alternative conservation strategies for several listed species including the spotted owl and marbled murrelet. Dr. Bigger earned his Ph.D. in Biology from the University of California at Santa Cruz.

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Ms. Melanie Steinkamp is with the U.S. Fish and Wildlife Service and is the mid-Atlantic Coordinator for the Atlantic Coast Joint Venture, a partnership dedicated to conserving habitat from Maine to Puerto Rico. Ms. Steinkamp also co-leads the Atlantic Marine Bird Conservation Cooperative, a voluntary group striving to connect researchers working to address issues faced by birds in their marine environments. She has spent much of her professional life overseeing research and developing monitoring methods to aid in the conservation of waterbirds and seabirds.

**Julia Tims**
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Ms. Julia Tims is a professional ornithologist with more than twenty years of experience in terrestrial ecology and natural resource management and environmental impact assessment. Ms. Tims has conducted environmental impact assessment and natural resources studies throughout the United States, South America, Africa, and Europe involving biodiversity assessment and management, wildlife and vegetation management, endangered species survey and management, and stakeholder engagement related to biodiversity and the interactions between biological and social issues. Ms. Tims has particular expertise in assessing the effects of wind power projects on biological communities, particularly birds and endangered species. Ms. Tims recently participated in the March 2010 Wind Turbine Guidelines
Advisory Committee meeting, where draft recommendations for protection of birds and bats at wind projects were unveiled and discussed.

**James Woehr, Ph.D.**

Bureau of Ocean Energy Management, Regulation, & Enforcement

[James.Woehr@boemre.gov](mailto:James.Woehr@boemre.gov)

Dr. James Woehr is an Avian Biologist in the Environmental Assessment Branch of the United States Department of the Interior Bureau of Ocean Energy Management, Regulation and Enforcement in Herndon, Virginia. Dr. Woehr has been a Certified Wildlife Biologist since 1979 and has over 25 years of involvement in bird conservation at local, state, and national levels. He has a B.S. degree in aerospace engineering, an M.S. in Wildlife Management, and a Ph.D. in Ecology. Dr. Woehr has been a Design Engineer in the aerospace industry, an Environmental Science Professor at the State University of New York College at Plattsburgh, a Financial Planner and Investment Broker for a Wall Street firm, Coordinator of Nongame and Endangered Species programs for Alabama Department of Conservation and Natural Resources, and Senior Scientist for the Wildlife Management Institute before joining BOEMRE as the headquarters avian biologist. These diverse experiences provide Jim with an understanding of the perspectives of the multiple parties in the wind energy development business and lead him to seek affordable, responsible solutions acceptable to all parties. Dr. Woehr represents BOEMRE at national and international bird conservation meetings and in negotiations with state and federal agencies and wind energy developers over bird conservation, monitoring, and mitigation measures related to siting and development of offshore wind energy facilities. He also reviews BOEMRE’s NEPA documents for adequacy in addressing bird conservation needs and issues. Dr. Woehr is also an active participant in BOEMRE’s environmental sciences program in which he proposes avian research projects, leads evaluation teams selecting the contractors who will perform the studies, and oversees the performance of selected contractors.

**Caleb Gordon, Ph.D.**

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Dr. Caleb Gordon is a Principal Ornithologist for Normandeau Associates, specializing in interactions between wind energy facilities and wildlife. He received a bachelor’s degree from Williams College, and a Ph. D. in ecology and evolutionary biology from the University of Arizona, where he studied community ecology of wintering grassland sparrows. He performed postdoctoral research at the Instituto de Ecología in Xalapa, Veracruz, Mexico, where he investigated bird communities in Mexican coffee plantations. He then taught biology and conducted research on songbird migratory biology at Lake Forest College near Chicago, before joining Normandeau Associates, then Pandion Systems, in 2008. At Normandeau, Dr. Gordon is a lead scientist and project manager on wind wildlife research projects in both onshore and offshore environments, including managing Normandeau’s BOEMRE-funded research efforts to pioneer new technologies for performing offshore wind-wildlife risk and impact studies. He is an internationally recognized leader in the offshore wind-wildlife arena, chairing AWEA’s offshore wind wildlife issues subcommittee, and with numerous publications, and panel and conference presentations in recent years.
Dr. Richard R. Veit, a Seabird Ecologist and tenured professor at the City University of New York, has led dozens of research cruises on National Science Foundation, National Oceanographic and Atmospheric Administration (NOAA), and Scripps Institute of Oceanography icebreakers and research vessels. He has been a team leader responsible for grant oversight for four grants from the National Science Foundation, including supervision of teams of ten persons at a time. In recent years, Dr. Veit has been very active in boat-based seabird surveys offshore in the mid-Atlantic, and has led numerous graduate students and ornithological professionals in seabird research on NOAA vessels. He has published about 75 peer-reviewed scientific papers, about half of these on ecology and behavior of seabirds at sea.
APPENDIX C:
LIST OF ATTENDEES
<table>
<thead>
<tr>
<th>Name</th>
<th>Organization</th>
<th>Title</th>
<th>Email</th>
<th>Phone</th>
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