OCS Study
BOEMRE 049-2011

ATLANTIC WIND ENERGY WORKSHOP
Summary Report

FINAL
28 September 2011

Prepared for:

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

Prepared by:

CSA International, Inc.
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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.

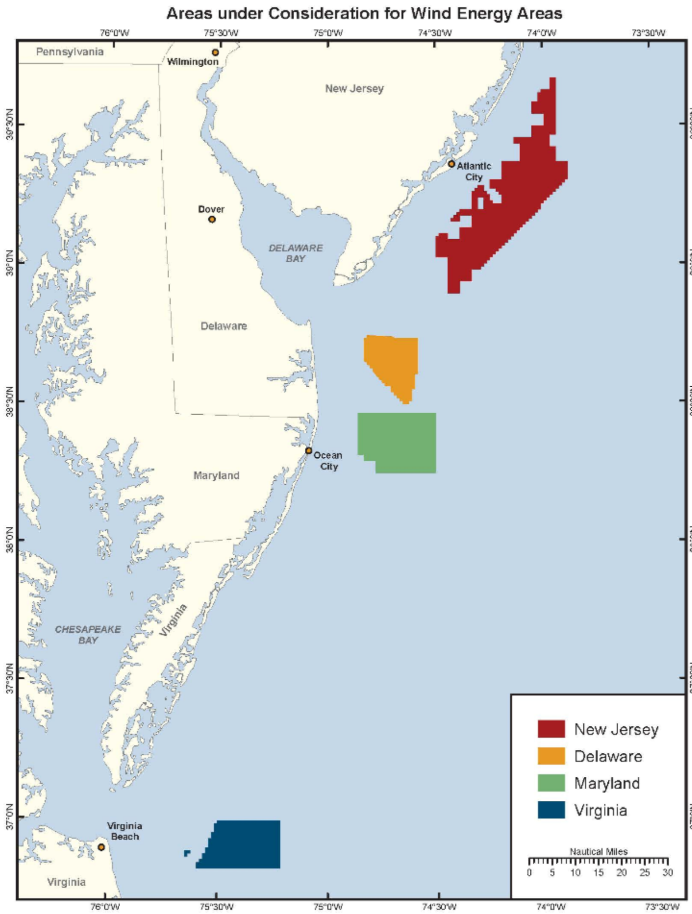
Director Bromwich opened the Workshop with a speech that touched on the role of offshore renewable energy development in the Administration's Blueprint for a Secure Energy Future, and explained how the bureau's Offshore Renewable Energy Program is being elevated through the overall reorganization of 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

1.3 AGENDA

Day One (July 12, 2011)
Plenary Session

8:00-8:45	**CIRRUS FOYER A**	**Registration and continental breakfast**
8:45-12:15	**CIRRUS BALLROOM**	**All groups until 12:15 PM**

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).

8:45-9:15	**Welcome & Keynote Address** – Introduction and Scope of Workshop including DOI-DOE MOU, "Smart from the Start" research initiatives, goals of workshop including an update of knowledge; priority data gap identification, and developing partnerships and collaboration – *Michael R. Bromwich, Director*
9:15-9:40	**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*
9:40-10:05	**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*
10:05-10:25	**Energy Market and Infrastructure Information for Evaluating Alternative Energy Projects for OCS Atlantic** – Summary of BOEMRE Study –*Maureen Kaplan, Ph.D., Eastern Research Group, Inc.*

10:25-10:35 Break

10:35-12:15 **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.

- **Moderator** – *Joel Whitman, CEO, Global Marine Energy, Inc.*
- **BOEMRE** – *Maureen Bornholdt, Program Manager, Office of Offshore Alternative Energy*
- **FERC** – *Tim Konnert, Fish Biologist, Office of Energy Projects*
- **FWS** – *David Cottingham, Senior Advisor to the Director*
- **USGS** – *Walter Barnhardt, 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 Page, Obstruction Evaluation Group*
- **USACE** – *James Haggerty, NAD 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 McCulloch, Senior Program Analyst*

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

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.

9:00-10:45 State Planning and Information
Session Objective: 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.

- **Moderator** – *Jennifer Ewald, BOEMRE*

9:00-9:15	**New Jersey Ecological Baseline Study** – *Gary A. Buchanan, Ph.D.,*
9:15-9:30	**Massachusetts Ocean Plan** – *Bill White*
9:30-9:45	**Maine State Planning Office, Maine Coastal Program** – *Matt Nixon*
9:45-10:00	**Rhode Island Ocean Special Area Management Plan** – *Grover Fugate*
10:00-10:15	**Developing Environmental Protocols** – *Michelle Carnevale and John King, Ph.D.*
10:15-10:45	**Facilitated Q & A session**

10:45-11:00 **Break**

11:00-12:00 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*

11:00-11:15 **Marine Mammal Permits** – *NOAA, Michelle Magliocca*

11:15-11:30 **ESA Consultations** – *NOAA, Kellie Foster (invited)*

11:30-11:45 **ESA Consultations** – *FWS, Julie Thompson*

11:45-12:00 **Facilitated Q & A session**

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

1:00-3:00 Broad Scale Habitat, Abundance & Distribution – Baseline Data
Session Objective: To identify what species are being studies in what locations, during which seasons, using which technologies, and if there is any data (or preliminary data).

- **Moderator** – *Kim Skrupky, BOEMRE*

1:00-1:35 **Fisheries Management Council Perspective: Spatial Aspects of Fishery Management Plans** – *Tom Hoff, MAFMC & Michelle Bachman, NEFMC & Roger Pugliese SAFMC*

1:35-1:50 **NMFS Surveys** – *Sofie Van Parijs, Ph.D., NMFS*

1:50-2:05 **AMAPPS** – Update on this multi-agency project – *Kim Skrupky, BOEMRE*

2:05-2:20 **Navy Baseline Studies** – *Robin Fitch, U.S. Navy*

2:20-3:00 **Facilitated Q & A session** – How these data may be incorporated in environmental analyses, which data gaps exist, and which data gaps can be closed soon.

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*

3:00-3:15 **OSC Acoustic Monitoring** – *David Zeddies, JASCO*

3:15-3:30 **Monitoring Technologies and Acoustics PNNL** – *Tom Carlson, PNNL*

3:45-4:00 **Acoustic Monitoring, Impacts and Sound Characterization** – *Peter Dugan, Cornell*

4:00-4:15 **Electromagnetic Fields** – *Ann Pembroke, Normandeau Associates*

4:15-4:45 **NMFS Large Whales and Acoustics** – *Sofie Van Parijs, Ph.D.,*

4:45-5:15 **Facilitated Q & A session** – How these data may be incorporated in environmental analyses, which data gaps exist, and which data gaps can be closed soon.

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

1:00-1:30	**Overview of TA&R Program and Summary Review of Renewable Energy Studies Conducted to Date** – *Lori Medley, BOEMRE*
1:30-2:00	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.*
2:00-2:45	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.*

2:45-3:00 Break

3:00-3:25	TA&R 656 "**Seabed Scour Considerations**" – *Tom McNeilan, Fugro Atlantic*
3:25-3:50	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*
3:50-4:15	TA&R 669 "**Floating Wind Turbines**" and TA&R 670 "**Design Standards for Offshore Wind Farms**" – *Qing Yu, American Bureau of Shipping*
4:15-4:30	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*
4:30-4:40	**IEC TC 88 status update** – *James Manwell, Univ. of Mass.*
4:40-4:50	**TRB "Structural Integrity of Offshore Wind Turbines" report** – *Walt Musial, NREL*

4:50-5:00 Closing remarks and instructions for tomorrow's sessions

Technology Assessment and Research (TA&R) Program: Renewable Energy Studies Breakout Sessions Day Two (July 13, 2011)

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

9:00-5:15 **ROCKBRIDGE ROOM**

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

Moderator: **Lori Medley, BOEMRE**

9:00-9:30	**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&R research efforts.
9:30-9:50	**"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?
9:50-10:10	**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?
10:10-10:30	**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?

10:30-10:45 **Break**

10:45-11:05	**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.
11:05-11:25	**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?
11:25-12:00	**Participants' Concerns** – Participants will be encouraged to introduce additional topics.

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

1:00-4:00	**Development of potential research topics** – Based on topics identified in the morning session, those deemed most appropriate for potential funding under the TA&R program will be further defined. Most critical topics will be identified and research requirements including data sources and other challenges will be discussed.

4:00-5:00 **Wrap Up**

Social-Economic Breakout:
Assessment Driven Issues
Breakout Sessions Day One (July 12, 2011)

3:15-5:30 LAYTON ROOM

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

3:15-3:35 **Discussion on the Assessment Driven Focus of This Workshop (Environmental Assessments/NEPA)**

3:35-5:30 **Cultural and Historic Resources**

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

9:00-9:10 **Recap: Assessment Driven Focus of This Workshop**

9:10-11:10 **Multi-Use Issues/Space-Use Conflicts**

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.*

11:10-12:10 **Lunch – bag lunches provided**

12:10-2:10 **Public Perception, Legal Studies, Visual Impacts, Tourism**

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*

2:10-2:40 **Break**

2:40-4:40 **Economic Impact, Regulatory, Policy, Stakeholder Issues and Infrastructure**

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.*

4:40-5:40 **Create Social Science Report – Facilitator/Support Staff, Panel Members, Moderators, and BOEMRE/DOE Personnel**

Birds, Bats and Offshore Wind Development: Remaining Information Gaps Breakout Sessions Day Two (July 13, 2011)

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

9:00-4:00 **LAYTON Room**

Day Two facilitator for all birds and bats sessions will be Julia Tims, ERM

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

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*

9:00-9:15 **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 indentify 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.

BOEMRE Press Release
http://www.boemre.gov/ooc/press/2011/press0714.htm

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/eppd/sciences/esp/RenewableEnergyResearch.htm
www.boemre.gov/tarprojectcategories/RenewableEnergy.htm
http://www.boemre.gov/offshore/RenewableEnergy/PDFs/MidAtlanticWEAs_DraftEA.pdf
Guidance Documents Links
www.boemre.gov/offshore/RenewableEnergy/PDFs/COP_Guidelines_122210.pdf
www.boemre.gov/offshore/RenewableEnergy/PDFs/GGARCH4-11-2011.pdf

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.
http://www1.eere.energy.gov/windandhydro/pdfs/national_offshore_wind_strategy.pdf

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, wither 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
    http://www.epa.gov/region1/communities/pdf/CapeWind/CapeWindFactSheetFinalVersionJune10.pdf
USCG Atlantic Coast Port Access Route Study (ACPARS)
    http://www.maritimedelriv.com/Govaffairs/BOEMRE/files/FederalRegisterUSCG-2011-0351.pdf

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 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 Section7 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-goiong 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
http://www.boemre.gov/tarprojectcategories/RenewableEnergy.htm

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**.

U.S. Army Corps of Engineers Wave Information Studies (WIS):
http://frf.usace.army.mil/wis2010

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
  - o Jeremy Firestone, Ph.D. – Professor, University of Delaware, College of Earth, Ocean and Environment
  - o Ms. Bettina Washington – Tribal Historic Preservation Officer, Wampanoag Tribe of Gay Head
  - o Mr. Ben Hoen – Principal Research Associate, Lawrence Berkeley National Laboratory
  - o 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/ESPIS/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 were 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:

Acoustic/Thermographic Monitoring of Temporal and Spatial Abundance of Birds near Structures on the Atlantic OCS (Pandion Systems, Inc. – now Normandeau Associates). 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/oconnell_seabird_dist.cfm

Massachusetts Audubon Society. 2009. Determining Night-time Distribution of Long-tailed Ducks Using Satellite Telemetry. OCS Study MMS 2009-020. Available at: http://www.gomr.boemre.gov/PI/PDFImages/ESPIS/4/4823.pdf

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

Potential for Interactions Between Endangered and Candidate Bird Species and Wind Facility Operations on the Atlantic OCS (Pandion Systems, Inc. – now Normandeau Associates).

http://www.pandionsystems.com/Resources/PandionProjects/FeaturedProject/tabid/145/ArticleId/8/Potential-for-Interactions-Between-Endangered-and-Candidate-Bird-Species-with-Wind-Facility-Operatio.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). http://www.acjv.org/mb_resources.htm

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/8/Potential-for-Interactions-Between-Endangered-and-Candidate-Bird-Species-with-Wind-Facility-Operatio.aspx

Acoustic/Thermographic Offshore Monitoring System. BOEMRE Contract M10PC00101, "Acoustic monitoring of spatiotemporal abundance of birds 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

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

Burger, J., C. Gordon, L. Niles, J. Newman, G. Forcey, and L. Vlietstra. 2011. Risk evaluation for federally listed (Roseate Tern, Piping Plover) or candidate (Red Knot) bird species in offshore waters: A first step for managing the potential impacts of wind facility development on the Atlantic Outer Continental Shelf. *Renewable Energy* 36:338-351.

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

Niles, L.J., J. Burger, R. Porter, A.D. Dey, H. Sitters, J. Fox, and C. Gordon. 2010. Preliminary data on migratory, breeding, and wintering movement patterns of Red Knot *Calidris canutus rufa* indicate unexpected variability. *Wader Society Group Bulletin* 117:123-130

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 to1) 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:

Manomet Center for Conservation Sciences, 1978-1980, Gulf of Maine, Mid-Atlantic Bight.
Cetacean and Seabird Assessment Program, 1980-1988, Gulf of Maine, Mid-Atlantic Bight.
Georgia pelagic surveys, 1982-1985, South Atlantic Bight.
Southeast Fisheries Science Center surveys, 1992, 1998, 1999, South Atlantic Bight.
Winter Survey of the Mid-Atlantic, 2001-2003, Mid-Atlantic Bight.
Cape Wind, Mass Audubon, 2002-2006, Nantucket Sound.
North Carolina shelf—trophic predators, 2004-2005, Offshore North Carolina.
Bar Harbor whale watch, 2005-2006, Offshore Mount Desert Island, Maine.

NOAA Herring Acoustic Survey, 2006-2010, Gulf of Maine, Mid-Atlantic Bight.
NOAA Ecosystem Monitoring Survey, 2007-2010, Gulf of Maine, Mid-Atlantic Bight.

Publications from current project:

O'Connell, Jr., A.F., B. Gardner, A.T. Gilbert, and K. Laurent. 2009. Compendium of Avian Occurrence Information for the Continental Shelf Waters along the Atlantic Coast of the United States (Database Section – Seabirds). A final report for the U.S. Department of the Interior, Minerals Management Service, Atlantic OCS Region, Herndon, VA. 50 pp. Contract No. M08PG20033.

Spiegel, C. and S. Johnston. 2011. Compendium of Avian Occurrence Information for the Continental Shelf Waters along the Atlantic Coast of the United States (Database Section – Shorebirds). A final report for the U.S. Department of the Interior, Bureau of Energy Management, Regulation, and Enforcement, Atlantic OCS Region, Herndon, VA. 27 pp. Contract No. M08PG20033//Interagency Agreement between USGS and USFWS, Region 5, Division of Migratory Birds, Hadley, MA.

Zipkin, E.F., B. Gardener, A.T. Gilbert, A.F. O'Connell, Jr., J.A. Royle, and E.D. Silverman. 2010. Distribution patterns of wintering sea ducks in relation to the North Atlantic Oscillation and other local environmental characteristics. Oecologia 163:893-902.

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.

Powers, K.D. 1983. Pelagic distributions of marine birds off the Northeastern United States. U.S. Department of Commerce. NOAA Technical Memorandum NMFS-F/NEC-27. 201 pp.

Santora, J.A., C.S. Reiss, V.J. Loeb, and R.R. Veit. 2010. Spatial Association between hotspots of baleen whales and demographic patterns of Antartic krill *Euphausia superba* suggests size-dependent predation. Marine Ecology Progress Series: 405-255-269.

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:

Ahlén, I, B. Hans, and B. Lothar. 2009. Behavior of Scandinavian Bats during Migration and Foraging at Sea. Journal of Mammalogy 90, 1318-1323.
Ahlén. 2005. Summary: Bat casualty risks at offshore wind power turbines. Report from introductory studies.
Ahlén. 2007. Risk Assessment for Bats at Offshore Windpower Turbines.
Cryan. 2007. Offshore Island Study.
Geo-Marine Inc. 2008. TI camera/vertical radar, New Jersey.
Griffin. 1940. Multiple observations aboard ships at sea summarized by
Hutterer et al. 2005. Bat migrations in Europe: a review of banding data and literature.
Merriam. 1887. Lighthouse counts, Mt. Desert Rock, Maine.
Miller. 1897. Highland Lighthouse, Truro, Massachusetts.
T. Kunz, Boston University. 1990. Mist netting, Cape Cod, Massachusetts.
Tetra Tech. 2009. Acoustic Surveys, Block Island, Rhode Island.

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 uncertainly; 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);

- Continue investigating other survey technologies – HD video and photo, AUV, UAV, marine mammal tagging;
- Need more information on risk to assess remaining data gaps; and
- Need to compile existing protocols and study results for project-specific surveys.

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**.

<u>**Suggested Research Topics:**</u>

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**).
- Fiscal Year 2010 Report Conceptual Model of Offshore Wind Environmental Risk Evaluation System, Environmental Effects of Offshore Wind Energy (**Section 4.7**).
- 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/ 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

4.2 DRAFT MEMO - BOEMRE 'SMART FROM THE START' ATLANTIC OCS WIND INITIATIVE - SUFFICIENT CONDITIONING OF COMMERCIAL WIND LEASE ISSUANCE

DRAFT MEMORANDUM
From: National Wildlife Federation (NWF), Natural Resources Defense Council (NRDC)
To: Environment, Ocean, and Energy NGOs
Re: BOEMRE 'Smart from the Start' Atlantic OCS Wind Initiative – Sufficient Conditioning of Commercial Wind Lease Issuance
Date: March 7, 2011

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 11^{th} 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."[1]

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."[2] 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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[1] 76 Fed. Reg. 7226-7227 (Feb 9, 2011).
[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.

4.3 FACT SHEET - RENEWABLE ENERGY ON THE OUTER CONTINENTAL SHELF

THE BUREAU OF OCEAN ENERGY MANAGEMENT, REGULATION AND ENFORCEMENT

FACT SHEET

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)

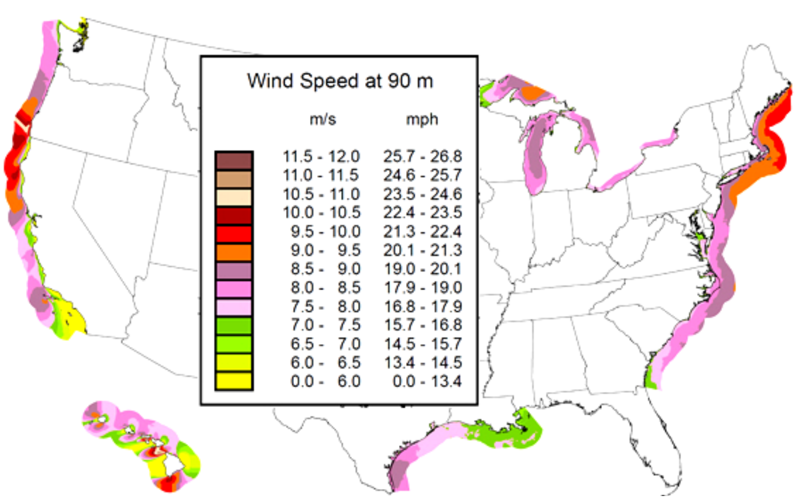
There is tremendous energy in ocean waves. Wave power devices extract energy directly from the surface motion of ocean waves. A variety of technologies have been proposed to capture that energy, and some of the more promising designs are undergoing demonstration testing.

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.



Source: National Renewable Energy Laboratory

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 interesting 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

4.4 USACE SUMMARY FOR WORKSHOP REPORT

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.

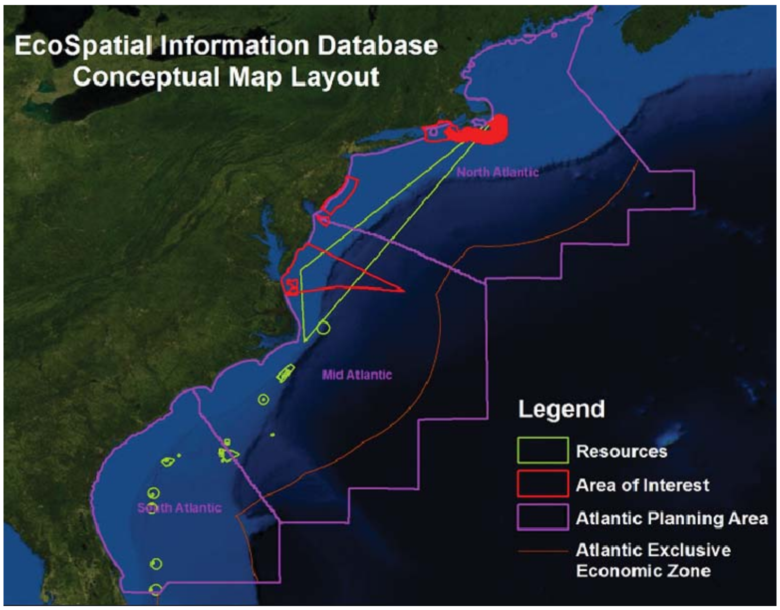
BOEMRE is the lead federal agency under the National Environmental Policy Act (NEPA) for wind energy projects on the OCS. The Corps participates in the NEPA process as a cooperating agency. Both agencies are currently working on a Memorandum of Understanding to synchronize administrative processes for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

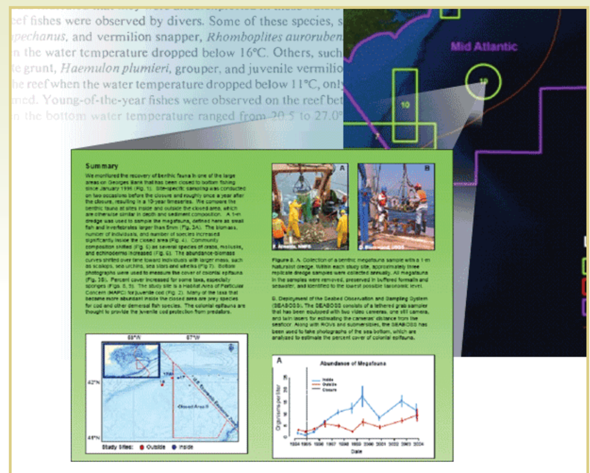
The Corps district offices stand ready to work collaboratively with applicants, federal and state agencies, and other key stakeholders in reviewing offshore wind energy projects.

EcoSpatial Information Database (ESID)

Department of the Interior
Bureau of Ocean Energy Management, Regulation & Enforcement



Contract No.: M09PC00047
Date of Contract: 9/24/2009
Location of Work: Nashville, TN and New Orleans, LA



Spatial Resource Boundary Identification

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

Relevant Project Features

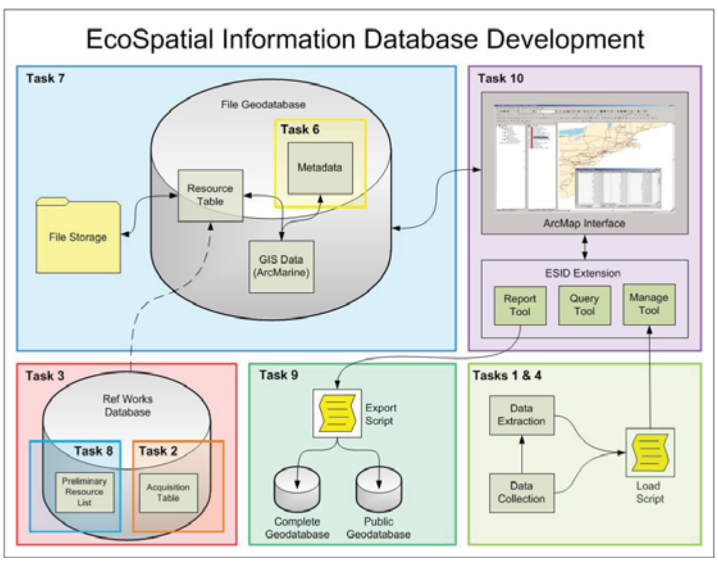
- Create an expandable & sustainable geodatabase
- Ecological data collected for selected geographic areas
- Create a searchable map interface to access the data

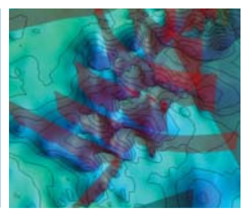
- Create an expandable & sustainable geodatabase
- Create a searchable map interface to access the data

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.





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4.6 ENERGY MARKET AND INFRASTRUCTURE INFORMATION FOR EVALUATING ALTERNATIVE ENERGY PROJECTS FOR OCS ATLANTIC

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.

U.S. DEPARTMENT OF ENERGY

PNNL-19500

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

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

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Conceptual Model of Offshore Wind Environmental Risk Evaluation System

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Prepared for
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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

DOE	U.S. Department of Energy
ERES	Environmental Risk Evaluation System
FY	fiscal year
GIS	geographic information system
GPS	Global Positioning System
KMS	knowledge management system
MHK	marine and hydrokinetic
PNNL	Pacific Northwest National Laboratory

Contents

Figures

Table

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.

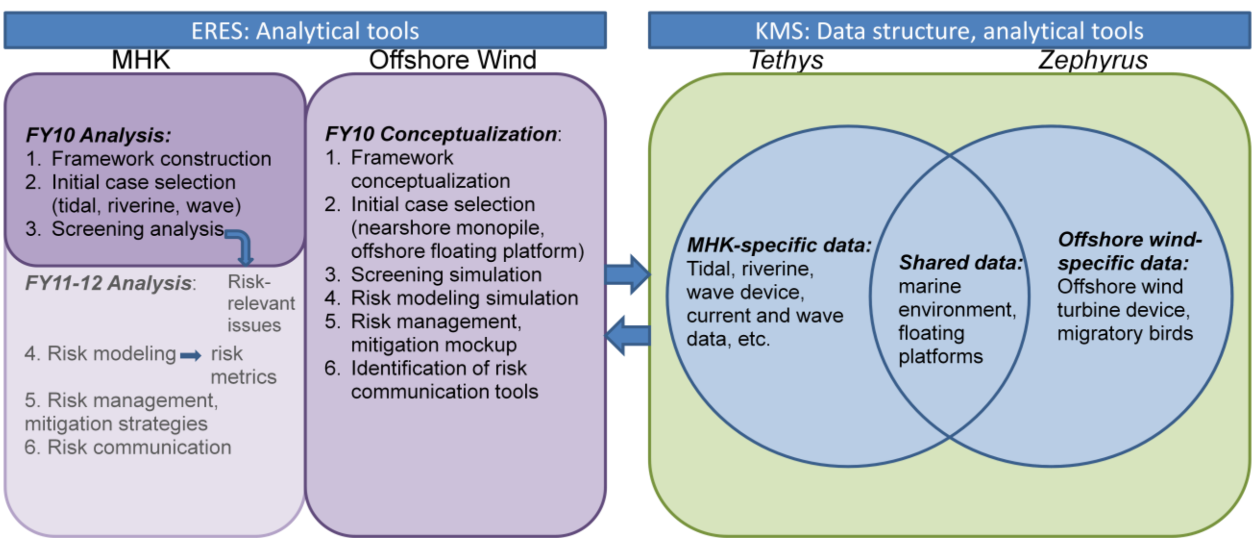

Figure 1. Relationship between the marine and hydrokinetic (MHK) and offshore wind environmental risk evaluation systems and knowledge management systems.

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.

Steps	Purpose	Inputs	Outputs	FY10
1. ERES framework development	Definition of domain for risk-relevant factors	Stressor, receptor, and context data	Risk-relevant attributes	Conceptual description
2. Initial case selection	Priorities include "spanning the analytical space"	Project info, selection criteria	3 initial cases selected for analysis	Conceptual description
3. Screening analysis on initial cases	Highest risk issues identified	Data for verification	Risk-relevant issues	Conceptual description, description of analytical tools, linkage to KMS
4. Risk modeling	Cumulative risk output calculated	Deterministic, probabilistic, impact models, sensitivity analysis	Risk metrics that relate each stressor to receptor	Conceptual description, description of analytical tools, linkage to KMS
5. Risk management and mitigation	Strategies developed, verified by field data	Risk-relevant issues, risk metrics	Risk mitigation strategies	Conceptual description
6. Risk communication	Risk and risk tools presented in formats accessible to stakeholders	Risk metrics, risk-relevant issues	Risk visualization, communication tools	Conceptual description, mockup of visualization tools

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.

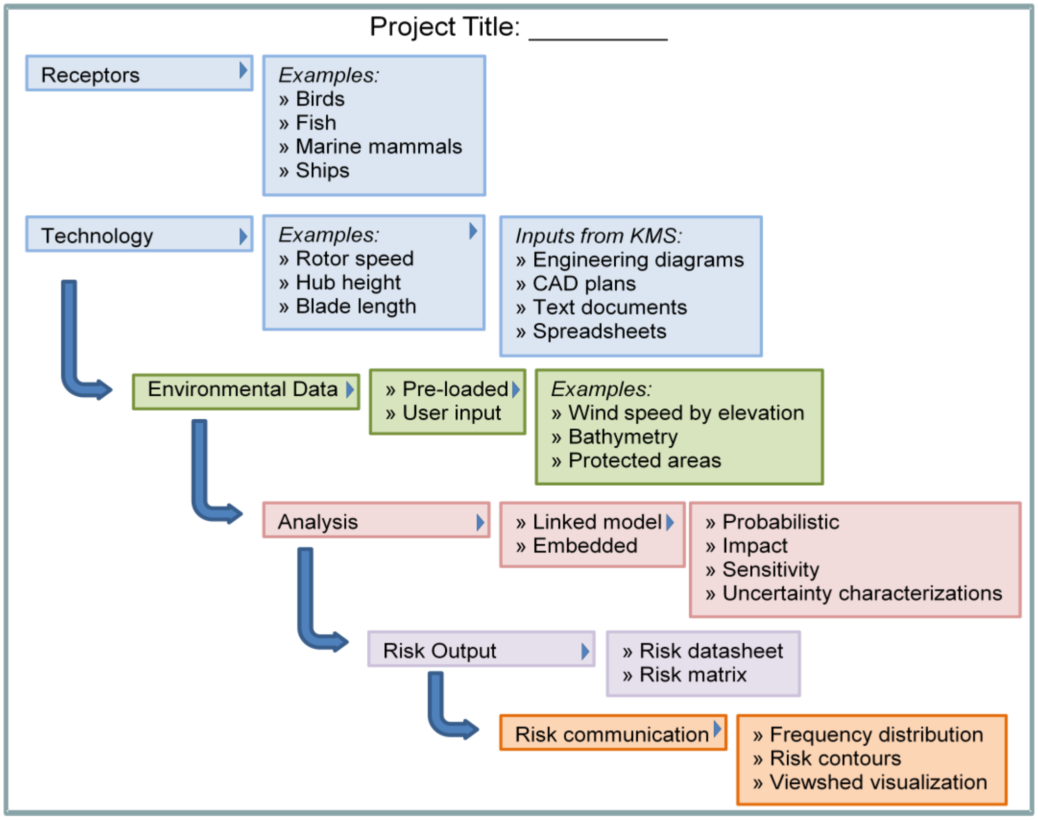

Figure 2. Stylized example of the ERES user interface. The boxes represent drop-down menus that will allow the user to interact with the ERES and KMS. The user would be able to customize a risk analysis by choosing specific case attributes (receptors or technologies) and environmental data, then applying 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.

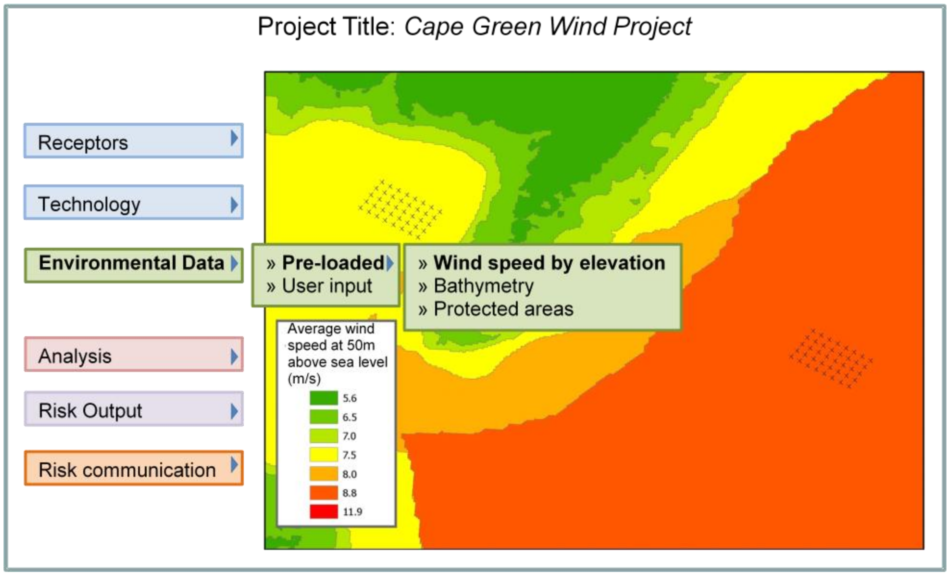

Figure 3. Example of visualization of ERES data.

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.

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4.8 NATIONAL OCEAN PARTNERSHIP PROGRAM OVERVIEW

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 Program Update

Maureen A. Bornholdt

Program Manager
Office of Alternative Energy Programs

Bureau of Ocean Energy Management, Regulation and Enforcement

July 12, 2011

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

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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. 13007 (Indian Sacred Sites)

3

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

4

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)

5

Research and Studies Efforts

- Environmental Studies Program

www.boemre.gov/eppd/sciences/esp/RenewableEnergyResearch.htm

- Technology Assessment and Research

  www.boemre.gov/tarprojectcategories/RenewableEnergy.htm

- 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

6

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

7

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

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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

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Key Stages of Renewable Energy Program*

Planning and Analysis

Lease or Grant

Site Assessment

Commercial Development

* Engage intergovernmental task forces, stakeholders, and public throughout

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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

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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)

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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)

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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

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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

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Guidance Documents

- Information Requirements for Renewable Energy Construction & Operations Plan.
  www.boemre.gov/offshore/RenewableEnergy/PDFs/COP_Guidelines_122210.pdf
- Geological & Geophysical (G&G) Technical and Report Guidelines for Physical Characterization Surveys & Archaeological Surveys.
  www.boemre.gov/offshore/RenewableEnergy/PDFs/GGARCH4-11-2011.pdf

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Future Guidance Documents

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

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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

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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

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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

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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

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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

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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

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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

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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

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Next Steps

- 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

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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

27

Workshop Objectives

- Identify key data needs
- Prioritize data collection and research initiatives
- Develop potential synergies for future studies
- Cultivate partnerships

28

Day 1 - 12 July 2011
Presentations/Introduction

Offshore Wind Market Barriers
July 12, 2011

Christopher G. Hart, PhD, MBA
Offshore Wind Manager
Wind and Water Power Program

Administration & DOE Priorities

White House
- *Generate 80% of nation's electricity from clean sources by 2035*
- *Stimulate jobs and economic recovery through renewable energy*

DOE
- *Promote energy security through reliable, clean, affordable energy*
- *Strengthening scientific discovery and economic competitiveness*

EERE
- *Strengthen U.S. energy security, environmental quality, and economic vitality through renewable energy development*

Wind and Water
- *Optimize growth of wind and water power deployment*

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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

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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. <u>**Understanding and reducing market barriers to offshore wind are critical to this strategy**</u>

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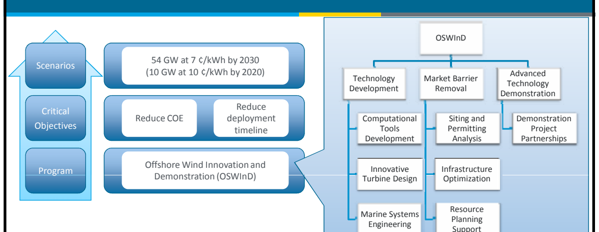
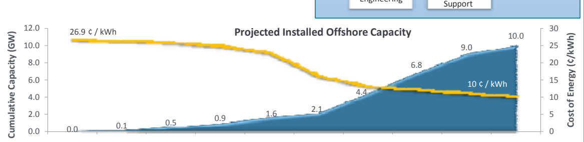
DOE Offshore Wind Strategy





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Meeting our Critical Objectives

Cost of Energy

- **Reduce capital costs**
  - Larger-scale systems with greater capacities
  - Innovative foundations and platforms
- **Decrease IO&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 CMSP
  - Provide technical input and data
- **Promote infrastructure development**
  - Domestic supply chain development
  - Interconnection planning
  - Research on specialized vessels and IO&M technology

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Day 1 - 12 July 2011
Presentations/Introduction

DOE's Strategy for Reducing Market Barriers

- **Addressing barriers to deployment**
  - Research the potential wildlife & social impacts of these technologies
  - Assess the size and nature of offshore renewable energy resources
  - Support the development of necessary infrastructure: ports, ships, transmission lines, workforce, etc
- **Collaboration with other stakeholders**
  - Interagency collaboration to address deployment issues
  - Inter-industry collaboration with utilities, financiers, marine engineering, and others to address deployment and technology issues

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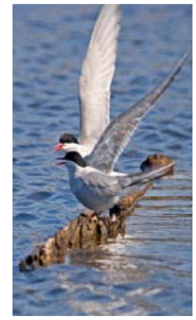
Environmental and Social Impacts of Offshore Wind

Wide range of potential impacts, little U.S. data:

- Environmental impacts
  - Benthic 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."*



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Offshore Wind Research Solicitations

	Next-Generation Drivetrain Development	Offshore Technology Development	Market Barrier Removal
Impact	Develop core technologies for next-generation turbines, ensuring competitiveness of domestic OEMs	Develop modeling tools, optimized system designs, and components necessary for long-term R&D to reduce cost of energy	**Close data gaps needed for efficient permitting; develop cost-competitive O&M strategies; transmission and interconnection planning**
Topics	Stage 1: Conceptual design Stage 2: Preliminary design Stage 3: Final design and prototyping	Fully integrated wind plant designs; floating platform dynamics models; wind/wave simulation models; long-life components to reduce O&M	**Market analysis; environmental risk reduction; supply chain development; ports, vessels & operations; resource characterization**
Total DOE Funding	up to $7.5M	up to $24M	**up to $18M**
Cost-Share	up to $3.75M	up to $4.6M	**up to $3M**
Timeline	2 years	5 years	**3 years**
Applicants	Industry consortia with national labs, universities and engineering firms	Industry consortia with national labs, universities and engineering firms	**Industry, NGOs, universities, national labs and consultancies**
Award Date	June 2011	August 2011	**September 2011**

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Siting and Permitting

Activity	Concern
Environmental / geospatial mapping & analysis	Environmental
Mid-Atlantic Ecological Baseline Studies	Environmental
Offshore Avian / Bat Monitoring Technologies	Environmental
Impact on Electronic Equipment	Competing Human Uses
Annual Market Assessment	Market Impacts
Cost and Benefits Analysis	Market Impacts

Issue	Siting concerns (wildlife, human-use, social acceptance) hinder project deployment
Magnitude	Example: $70M spent by Cape Wind on preconstruction site development; ongoing marine spatial planning efforts can enable or exclude wind development over huge ocean areas
DOE involvement	Informing good siting policy; understanding and mitigating environmental impacts
Solutions	Data collection and analysis; development of monitoring tools; stakeholder engagement
Key partners	DOI-BOEMRE (MOU), NOAA (MOU), NMFS, USCG, DoD, USFWS
Success metrics	Reduced overall cost of siting and permitting; faster time to deployment

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Infrastructure

Activity	Concern
National offshore wind energy grid interconnection study	Interconnection
Offshore Interconnection and integration case studies	Interconnection
Wind integration studies	Integration
Increased utilization of existing transmission	Transmission
Optimized ports and vessels assessment	Infrastructure
Baseline assessment of current offshore domestic M&SC Infrastructure	Infrastructure

Issue	Lack of wind specific ports, vessels, workforce, supply chain, etc will drive up costs and deployment timelines for offshore wind
Magnitude	Example: €100M minimum for new turbine installation vessel
DOE involvement	Identify infrastructure needs and catalyze stakeholder-led efforts to meet those needs
Solutions	Surveys to identify port infrastructure, supply chain, and workforce needs; vessel design concept studies; engagement with ports & economic development authorities;
Key partners	DOT, DOC, ACOE, port authorities, turbine OEMs, marine engineering firms
Success metrics	Lower lifecycle costs per kW of installed offshore wind capacity

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Interagency Collaboration

BOEMRE
States
NOAA
Industry
ACOE
USCG
DOD
Universities
NIST
DOT
FERC
Labs
NASA

Activity	Partners
MOU for Coordinated Deployment of Offshore Wind and Marine Hydrokinetic Energy	DOI
Intergovernmental State Task Forces	DOI, state, local, & tribal govts, federal agencies
Collaborative development of environmental monitoring methods	DOI, NOAA
Smart from the Start Initiative	DOI
MOU on Weather-dependent and Oceanic Renewable Energy Resources	NOAA
Coordination to facilitate offshore wind deployment in Great Lakes	CEQ
Coastal and marine spatial planning efforts	National Ocean Council
Ocean observation, mapping, and infrastructure	NOC
Federal Renewable Ocean Energy Working Group	DOI, NOAA, FWS, DoD

Program	Interagency collaboration on range of development and deployment issues to leverage capabilities and magnify impact
DOE involvement	Technical input & assistance to agencies, applied research on key issues, policy and economic analysis
Solutions	Data collection and analysis; leveraging efforts; stakeholder engagement
Key partners	DOI-BOEMRE, NOAA, NMFS, USCG, DoD, USFWS
Success metrics	Development of efficient permitting processes and informed decision-making

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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

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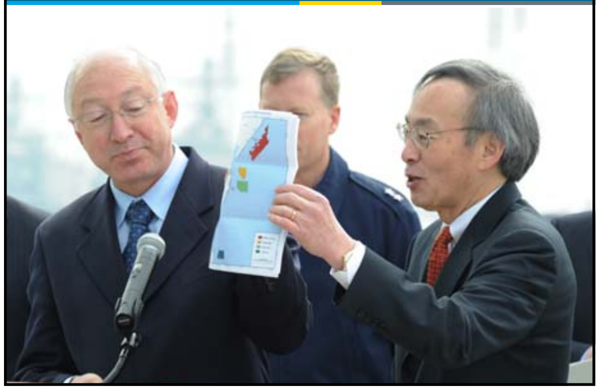
A Call to Action



Thank You

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

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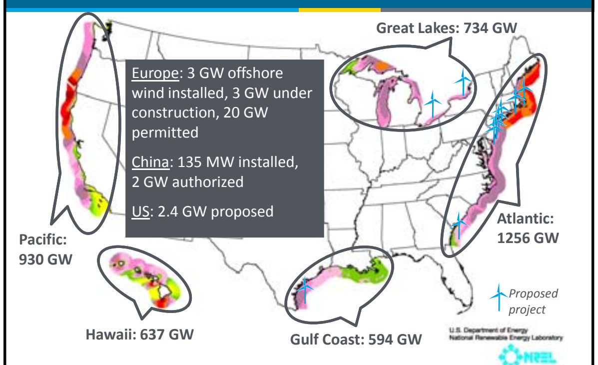
Offshore Wind: Huge Potential



Total gross resource potential does not consider exclusion zones or siting concerns

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Offshore Wind Benefits

Energy	Environment	Economy
Large renewable resource close to load *(1070 GW in shallow waters; 4150 GW total)*	**Reduced GHG emissions** *(2.7 M tons CO^2 emissions avoided / GW / year)*	**Jobs manufacturing, installing, operating, and maintaining systems** *(54 GW of offshore = 43,000 permanent jobs)*
Availability matches peak load *(28 coastal states consume 78% of electricity)*	**Reduced water consumption** *(81 billion gallons saved annually)*	**Economic recovery and industrial development** *(1 GW offshore = $4.2B investment)*
Energy diversity & security	**Reduced need for new land-based transmission**	**Potential for cost-competitive electricity in high-price markets**

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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 $18M, 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**
    3. Manufacturing & supply chain development
    4. Transmission planning & interconnect strategies
    5. Ports, vessels & operations
    6. Wind energy resource characterization & design conditions
    7. Marine navigation & communications equipment impacts
- Next-Generation On/Offshore Drivetrain FOA (up to $7.5M, 3 years)
  - Develop core technologies for next-generation turbines, ensuring competitiveness of domestic OEMs
- **More to come – Stay tuned**

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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

1

Introduction

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

2

Maritime Infrastructure

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

3

Ports

- 35 deep draft ports along East Coast

Ports

- 2 in DE (Newcastle, Wilmington)
- 1 in MD (Baltimore)
- 3 in NJ (Camden, Paulsboro, Trenton)
- 3 in VA (Hampton Roads, Hopewell, Richmond)

5

What Size Port Do We Need? Part 1

- Quonset Point, RI
- New Bedford, MA
- Falmouth, MA
- Wilmington, DE
- Camden, NJ
- Paulsboro, NJ

6

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?

ERG 7

U.S. Privately Owned Fleet by Segment, 2008

Fleet	Ocean	Great Lakes	Coastal and Waterways	Offshore
Total owned	628	47	38,502	689
Foreign flag	437	0	0	138
U.S. flag	191	47	38,502	551
Jones Act	***98***	***47***	***38,502***	***551***
Other	*93*	*0*	*0*	*0*

Source: USDOT MARAD (2009b).

ERG 8

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

ERG 9

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

ERG 10

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

ERG 11

Submarine Cable

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

ERG 12

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?

ERG

13

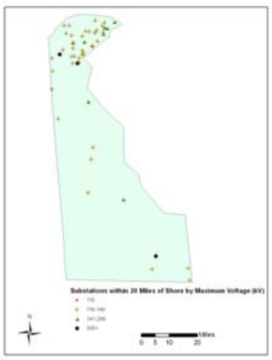
Energy Infrastructure

- Platt's data
  - Power plants
  - Substations
  - Transmission lines
  - GIS format
  - BOEMRE (Feb 2009)

ERG

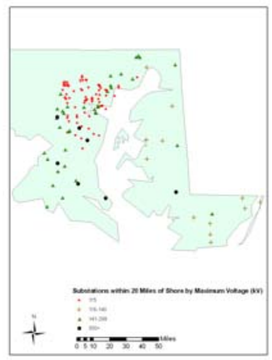
14

Delaware



ERG

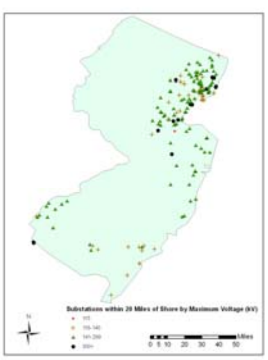
Maryland



ERG

16

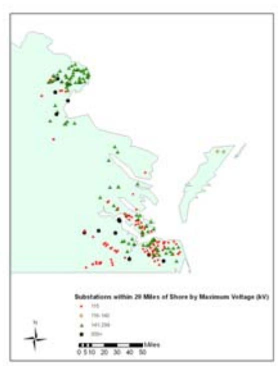
New Jersey



ERG

17

Virginia



ERG

18

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")

ERG 19

Observations - Part 2

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

ERG 20

Workshop Goal

ERG 21

Day 1 - 12 July 2011
Presentations/Federal Agency Panel

Federal Agency Panel
July 12, 2011

Atlantic Wind Energy Workshop July 12-14, 2011

Bureau of Ocean Energy Management, Regulation and Enforcement

Federal Agency Panel

- **Moderator** – *Joel Whitman, CEO, Global Marine Energy, Inc.*
- **BOEMRE** – *Maureen Bornholdt, Program Manager, Office of Offshore Alternative Energy Programs*
- **FERC** – *Tim Konnert, Fish Biologist, Office of Energy Projects*
- **FWS** – *David Cottingham, Senior Advisor to the Director*
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Bureau of Ocean Energy Management, Regulation and Enforcement

Bureau of Ocean Energy Management, Regulation and Enforcement

- Energy Policy Act 2005 (EPAct)

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"***

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Bureau of Ocean Energy Management, Regulation and Enforcement

Bureau of Ocean Energy Management, Regulation and Enforcement

- 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)

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Key Stages of Renewable Energy Program*

Planning and Analysis

Lease or Grant

Site Assessment

Commercial Development

* Engage intergovernmental task forces, stakeholders, and public throughout

Atlantic Wind Energy Workshop July 12-14, 2011

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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 Energy Regulatory Commission

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

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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

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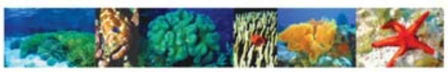
U.S. Geological Survey

USGS science for a changing world

- Assets for CMSP: 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

OBIS USA



Atlantic Wind Energy Workshop July 12-14, 2011

Bureau of Ocean Energy Management, Regulation and Enforcement

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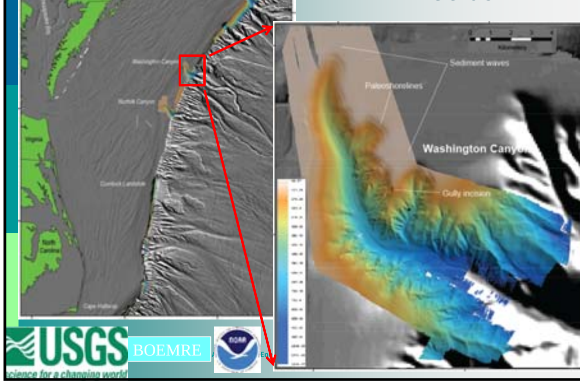
MID-ATLANTIC SUBMARINE CANYONS : 2011 MULTIBEAM MAPPING CRUISE



USGS science for a changing world

BOEMRE

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National Park Service
U.S. Department of the Interior

- **Jurisdiction:** National Parks, National Seashores, National Historic Trails, Wild and Scenic Rivers, 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 "purpose is to conserve the scenery and the natural and historic objects and the wild life therein and to provide for the enjoyment of the same in such manner and by such means as will leave them unimpaired for the enjoyment of future generations."
  - **NPS General Authorities Act, 1978 Amendment (Special Park Uses)**
    NPS "shall promote and regulate the use of [national parks] by such means and measures 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 2006**
    Also requires protection of natural conditions, natural soundscapes, clear skies, scenic views, physical and biological processes, and ecosystems

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National Park Service
U.S. Department of the Interior

- **NPS Coordination on Offshore Wind**
  - **Atlantic Offshore Wind Energy Consortium Working Groups**
  - **Cooperation with lead 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**
  - **Response 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**

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Day 1 - 12 July 2011
Presentations/Federal Agency Panel

National Oceanic Atmospheric Administration

Key Regulatory 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 living marine resources, marine and coastal habitat, and coastal communities
- Potential user-conflicts (especially impacts to commercial and recreational fishing)

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National Oceanic Atmospheric Administration

Key NOAA Non-Regulatory or Service-Oriented Mandates:

- National Weather Service Organic Act (authorizes weather forecasting and collection of meteorological observations)
- Energy Policy Act of 2005 (directed the Multipurpose Marine Cadastre)
- Coast and Geodetic Survey Act/Hydrographic Services Improvement Act (authorizes collection of data for safe navigation; mapping and charting of U.S. waters; tides, currents, and water level observations)
- Executive Order implementing the Recommendations of the Ocean Policy Task Force (Coastal and Marine Spatial Planning (CMSP)

Key Federal Coordinating Partners

- DOE-NOAA MOU on Weather-Dependent and Oceanic Renewable Energy Resources
- Multipurpose Marine Cadastre co-led by BOEMRE
- CMSP includes multiple federal agencies

Priority research interests

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

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Federal Aviation Administration

Where Does the FAA Get its Authority?

- Title 49, United States Code, Section 40103, Sovereignty & Use of Airspace
- Title 14, Code of Federal Regulations (14 CFR), Part 77, Objects Affecting Navigable Airspace
- FAA Order 7400.2, Procedures for Handling Airspace Matters

Title 49, USC, Section 40103, Sovereignty & Use of Airspace

- **(a) Sovereignty and Public Right of Transit** – The U.S. Government has exclusive sovereignty of airspace of the United States.
- **(b) Use of Airspace –** The Federal Aviation Administration (FAA) shall develop plans and policy for the use of the navigable airspace and assign by regulation or order the use of the airspace necessary to ensure the safety of aircraft and the efficient use of airspace.

Scope of 14 CFR, Part 77

- Part 77 establishes standards for determining obstructions to air navigation.
- A structure that exceeds one or more of these standards is presumed to be a hazard to air navigation unless the obstruction evaluation study determines otherwise.

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Federal Aviation Administration

Scope of FAAO JO 7400.2

Obstruction Evaluation Study Identifies

The effect the proposal would have:

- **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.**

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Federal Aviation Administration

Our Focus in Evaluating the Effect of Proposed Wind Turbines

- Safety of aircraft & efficient use of airspace (flying public)
- Protecting the navigable airspace
- Proposed structures' effect on the navigable airspace

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Federal Aviation Administration

Who must file notice?

- Any person or an agent who intends to sponsor construction is required to submit notice if the proposed construction or alteration is:
  - 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

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Federal Aviation Administration

FAA Wind Turbine Numbers

Volume of Wind Turbine Cases:

- 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

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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 10 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

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US COAST GUARD

- JURISDICTION
  - Navigable waters of the U.S. including OCS
- Rivers, Harbors, Great Lakes
- PHILOSOPHY
  - Support President's goals on renewable energy
  - Matters of National Importance
- Navigation & Vessel Safety
- Protection of Marine Environment
- Safety of Ports & Waterways

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US COAST GUARD

- COORDINATING PARTNERS
  - BOEMRE, FERC, NOAA, USACE, DOE, CEQ
  - Cooperating Agency
- Provide recommendations on:
  - Safety of Navigation
  - Existing uses
  - Mitigating measures
  - Impact to CG missions
- PRIORITY RESEARCH
  - Conduct Atlantic Coast Port Access Route Study (ACPARS)
  - Designate fairways, Traffic Separation Schemes (in CFR) or other routing measures
- Navigation paramount over all other uses

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Overview: DoD Operating Areas (OPAREAs) & Warning Areas

Methodology

- Categorize DoD offshore equities and potential wind energy development using:
  - Unrestricted
  - Site Specific Stipulations
  - 3. 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

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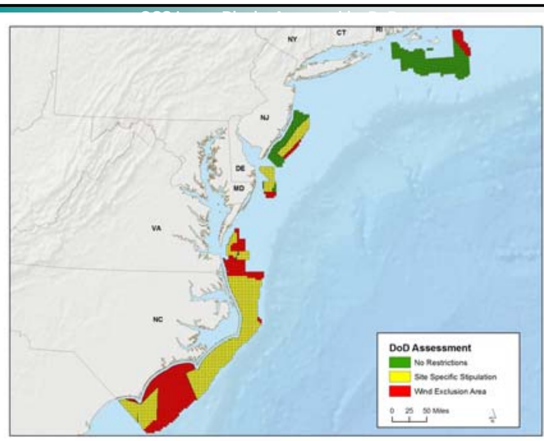

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U. S. Environmental Protection Agency

- 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 area 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:
  - Interagency Memorandum of Understanding (MOU) on Transmission Siting
  - Renewable Energy Rapid Response Team
  - BOEMRE State task forces
  - Atlantic Offshore Wind Interagency Working Group
  - Great Lakes Wind Collaborative

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U. S. Environmental Protection Agency

EPA's Clean Energy Programs

Is designed to help energy consumers in all sectors, state policy makers and energy providers improve their knowledge about Clean Energy technology and policy options by providing objective information, creating networks between the public and private sector and providing technical assistance.

- The Green Power Partnership is a voluntary program that encourages organizations to buy green power as a way to reduce the environmental impacts associated with purchased electricity use. The Partnership currently has hundreds of Partner organizations voluntarily purchasing billions of kilowatt-hours of green power annually.
- The Combined Heat and Power Partnership is a voluntary program seeking to reduce the environmental impact of power generation by promoting the use of CHP. The Partnership works closely with energy users, the CHP industry, state and local governments, and other clean energy stakeholders to facilitate the development of new projects and to promote their environmental and economic benefits.

What's New:

- Updated Power Profiler and Greenhouse Gas Equivalencies Calculator.
- Released eGRID2010.

For further information: http://www.epa.gov/cleanenergy/

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Advisory Council on Historic Preservation

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 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
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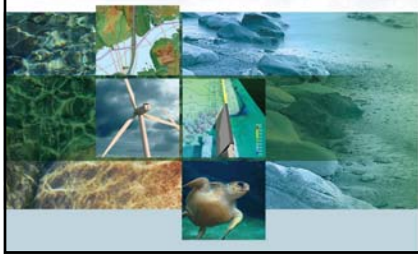
EcoSpatial Information Database (ESID)

"Smart from the Start"

"If we are wise with our planning, we can help build a robust and environmentally responsible offshore renewable energy program that creates jobs here at home."



ATLANTIC WIND ENERGY WORKSHOP

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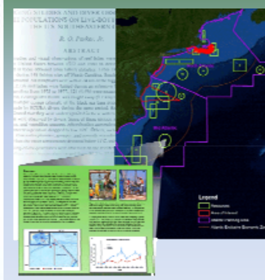
What is the ESID?

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.



7 Steps for Verified Scientific Information
Data Collection

1. Establish consistent protocol
   Transparent and unified guidelines
2. Define topics of interest
   Align information needs for BOEMRE process
3. Assemble team of scientific experts
   Subject matter expertise for all ecological categories
4. Locate and obtain relevant data
   Efficient search and acquisition by professional librarian

Steve W. Ross/UNCW

Pelagic Ecology Keywords

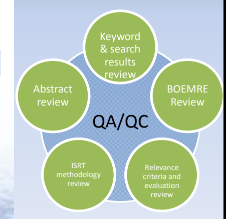
Set 1a
SS pelagic or mesopelagic or epipelagic or bathypelagic or water()column or thermocline or halocline or vertical()profile or migration or nekton or Sargassum or predation or predator? Or trophic or food()web? Or (producti? NOT primary);SS connectivity or life()histor? Or population()dynamics or biodiversity or highly()migratory()species Or marmap or seamap or plankton? Or holoplankton or zooplankton or meroplankton or ichthyoplankton;

Set 2
SS red()tide? Or cnidaria? Or krill or chaetognath? Or pteropod? Or salp? Or ctenophore? Or diel OR neuston OR copepod?;

Set 3
SS western()north()atlantic OR (Atlantic()Ocean AND (Maine OR Massachusetts OR Connecticut OR Rhode()Island OR Delaware OR Maryland OR Virginia OR Georgia OR Florida OR New()(Hampshire OR Jersey OR York) OR (North OR South)()Carolina)) OR (east OR northeast? OR southeast?) (1n) coast AND (US or USA or United()States)

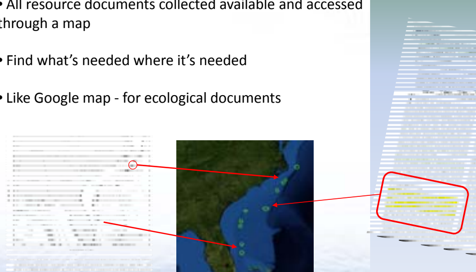
7 Steps for Verified Scientific Information
Data Evaluation

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



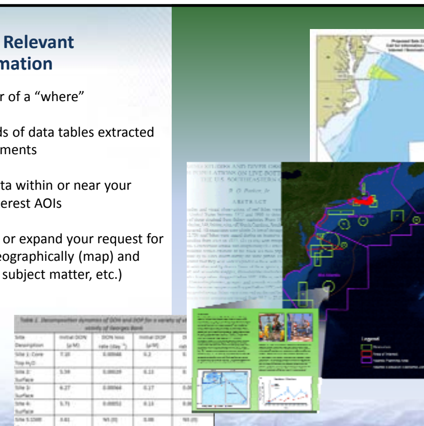
Geographically Relevant Scientific Information

- 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



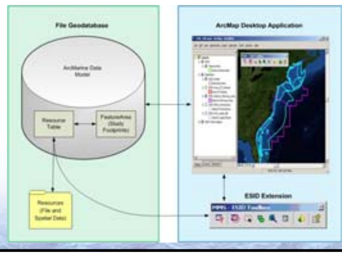
Geographically Relevant Scientific Information

- 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.)



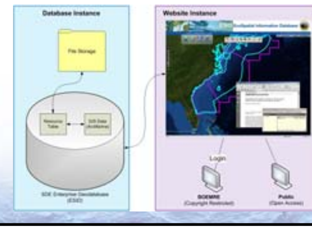
Accessible Application to Find Scientific Information
Desktop Version

- 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)



Accessible Application to Find Scientific Information
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 and 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

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Esri
Doug Cribbs, Eric Chiasson

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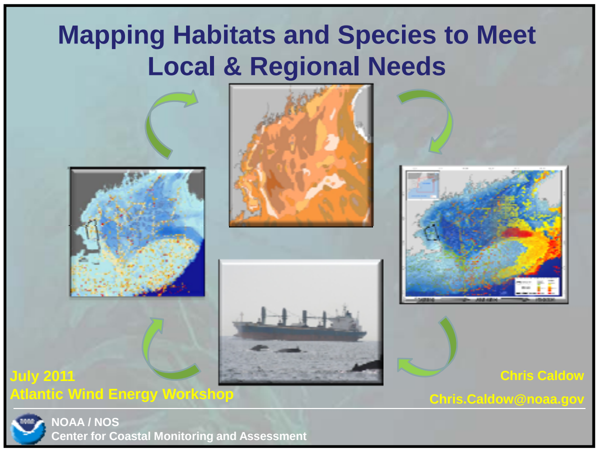
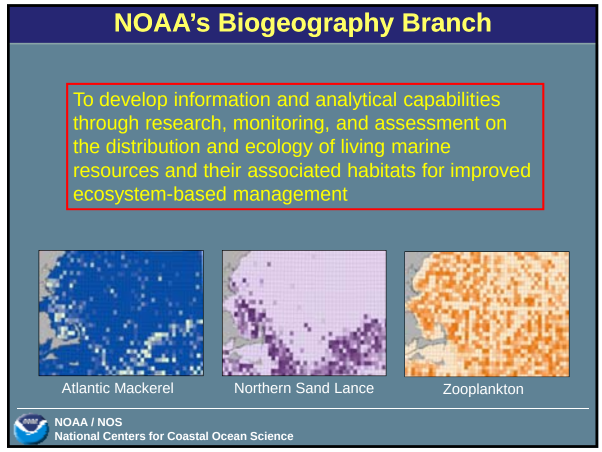
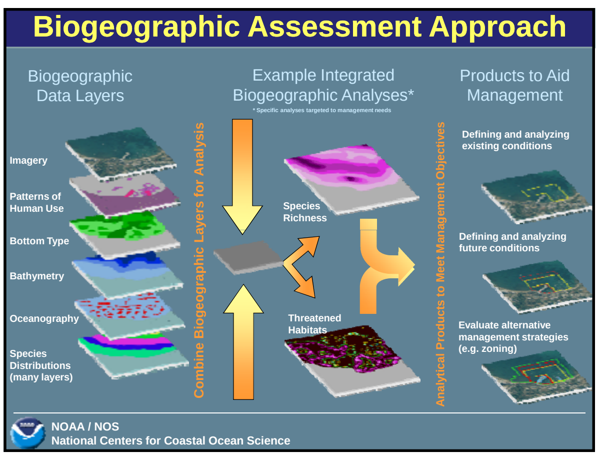
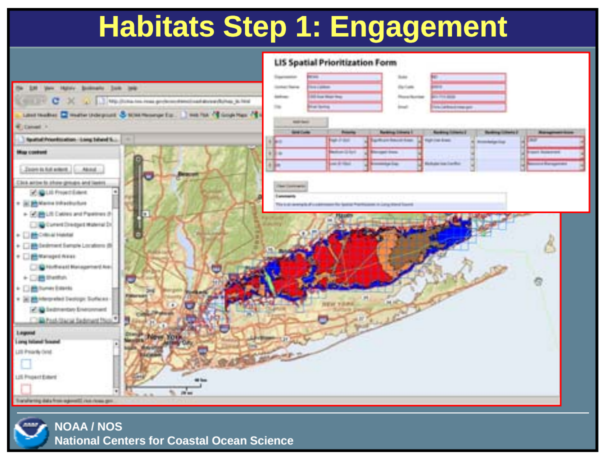
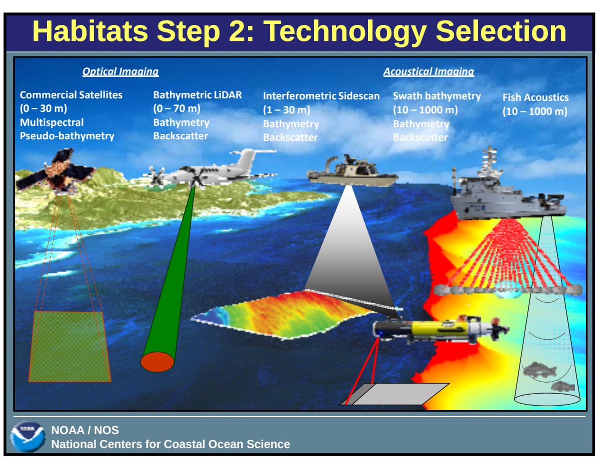
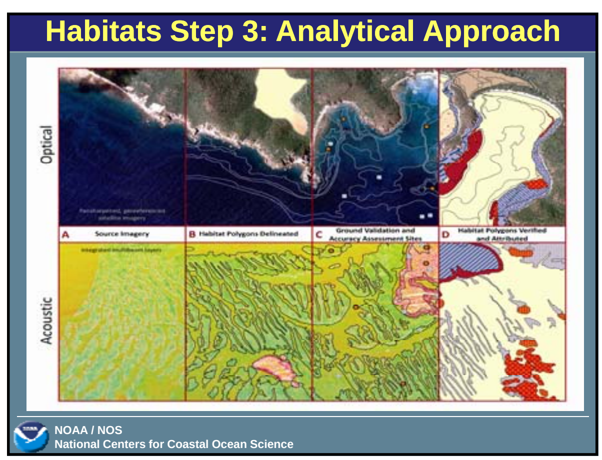


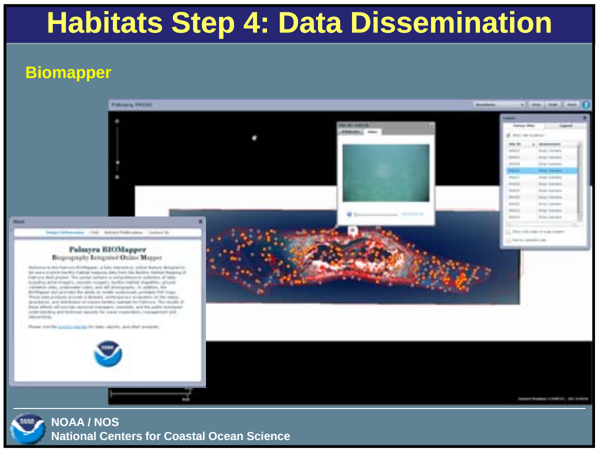


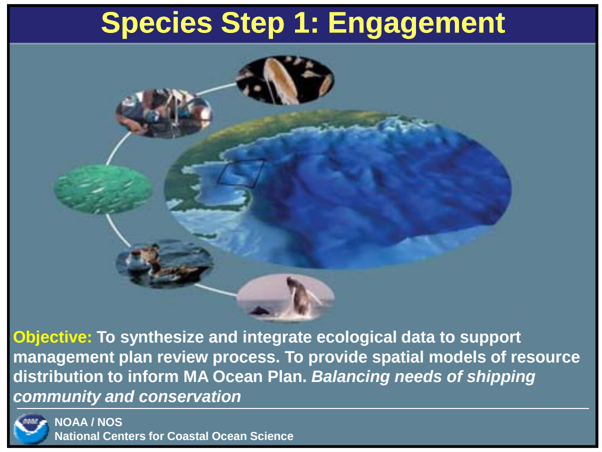


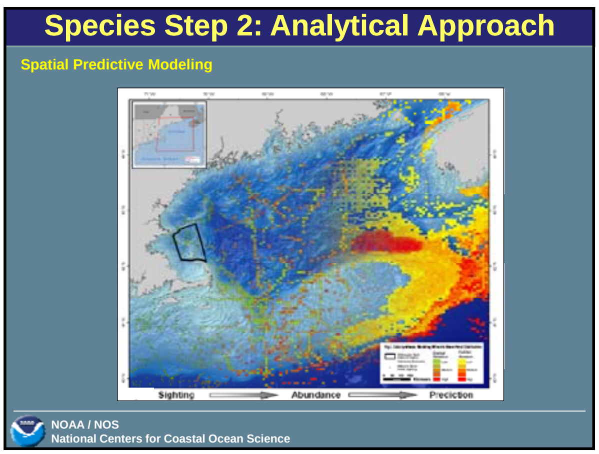


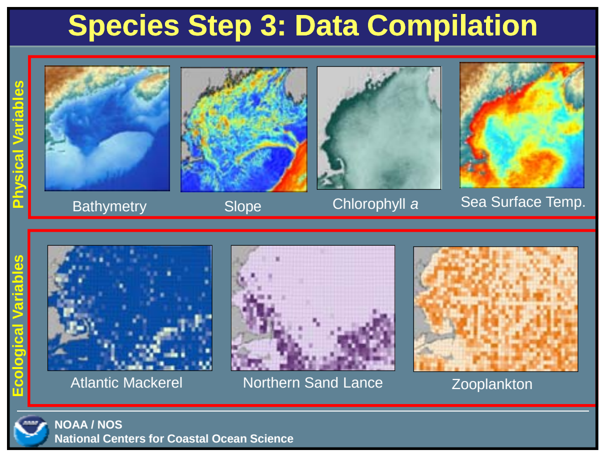


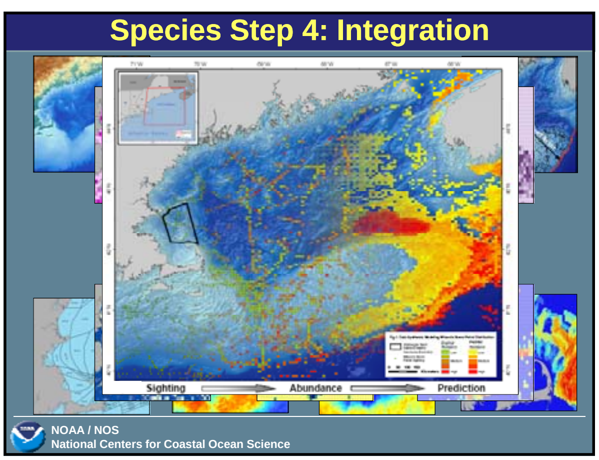


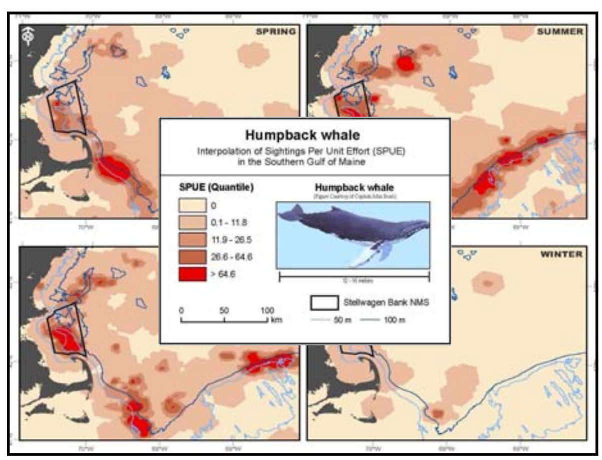

Habitats Step 4: Data Dissemination
Biomapper
Palmyra BIOMapper
Biogeography Integrated Online Mapper
NOAA / NOS
National Centers for Coastal Ocean Science

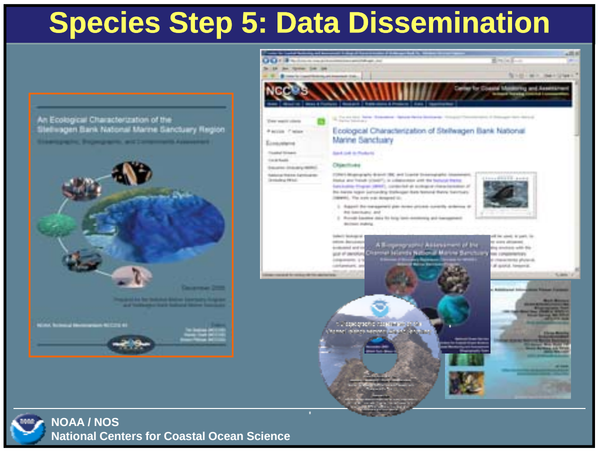

Species Step 1: Engagement
Objective: To synthesize and integrate ecological data to support management plan review process. To provide spatial models of resource distribution to inform MA Ocean Plan. Balancing needs of shipping community and conservation
NOAA / NOS
National Centers for Coastal Ocean Science


Species Step 2: Analytical Approach
Spatial Predictive Modeling
Sighting
Abundance
Prediction
NOAA / NOS
National Centers for Coastal Ocean Science

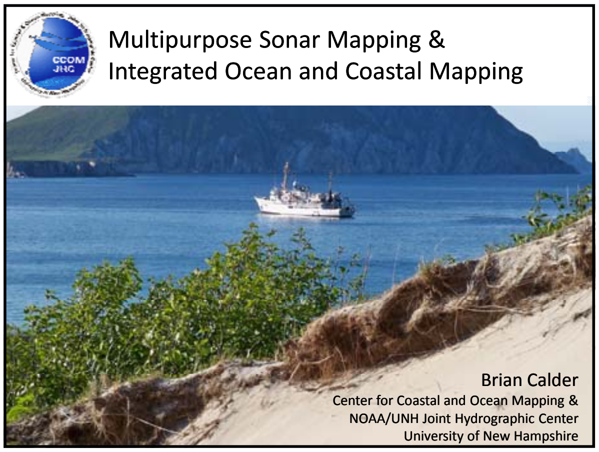

Species Step 3: Data Compilation
Physical Variables
Bathymetry
Slope
Chlorophyll a
Sea Surface Temp.
Ecological Variables
Atlantic Mackerel
Northern Sand Lance
Zooplankton
NOAA / NOS
National Centers for Coastal Ocean Science

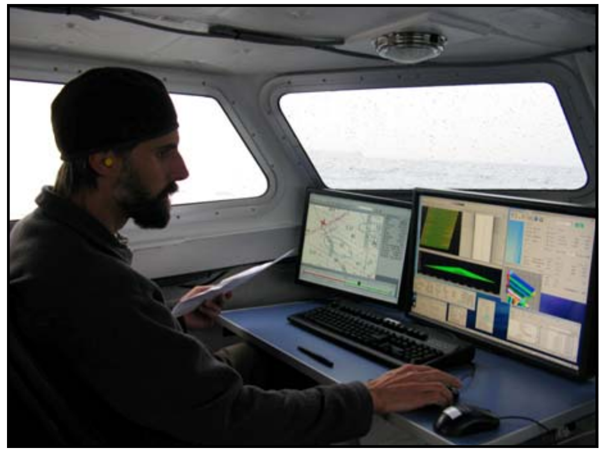

Species Step 4: Integration
Sighting
Abundance
Prediction
NOAA / NOS
National Centers for Coastal Ocean Science

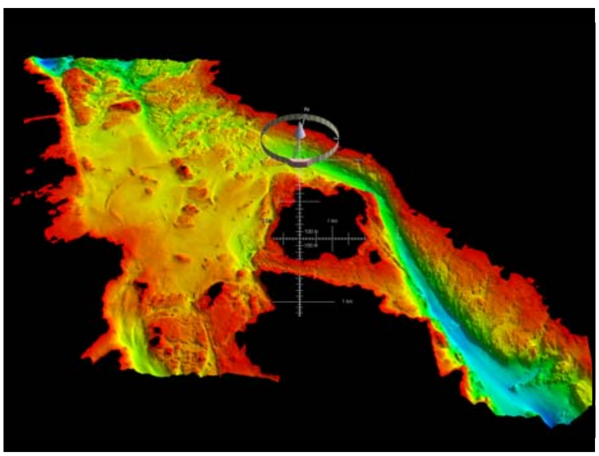

SPRING
SUMMER
WINTER
Humpback whale
Interpolation of Sightings Per Unit Effort (SPUE)
in the Southern Gulf of Maine
SPUE (Quantile)
0
0.1 - 11.8
11.9 - 26.5
26.6 - 64.6
> 64.6
Humpback whale
Stellwagen Bank NMS
50 m
100 m
0 50 100 km

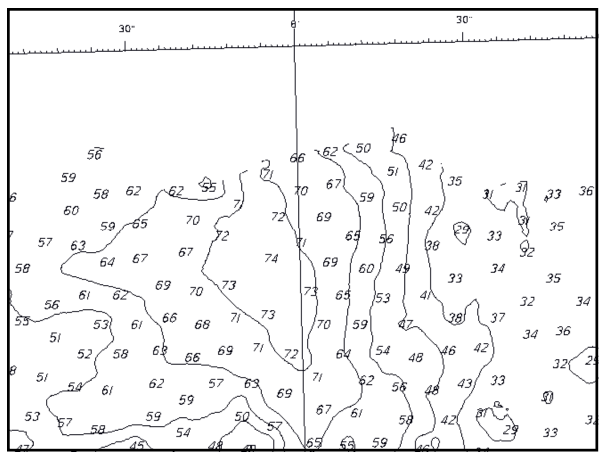

Species Step 5: Data Dissemination
An Ecological Characterization of the
Stellwagen Bank National Marine Sanctuary Region
NCCOS
Ecological Characterization of Stellwagen Bank National Marine Sanctuary
Objectives
A Biogeographic Assessment of the
Channel Islands National Marine Sanctuary
NOAA / NOS
National Centers for Coastal Ocean Science

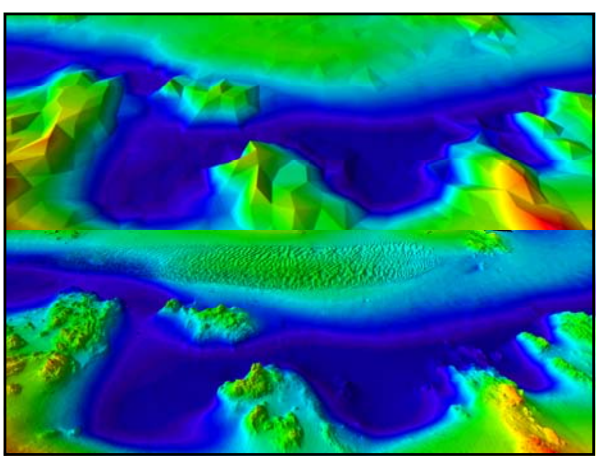
Day 1 - 12 July 2011
Presentations/Information Management and Data Sharing Products Panel

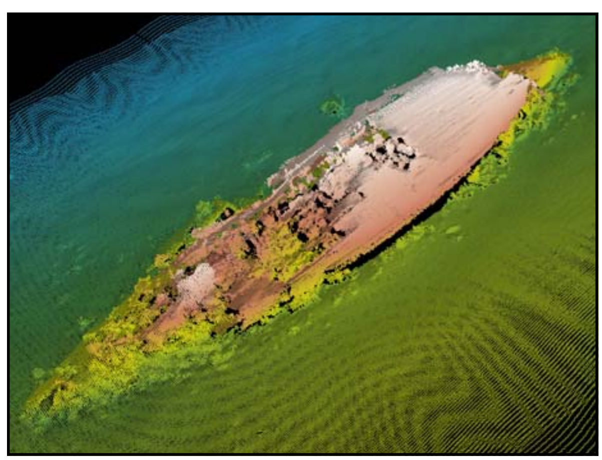


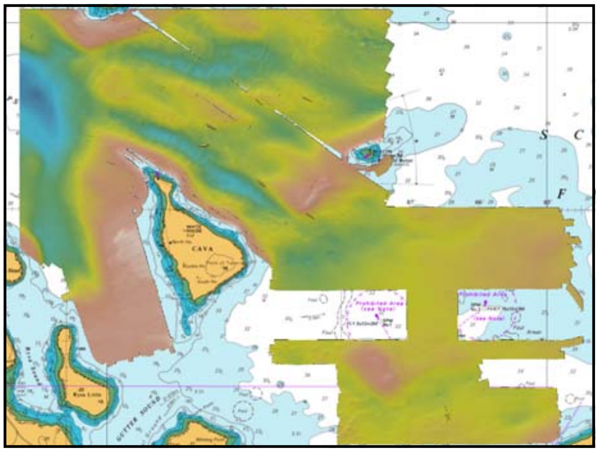








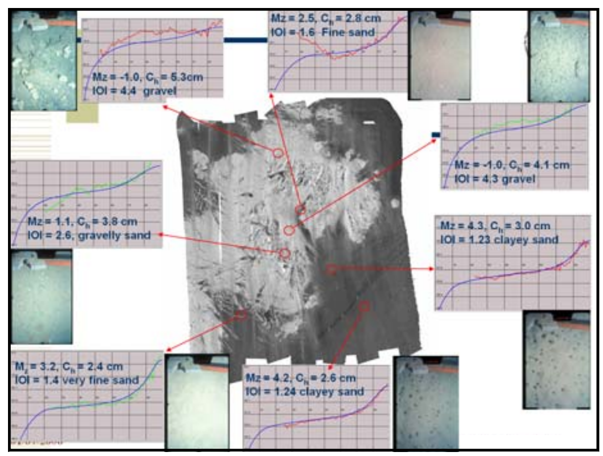


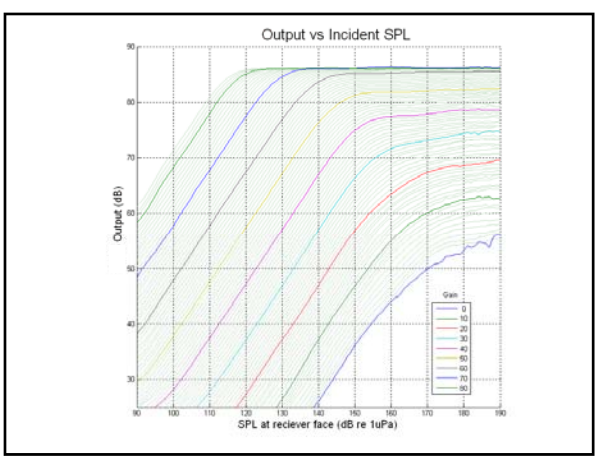


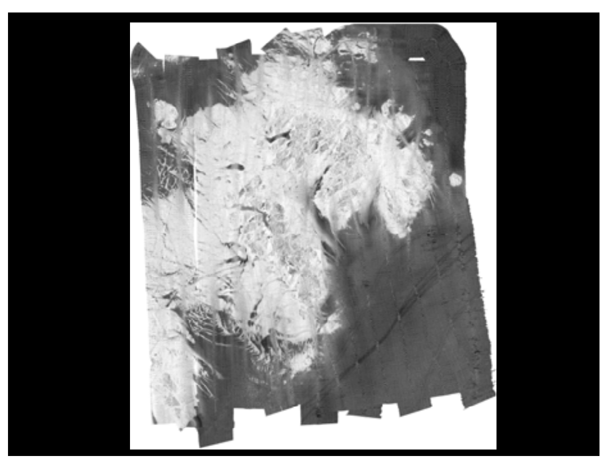
Map Once, Use Many Times

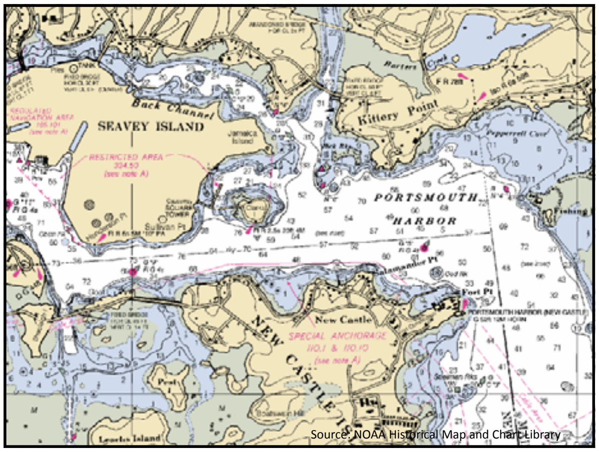
Integrated Ocean and Coastal Mapping Workshop
Data Collection Recommendations

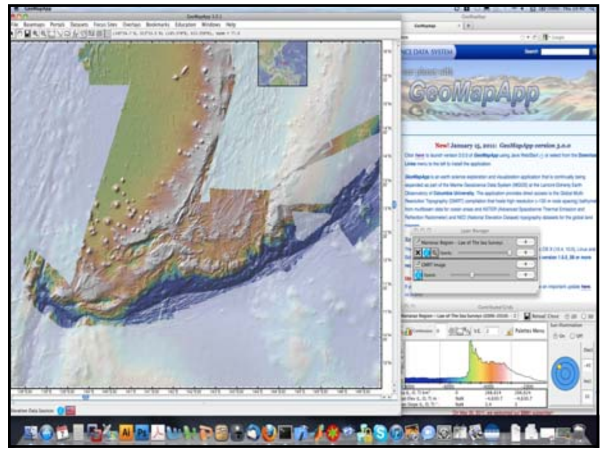
Characteristic	Requirement
Instrument	MBES Echosounder with Full Time-Series Backscatter
Coverage Mode	Full bottom coverage (exceptions possible)
Object Detection	IHO Order 1A (IHO S.44 5ed) [≥2m in <40m Depth]
Horizontal Uncertainty	IHO Order 1A (IHO S.44 5ed) [5m+5% Depth (m, $2d_{rms}$)]
Vertical Uncertainty	IHO Order 1A (IHO S.44 5ed) [$\sqrt{(0.5)^2+(0.013z)^2}$ (m, 95%)]
DTM Resolution	≤2m in <40m Depth
Reference Frame	WGS-84 [H]; MLLW or WGS-84 (preferred) [V]
Metadata	FGDC [now typ. ISO19115/19139]
Data Sharing	To NGDC within 1 yr of collection

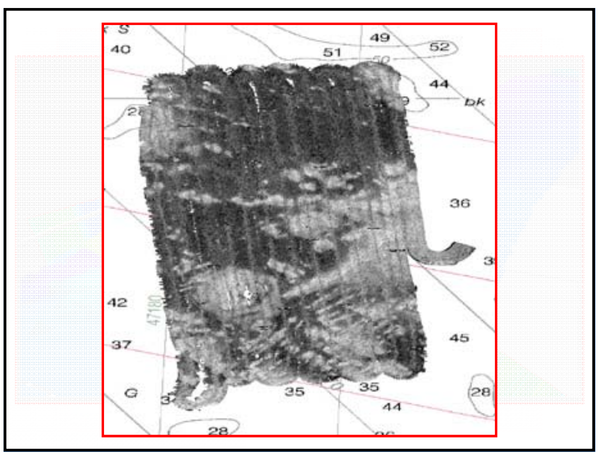












- "Map once, use many times"
- Needs agreement on:
  - What (extra) field data to collect
  - Data accuracy (and datums) required
  - Calibration schedules for all sensors
  - Data formatting and distribution processes
  - Metadata formats & content (in multiple levels)
- Problems:
  - Direct v's Opportunity cost
  - Common data processing procedures
  - Coordination of efforts across multiple agencies

Day 1 - 12 July 2011
Presentations/Information Management and Data Sharing Products Panel

IEc

Outer Continental Shelf Space Use Conflicts and Analysis of Potential Mitigation Measures

Geodatabase Development

Prepared for
BOEMRE Atlantic Wind Energy Workshop

12 July 2011

INDUSTRIAL ECONOMICS, INCORPORATED

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.

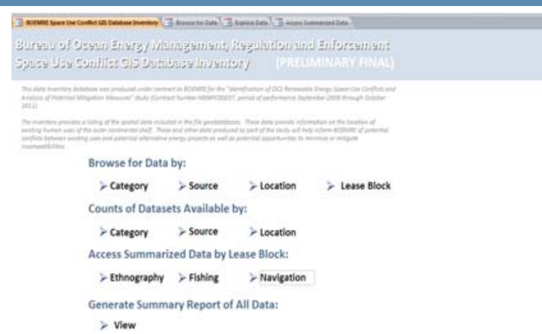
INDUSTRIAL ECONOMICS, INCORPORATED 1

Project elements

1. Literature review and annotated bibliography.
2. Development of a geospatial database.
3. Stakeholder engagement.
4. Report with recommendations.

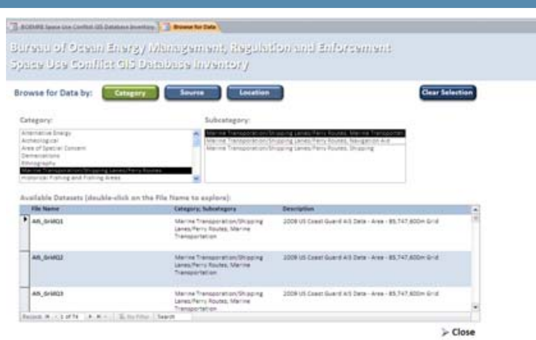
INDUSTRIAL ECONOMICS, INCORPORATED 2

Database navigation



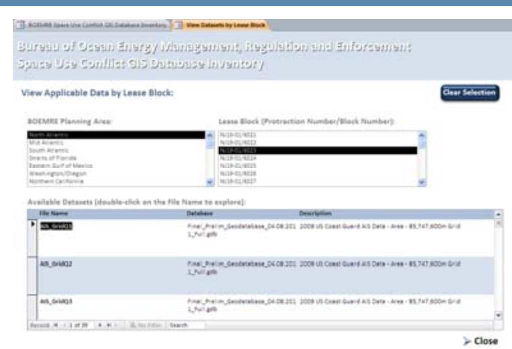
INDUSTRIAL ECONOMICS, INCORPORATED 3

Database navigation – data by category



INDUSTRIAL ECONOMICS, INCORPORATED 4

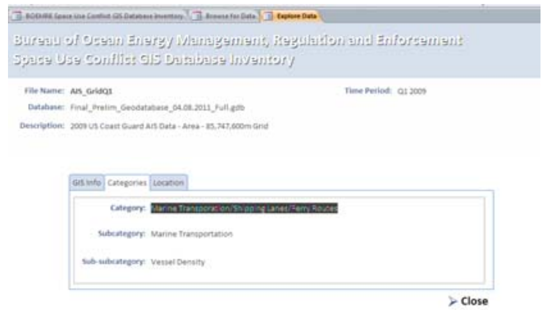
Database navigation – datasets by lease block



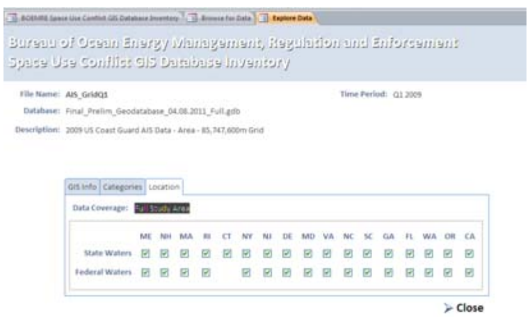
INDUSTRIAL ECONOMICS, INCORPORATED 5

Database navigation – dataset details

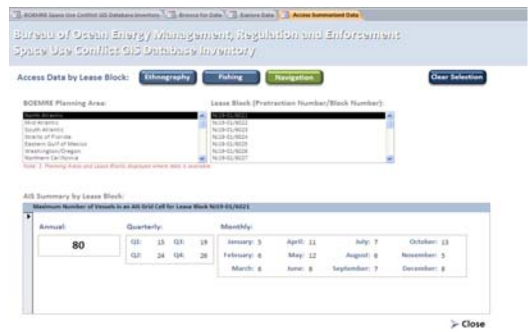
Database navigation – dataset details



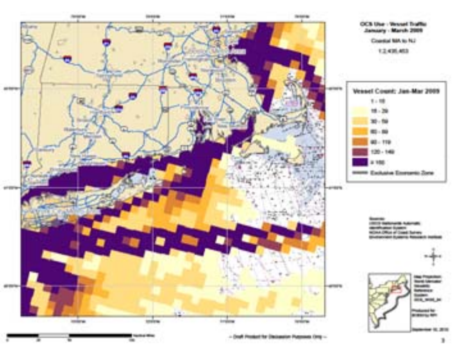
Database navigation – dataset details



Database navigation – raw data by lease block



Sample GIS layer



Contact

John Weiss

Industrial Economics, Incorporated
617.354.0074
jweiss@indecon.com

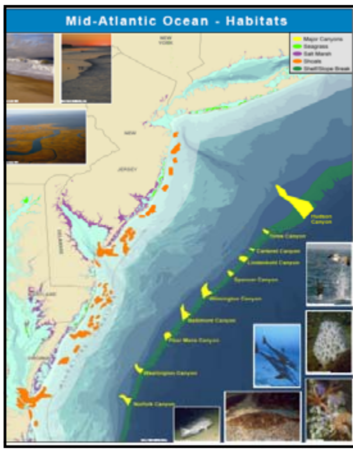
MARCO
Mapping & Planning Portal

Laura McKay

Virginia Coastal Zone MANAGEMENT PROGRAM

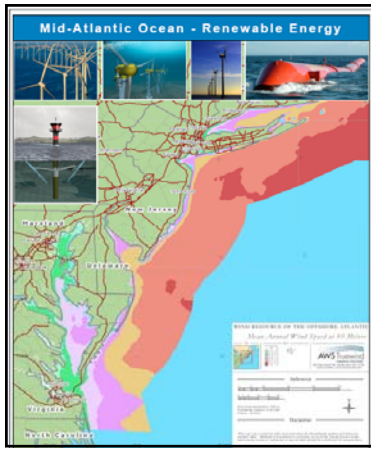
Mid-Atlantic Regional Council on the Ocean (MARCO)

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



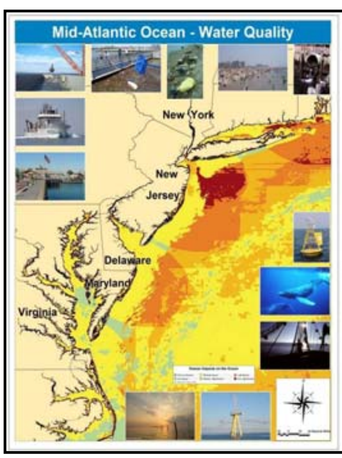
Protect Key Ocean Habitats

- 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

Day 1 - 12 July 2011
Presentations/Information Management and Data Sharing Products Panel

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

COUNCIL:
Governors of New York, New Jersey, Delaware, Maryland, Virginia

EXECUTIVE COMMITTEE:
State Agency Heads/ Cabinet Secretaries

MANAGEMENT BOARD:
State CZM Managers/Senior Policy Advisors

Action Team

Action Team

Action Team

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/NROC Data Portal Crosswalk draft: 7/8/2011
Yellow rows/cells denote new information

Portal		Category	Data Layer	Source	Sufficient?	If not sufficient, why not?	Is Better Data Available or Under Development?
MARCO	NROC	Administrative	Marine Jurisdictions	BOEMRE	Yes		
MARCO	NROC	Administrative	OCS Administrative Boundaries	BOEMRE	Yes		
MARCO	NROC	Administrative	Protraction Diagram Boundaries	BOEMRE	Yes		
MARCO	NROC	Administrative	OCS Blocks	BOEMRE	Yes		
MARCO	NROC	Administrative	Mid-Atlantic Wind Energy Areas	BOEMRE	Yes		
	NROC	Administrative	Northeast Region Extent	NOAA	Yes		
	NROC	Administrative	Coastal Barrier Resource System	DOI	Yes		
	NROC	Administrative	County Laterals	Census Bureau	Yes		
	NROC	Administrative	State Laterals	Census Bureau	Yes		
	NROC	Administrative	Danger Restricted Areas Draft	Coast Guard?	Yes		
	NROC	Administrative	Collision Regulation Boundaries	USCG	Yes		
	NROC	Administrative	National Marine Sanctuary	NOAA	Yes		
	NROC	Administrative	Refuges (Approved, Interest, Special Interest)	DOI	Yes		
MARCO		Administrative	Unofficial NROC/MARCO Boundaries	Marine Cadastre	Yes		
MARCO	NROC	Human Use	Fishing Vessel Trip Report Data (effort, landings and value)	NMFS	Yes		Enhanced and updated database obtained from NMFS 6/2011, now covers 10 years (2000-2009) with ability to map catch by species. Summer

Data Needs | Currently in Viewer

MARCO focused has about 30 layers, NROC has about 50.

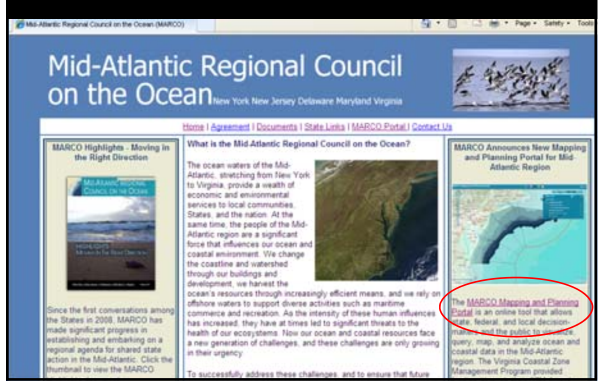
Critical Data Needs for CMSP - Identified by MARCO and NROC 8-Jul-11

Category	Data Type	Description	Source of Data	Notes
Administrative	Military, hazard and restricted areas	Information pertaining to uses of the marine environment by the Department of Defense for training, classified or restricted areas, with unexploded ordinances, etc.	USCG & DOD including ACOE, Navy, etc.	Most spatial data exists, but may need to be attributed with additional information (e.g. permitted uses with zone types).
Biological	Marine mammal migration paths	Existing marine mammal data highlights important concentration areas, yet may not reveal critical migratory pathways.	Unknown	Need to leverage existing data and survey efforts; additional surveys needed.
Biological	Important bird habitat (e.g. nesting, breeding, wintering, stopover)	Point and polygon data on sea bird and sea duck use of coastal and marine habitats.	Multiple sources	Need to leverage existing data and efforts; additional data needs to be collected.
Biological	Regional scale sea bird and sea duck habitat model	A high resolution, predictive model for sea bird and sea duck habitat and distribution.	PIROP/Manomet	BOEMRE recently committed funds to enable NCCOS to expand New York scale work to Mid-Atlantic region.
Biological	Coldwater coral model	A high resolution, predictive model of coral habitat and distribution.	Multiple sources	Currently, point data is available; NCCOS and partners working on a layer for New York that could be expanded to the Bay of Fundy to Cape Hatteras region; estimated cost is $75K.
Geophysical	Finite Volume Coastal Ocean Model (FVCOM) results	FVCOM is a coastal ocean circulation model developed by UMASSD-WHOI and includes information on current, wave regime, temperature, salinity and density.	Multiple including UMASS Dartmouth, Rutgers, NERACOOS, and MARACOOS	FVCOM will include all of the NROC area and the northern part of MARCO area; additional modeling may be needed for MARCO.
Human Use	Automatic Identification System (AIS) shipping data	AIS is an automated tracking system used on ships and by Vessel Traffic Services for identifying and locating	NOAA	AIS data and tools expected from NOAA CSC, Summer, 2011.

Data Needs | Currently in Viewer

16 data gaps have been identified.

MARCO Website



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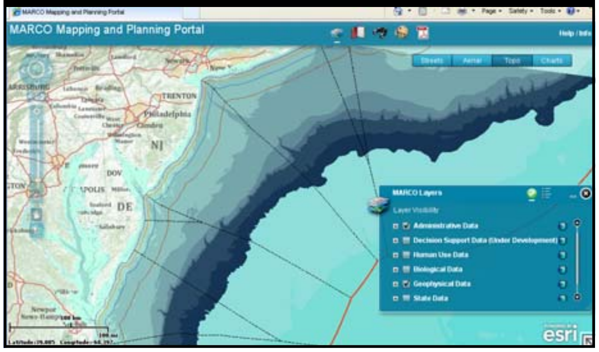
MARCO Mapping & Planning Portal

Available at www.midatlanticocean.org



MARCO Mapping & Planning Portal

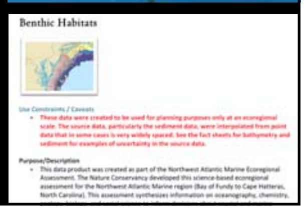
6 Data Categories:

1. Administrative (6)
2. Decision Support (2)
3. Human Use (4)
4. Biological (7)
5. Geophysical (8)
6. State Specific (2)

29 data layers

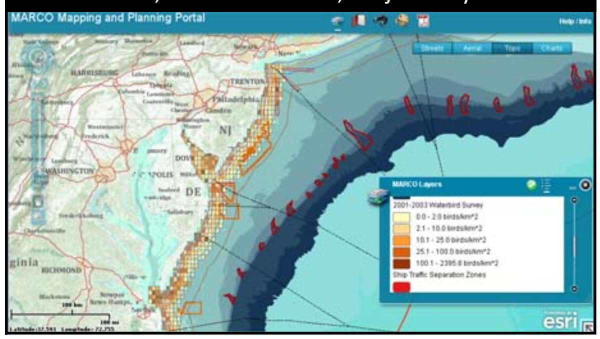
MARCO Portal Features

- 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



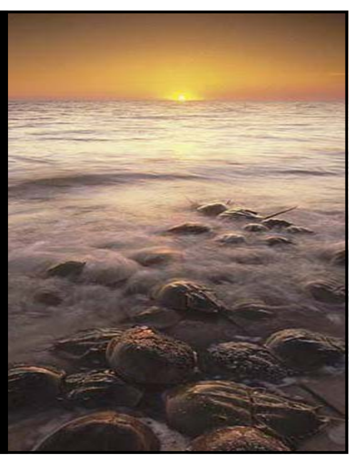
MARCO Area

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

Day 1 - 12 July 2011
Presentations/Information Management and Data Sharing Products Panel

NORTHEAST OCEAN DATA PORTAL
SUPPORT FOR COASTAL AND MARINE SPATIAL PLANNING

Atlantic Wind Energy Workshop

July 12, 2011

NORTHEAST REGIONAL OCEAN COUNCIL

Nick Napoli, MA Ocean Partnership
Jenn Greene & Eric Howard, TNC
Daniel Martin, NOAA CSC
Ru Morrison, NERACOOS
Eoin Howlett & Rachel Shmookler, ASA
Riley Young-Morse, GMRI

NORTHEAST OCEAN DATA PORTAL
SUPPORT FOR COASTAL AND MARINE SPATIAL PLANNING

NE Portal Working Group

- A volunteer effort closely coordinated with the Northeast Regional Ocean Council (NROC)
- Building off State ocean planning and data integration efforts in the region
- Entirely self funded – cash and in-kind investments
- Goal to integrate data from many providers and provide regionally consistent data products and tools

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NORTHEAST OCEAN DATA PORTAL
SUPPORT FOR COASTAL AND MARINE SPATIAL PLANNING

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

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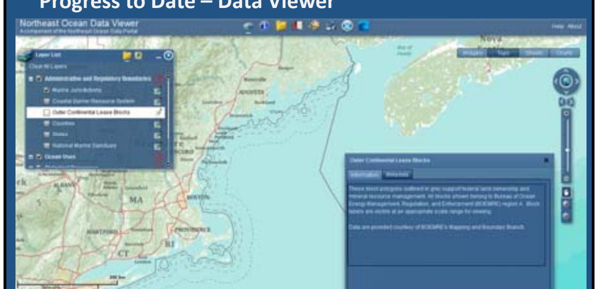
NORTHEAST OCEAN DATA PORTAL
SUPPORT FOR COASTAL AND MARINE SPATIAL PLANNING

Progress to Date - Website

northeastoceandata.org

NORTHEAST OCEAN DATA PORTAL
SUPPORT FOR COASTAL AND MARINE SPATIAL PLANNING

Progress to Date – Data Viewer



Simple list of data categories, several common base map options, and simple dataset descriptions

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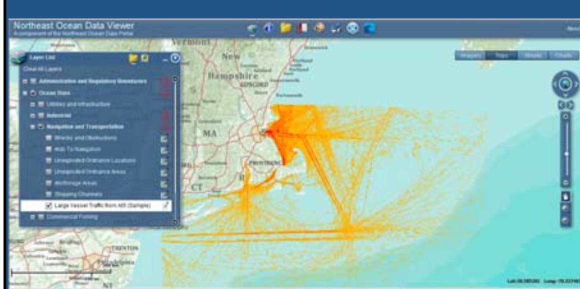
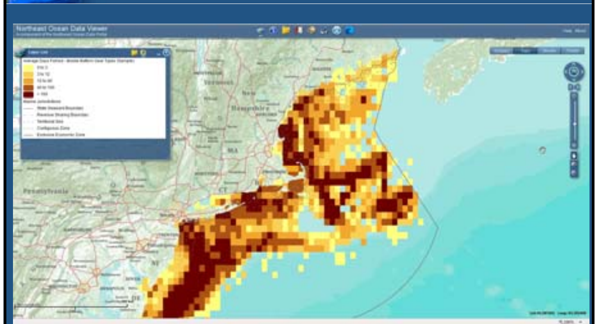
NORTHEAST OCEAN DATA PORTAL
SUPPORT FOR COASTAL AND MARINE SPATIAL PLANNING



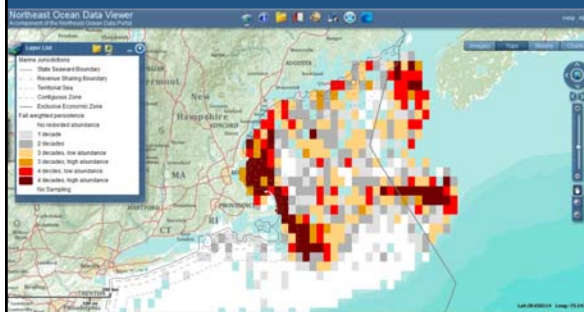
Example Ocean Use Data – AIS vessel traffic – MA and RI merged

NORTHEAST OCEAN DATA PORTAL
SUPPORT FOR COASTAL AND MARINE SPATIAL PLANNING



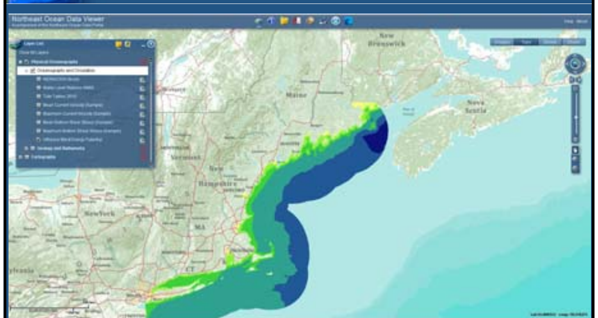
Example Ocean Use Data – Commercial Fishing Effort

NORTHEAST OCEAN DATA PORTAL
SUPPORT FOR COASTAL AND MARINE SPATIAL PLANNING



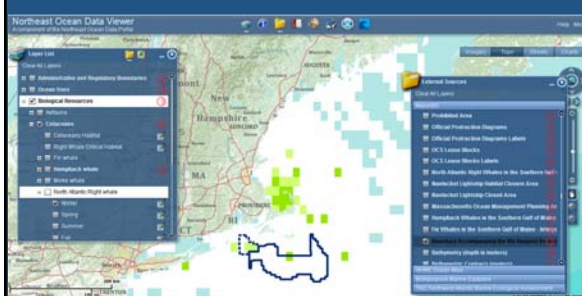
Example Biological Resource Data – Fall Cod Abundance from NMFS

NORTHEAST OCEAN DATA PORTAL
SUPPORT FOR COASTAL AND MARINE SPATIAL PLANNING



Example Physical Data – Wind Energy Potential

NORTHEAST OCEAN DATA PORTAL
SUPPORT FOR COASTAL AND MARINE SPATIAL PLANNING



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

NORTHEAST OCEAN DATA PORTAL
SUPPORT FOR COASTAL AND MARINE SPATIAL PLANNING

Data package and download

NORTHEAST OCEAN DATA PORTAL
SUPPORT FOR COASTAL AND MARINE SPATIAL PLANNING

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

NORTHEAST OCEAN DATA PORTAL
SUPPORT FOR COASTAL AND MARINE SPATIAL PLANNING

Next Steps & Ongoing Efforts

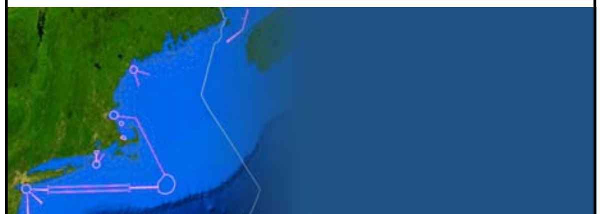
Continued data product development and collaboration with data providers, especially for the data priorities:

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
Avifauna
Cetacean
Fish habitat – EFH, resource surveys
Shellfish habitat
Benthic communities
Bathymetry
Seafloor geomorphology
Wind regime
Surface current and waves (circulation)

NORTHEAST OCEAN DATA PORTAL
SUPPORT FOR COASTAL AND MARINE SPATIAL PLANNING



Massachusetts Ocean Partnership · The Nature Conservancy · NERACOOS · NOAA · Gulf of Maine Research Institute · asa

Day 1 - 12 July 2011
Presentations/Information Management and Data Sharing Products Panel

OBIS-SEAMAP

marine megavertebrate geo-archive

http://seamap.env.duke.edu

OBIS-SEAMAP
Protected Species Information & Analysis System

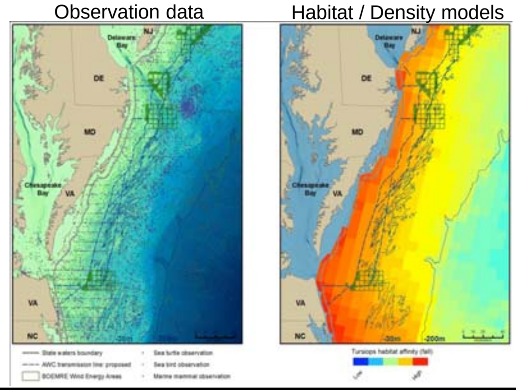
Atlantic Wind Energy Workshop
July 12th, 2011

P.N. Halpin
The OBIS-SEAMAP Team

Marine Geospatial Ecology Lab
Nicholas School of the Environment
Duke University

Data needs for renewable energy siting & permitting

Observation data | Habitat / Density models



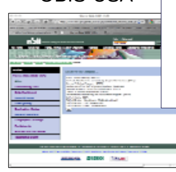
Data needs for renewable energy siting & permitting

The is significant correspondence between migratory corridors and wind-energy potential on the Atlantic Coast

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.

OBIS-USA, OBIS-SEAMAP, iOBIS

OBIS-USA



National marine biodiversity data archive

OBIS-SEAMAP Niche:
Protected species data / tools
- Telemetry / tracking data
- Photo-ID
- Passive acoustics
- Spatial Decision Support

Mapping & Analysis R&D*

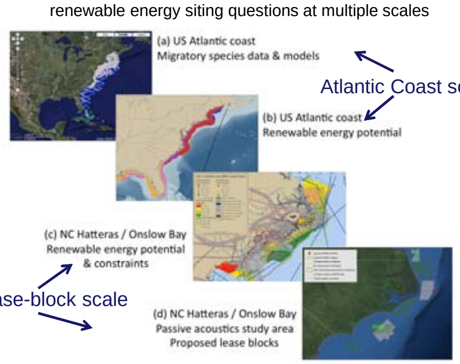
OBIS-SEAMAP

iOBIS

International marine biodiversity data archive

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

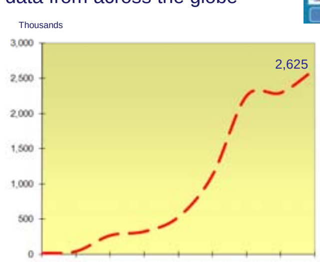


Atlantic Coast scale

Lease-block scale

OBIS-SEAMAP

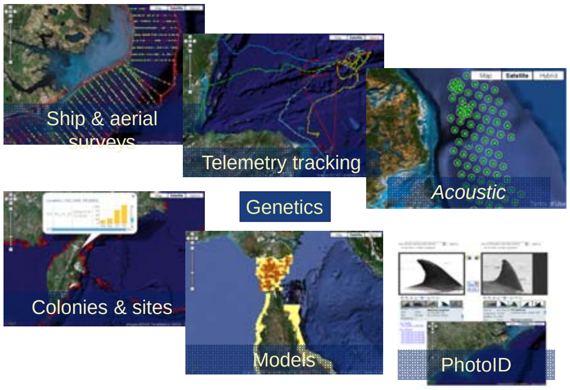
Spatially referenced online database, aggregating marine mammal, seabird and sea turtle data from across the globe



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

National Science Foundation

OBIS-SEAMAP supports multiple data types

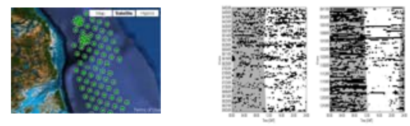


Passive acoustic data in OBIS-SEAMAP

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 **P**assive **A**coustic **M**onitoring (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)



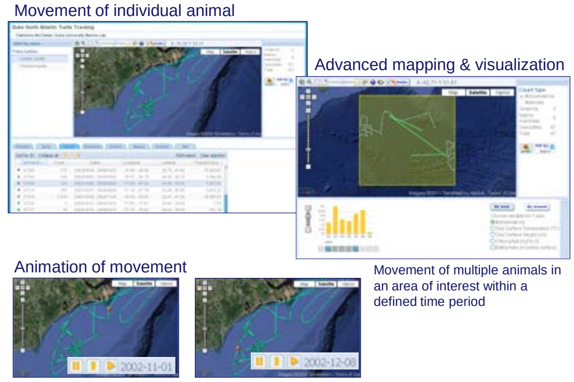
A sample of the proposed date-hour plot

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

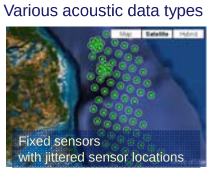
Telemetry data in OBIS-SEAMAP

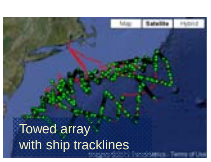


Movement of multiple animals in an area of interest within a defined time period

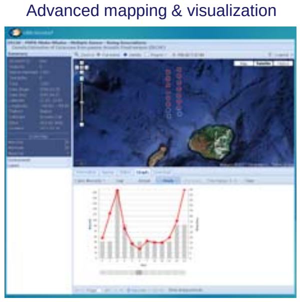
Passive acoustic data in OBIS-SEAMAP

Various acoustic data types





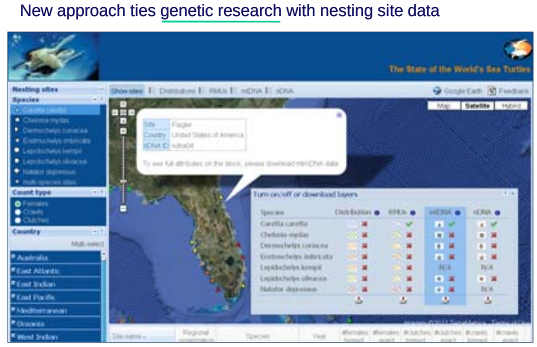
Advanced mapping & visualization



Navy-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

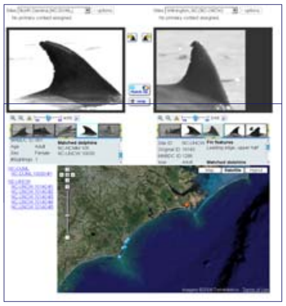


DNA sampling sites along with nesting sites (*both are downloadable*)

PhotoID in OBIS-SEAMAP

Community-oriented expansion of OBIS-SEAMAP

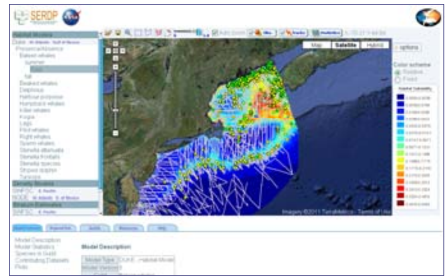
- Started for Mid-Atlantic Bottlenose Dolphin Catalog
- Provides an online scientific workflow for fin matching processes



Cetacean density models in OBIS-SEAMAP

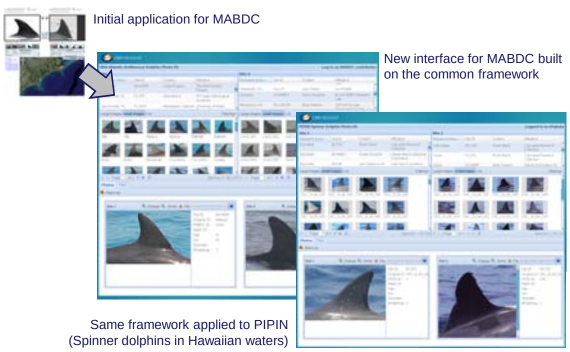
Interactive decision support

Model outputs presented with original data (including effort)



PhotoID in OBIS-SEAMAP

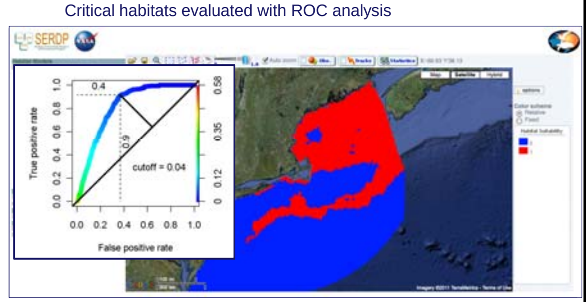
Building common framework to incorporate other PhotoID catalogs



Cetacean density models in OBIS-SEAMAP

Interactive decision support

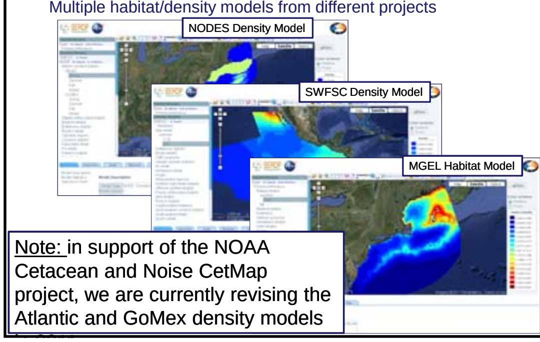
Critical habitats evaluated with ROC analysis



Cetacean density models in OBIS-SEAMAP

SERDP Spatial Decision Support System
originally funded by SERDP continuing development by NASA

Multiple habitat/density models from different projects

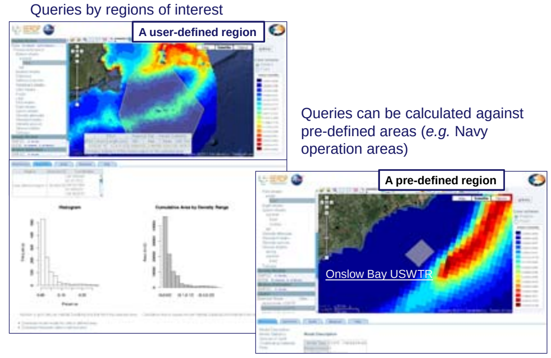


Note: in support of the NOAA Cetacean and Noise CetMap project, we are currently revising the Atlantic and GoMex density models

Cetacean density models in OBIS-SEAMAP

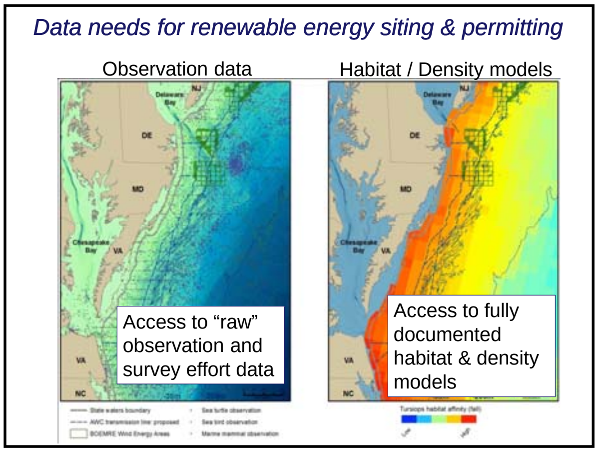
Interactive decision support

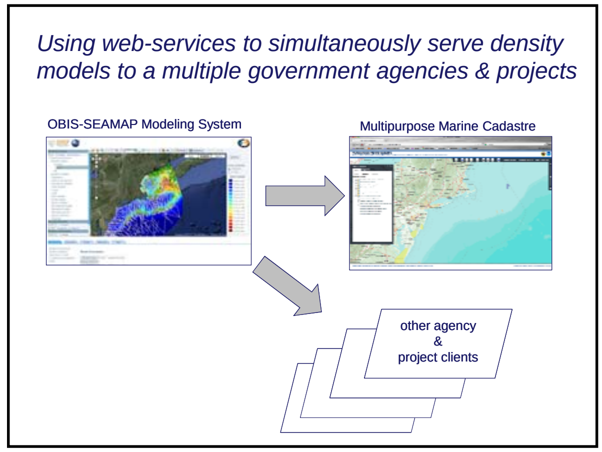
Queries by regions of interest

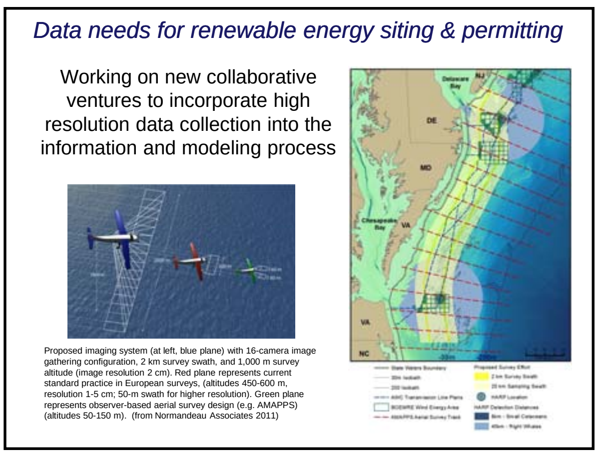


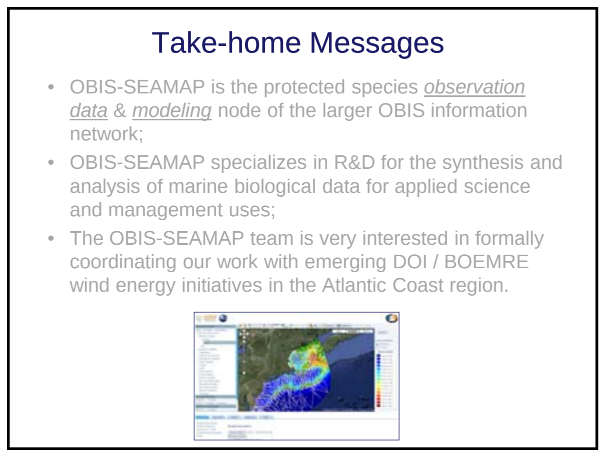
Queries can be calculated against pre-defined areas (*e.g.* Navy operation areas)

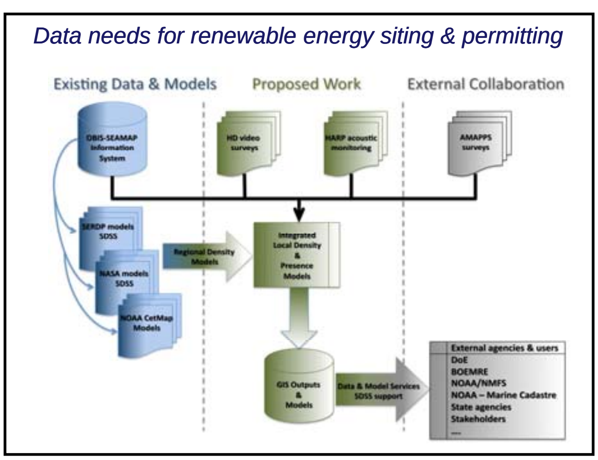
Day 1 - 12 July 2011
Presentations/Information Management and Data Sharing Products Panel











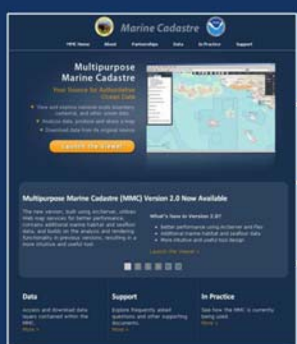
The Multipurpose Marine Cadastre

A Tool for Planning & Decision Making
in the Marine Environment

Christine Taylor
Bureau of Ocean Energy Management, Regulation and Enforcement

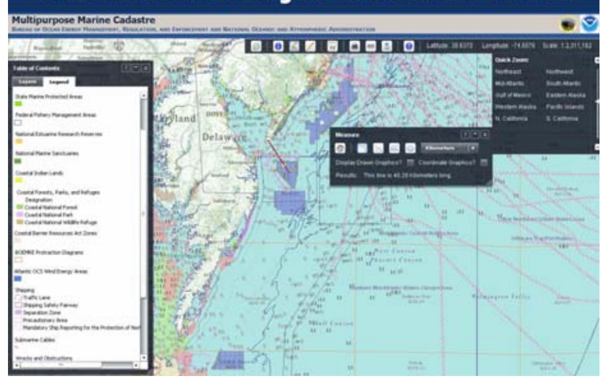
Brian Smith
National Oceanic and Atmospheric Administration (NOAA)
Coastal Services Center

MMC Summary



- **Authoritative Data**
  - Web Portal
  - Web Services
- **Viewer**
  - Visualize data
  - Make and share maps
  - Plot points
- **Support**
  - Best Practices
  - Templates and code
  - Consultation

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
- NOC National Information Management System (TBD how)
- Regional Ocean Councils – NROC, MARCO
- NOAA – Fisheries, ERMA
- Energy Industry
- Policy Makers

Multipurpose Marine Cadastre Data Themes

- Jurisdictional Boundaries
- Federal Agency Regions
- Federal Georegulations
- 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
- Navy/NGA Areas
- Raster Nautical Chart background.
- Selected State planning data
- AIS tracks and hot/cold maps
- Hurricane and extra-tropical storms
- IOOS data collector locations
- Environmental Studies Footprints with links to studies.
- TNC NAMERA – 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. 9 planning bodies.

- Data, Tools, Templates, and Tech Support

The Multipurpose Marine Cadastre

www.marinecadastre.gov

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
Chrisitne.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
Hyatt Dulles Hotel
Herndon, Virginia

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

2

Fishermen's Energy Investors are principals of the fishing industry

www.atlanticcapes.com

www.lundsfish.com

www.essf.com

Sea Products, Inc.

www.vikingvillage.net

Cold Spring Fish & Supply Co.

Atlantic Shellfish

Dock Street Seafood

Truex Enterprises

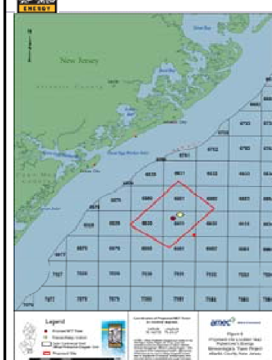
Foxy Investments

www.thelobsterhouse.com

www.seawatch.com

3

350MW Project in Federal Waters



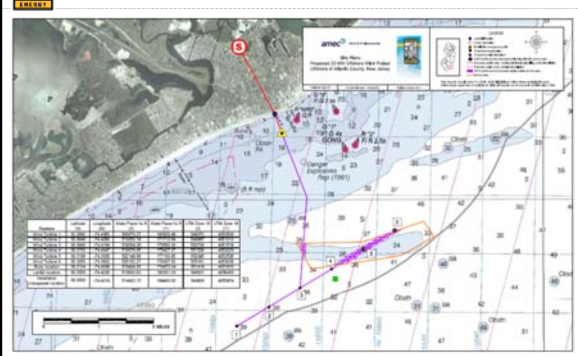
4

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

Fishermen's Atlantic City Windfarm, 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***

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



6

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 windfarm

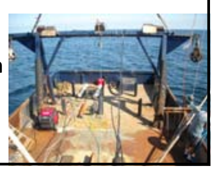
Required Data Types

- **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

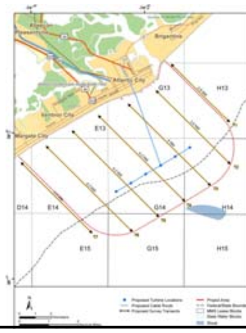
Historical data
- Publicly funded research and studies
- Commercial fishery effort / VMS data
- Contracted desktop studies

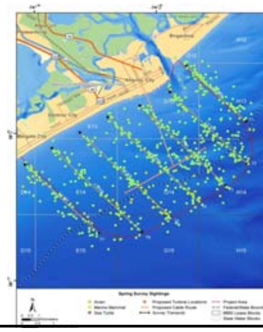
Real-time Data in the public domain
- NOAA data buoys
- PORTS and NWLON data



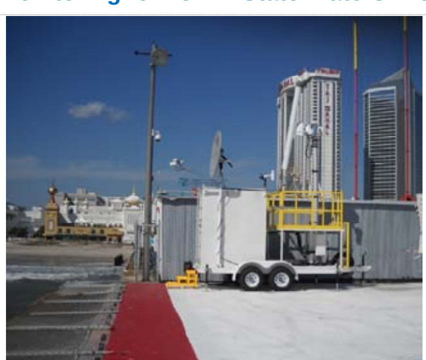
Project Specific Field data collection
- Initiated during Spring 2010

Living Resources -Boat Transects for Species Surveys start May 2010 - weekly pre, during, and post construction





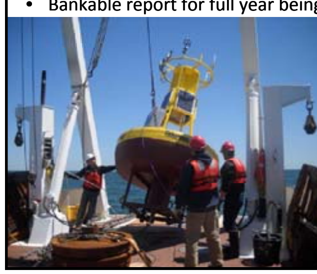
October 2010 -Avian Radar on Steel Pier monitoring for 25MW State Waters Project



11

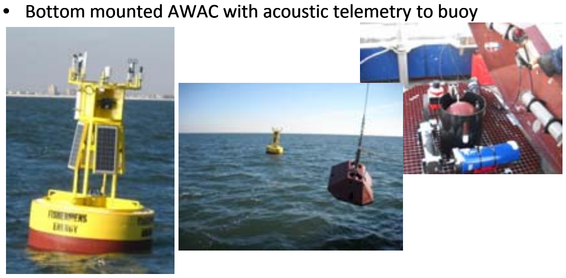
Wind Assessment - April 2010, Installed Monitoring Buoy #1 full year

- Provides near surface wind data for extrapolation to hub height
- Real time data transmissions to shore
- Bankable report for full year being compiled



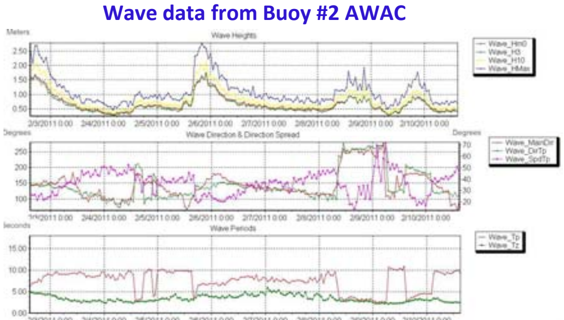
December 2010, Installed Monitoring Buoy #2

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

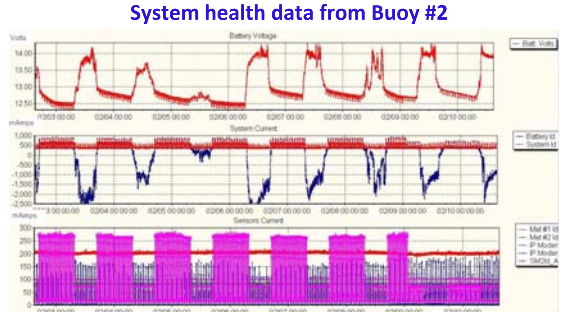


Acoustic Monitoring –Buoy #2

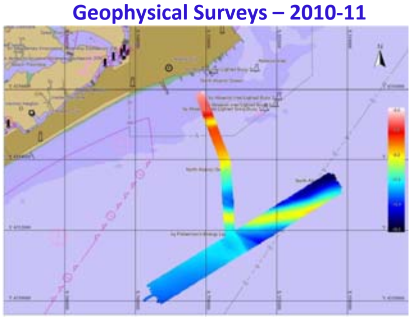
Wave data from Buoy #2 AWAC



System health data from Buoy #2

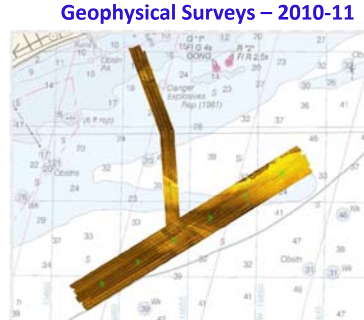


Geophysical Surveys – 2010-11



Multibeam bathymetry of turbine field and cable route

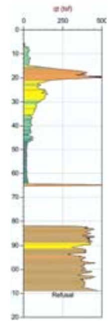
Geophysical Surveys – 2010-11



Side Scan sonar imaging of turbine field and cable route

Day 1 - 12 July 2011
Presentations/Developers Panel

Geotechnical drilling – October 2010



Jackup barge and drilling equipment at turbine locations

Next Phase - Wind Resource Assessment: Innovative Approach -1st in the world deployment

- AXYS / Vindicator Floating Vertical LIDAR
  - LIDAR unit ("Vindicator") manufactured by Catch the Wind, a "spin-off" of Optical Air Data Systems, a defense contractor
  - Nomad type buoy manufactured and system integrated by AXYS Technologies
- Lockheed Martin Horizontal scanning LIDAR
  - Unit ("Wind Tracer") manufactured by Lockheed Martin's Coherent Technologies division
  - Latest model can measure wind up to 25 kilometers
  - Technology deployed at airports, but not for wind project resource assessment yet

20

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

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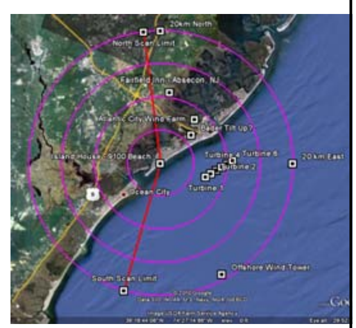
Wind Resource Assessment: Program Validation

- 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



22

Innovative Wind Assessment Program

- **Block 6931**
  - AYXS 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 Buoys at State Water Site
  - ACUA – Jersey Atlantic Wind Farm
  - Three 60 meter shore based met towers

WindTracer®

LOCKHEED MARTIN

Cutting Edge Technology for Wind Power, Proven for Aviation Safety

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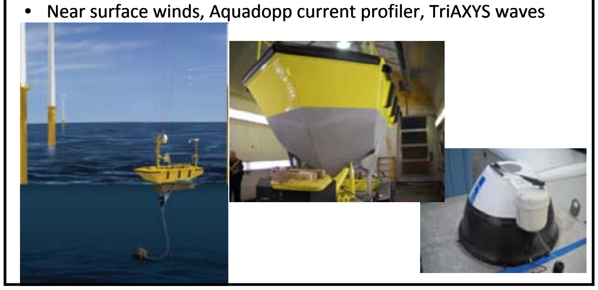
AXYS Buoy to be deployed in August 2011 to commence validation

- 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!

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DEEPWATERWIND

CLEAN ENERGY IS JUST OVER THE HORIZON

Environmental Studies and Monitoring for Offshore Wind Energy

Atlantic Wind Energy Workshop

July 12, 2011

Aileen Kenney, Director of Permitting: akenney@dwwind.com

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, that state's preferred developer of offshore wind.

–Our management team includes **CEO Bill Moore**, the developer of the 325 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 Meggs**, former Group VP for Technology of BP and co-chair of the MIT Natural Gas Study
- The Hon. **Spencer Abraham**, former Secretary of Energy and Michigan Senator
- **Stephen Key**, former CFO of ConAgra and Textron
- **Paul Gaynor**, CEO of First Wind

2

"Over the horizon wind"

▪ **Reduced visibility.** Locate 13-20+ 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.

3

Regional Project Portfolio

- **New England Region**
  - Chosen as RI's preferred developer
    - 30 MW project in state waters off of Block Island
  - Memorandum of Understanding with Massachusetts
    - 1,000 MW project in federal waters in the Area of Mutual Interest between the states
  - Developing offshore transmission network to form regional energy center
- **Greater New York Region**
  - Commissioned detailed site suitability studies on multiple sites
  - Developing 1,000 MW project in federal waters and a regional transmission network (NY and NJ)
- **Southern New Jersey Region**
  - Chosen as NJ preferred developer
  - Partnership with PSEG – Garden State Offshore Energy (GSOE)
  - Awarded $3 MM grant to deploy advanced offshore monitoring system
  - Developing 1,000 MW project in federal waters

4

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 data long term
    - 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

5

Typical Studies and Associated Technology

- Avian and Bat
  - **Avian Radar:** provides an assessment of migration; spatial and temporal occurrence patters
  - **NEXRAD (Next Generation Radar):** U.S. National Weather Service network; provide 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
  - **Acoustic Monitoring:** Passive and Active
- 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:

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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

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Typical Studies and Associated Technology

- 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

8

Typical Studies and Associated Technology

- 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

9

CLEAN ENERGY IS JUST OVER THE HORIZON

DEEPWATERWIND

Interim Policy Leases

NRG Bluewater Wind

Laurie Jodziewicz, Director of Permitting

July 12, 2011

NRG Bluewater Wind — Slide 1 — nrgbluewaterwind.com

Safe Harbor Statement

This Presentation contains forward-looking statements within the meaning of Section 27A of the Securities Act of 1933 and Section 21E of the Securities Exchange Act of 1934. Forward-looking statements are subject to certain risks, uncertainties and assumptions and typically can be identified by the use of words such as "expect," "estimate," "should," "anticipate," "forecast," "plan," "guidance," "believe," "will" and similar terms. Such forward-looking statements include information relating to NRG Bluewater Wind, an NRG Company, and NRG's offshore wind development strategy and projects. Although NRG believes that these expectations are reasonable, it can give no assurance that these expectations will prove to have been correct, and actual results may vary materially. Factors that could cause actual results to differ materially from those contemplated above include, among others, general economic conditions, hazards customary in the power industry, weather conditions, construction delays, competition in wholesale power markets, the volatility of energy and fuel prices, failure of customers to perform under contracts, changes in the wholesale power markets, changes in government regulation of markets and of environmental emissions, the condition of capital markets generally, and the inability to implement value enhancing improvements to plant operations and companywide processes.

NRG undertakes no obligation to update or revise any forward-looking statements, whether as a result of new information, future events or otherwise. The foregoing review of factors that could cause actual results to differ materially from those contemplated in the forward-looking statements included in this Presentation should be considered in connection with information regarding risks and uncertainties that may affect NRG's future results included in NRG's filings with the Securities and Exchange Commission at www.sec.gov.

NRG Bluewater Wind — Slide 2 — nrgbluewaterwind.com

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 200-450 MW
    - 25 year Power Purchase agreement signed with Delmarva Power and Light
    - Supported by DE Governor and Legislature
    - Enough power for over 100,000 households
  - Over 3,300 MW in additional development in New Jersey, Maryland, New York, Long Island and Great Lakes

NRG Bluewater Wind — Slide 3 — nrgbluewaterwind.com

Interim Policy Leases

- On November 1, 2009, Bluewater Wind Delaware LLC and Bluewater Wind New Jersey Energy LLC executed leases for OCS blocks 6325 and 6936, respectively
- NRG Bluewater intends to install a meteorological data collection facility (MDCF or met tower) off Delaware
  - This fixed platform allows us to collect financeable wind data and avian information
  - Met tower will be approximately 16 miles offshore and in about 30 feet of water
- NRG Bluewater also intends to install a met tower off New Jersey

Horns Rev, Denmark

NRG Bluewater Wind — Slide 4 — nrgbluewaterwind.com

Met Tower Permits

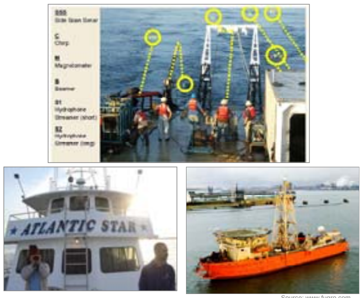
- Four permits and a BOEMRE Project Plan required prior to construction:

EPA/DNREC 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

NRG Bluewater Wind — Slide 5 — nrgbluewaterwind.com

Survey Work Completed

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



Source: www.fugro.com

NRG Bluewater Wind — Slide 6 — nrgbluewaterwind.com

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

NRG Bluewater Wind Slide 7 nrgbluewaterwind.com

Thank you.
For more information contact:

Laurie Jodziewicz
Director of Permitting
NRG Bluewater Wind
(202) 756-0252
laurie@bluewaterwind.com

NRG Bluewater Wind Slide 8 nrgbluewaterwind.com

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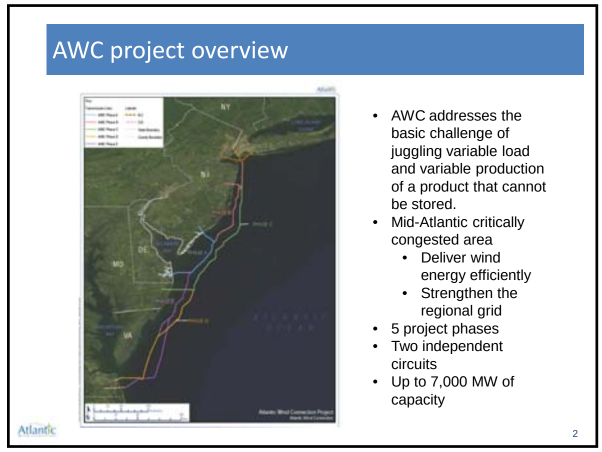

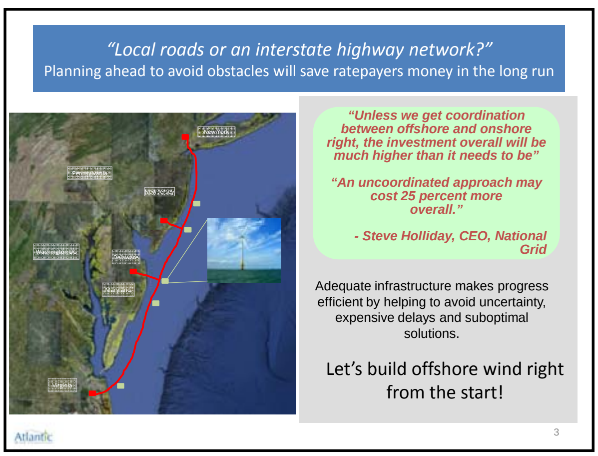

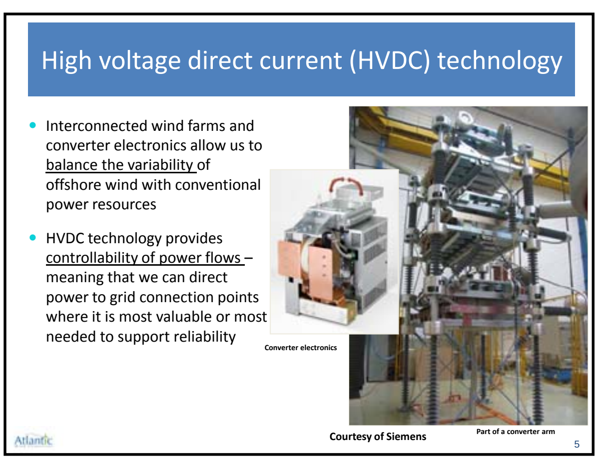

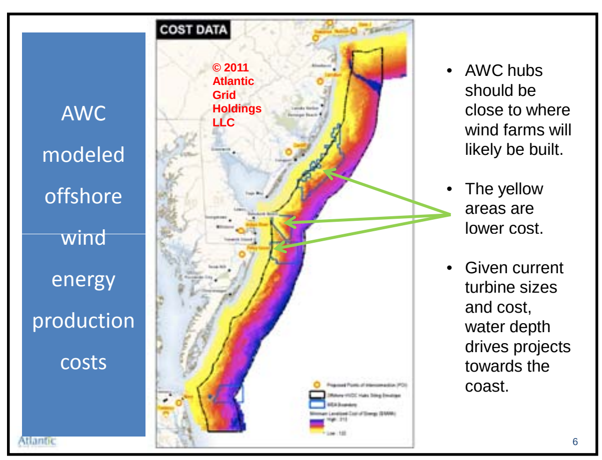

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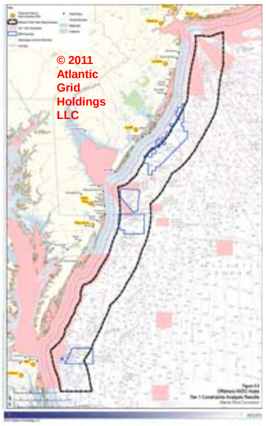
TIER I: uses and conditions that preclude wind development



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

Atlantic

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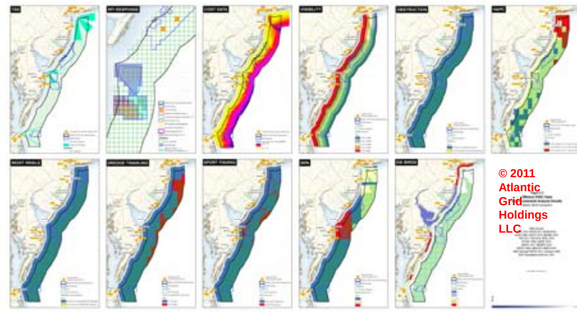
TIER II: uses and conditions that influence, but do not preclude, wind farm development



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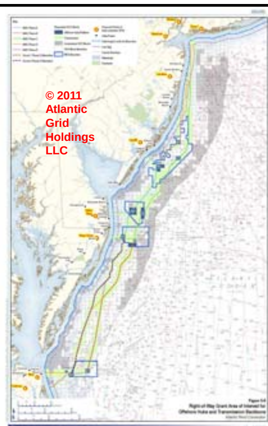
Project Status: AWC has filed with BOEM to obtain cable ROW and hub sites



Anticipate submitting General Activities Plan (GAP) in early 2012

Surveys and studies to collect data for filing
- Geotechnical & geophysical to begin late this summer
- Working with BOEMRE staff on GAP contents
- Plan to follow GAP Guidelines when released

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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**

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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 WEAs**
  - **Fewest cable-crossings as possible**
  - **Best locations for offshore hubs to service wind farms**

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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**

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Presentations/Developers Panel

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BOEMRE's

Technology Assessment and Research (TA&R) Program

Lori Medley
Atlantic Wind Energy Workshop
July 12- 14, 2011
Herndon, VA

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.

618	Comparative Study of Offshore Wind Turbine Generators (OWTG) Standards
627	Assess/Develop Inspection Methodologies for Offshore Wind Turbine Facilities
628	Assess the Design/Inspection Criteria/Standards for Wave and/or Current Energy Generating Devices
629	Assess the Design and Inspection Criteria and Standards for Wave and Current Energy Generating Devices
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
634	Mitigation of Underwater Pile Driving Noise During Offshore Construction
636	Characteristics, Behavior and Response Effectiveness of Spilled Dielectric Insulating Oil in the Marine Environment
648	Offshore Wind and Ocean Energy Installation Cost Estimation in the U.S. Outer Continental Shelf
650	Offshore Wind Turbine Inspection Refinements
651	Evaluate the Effect of Turbine Period of Vibration Requirements on Structural Design Parameters
656	Seabed Scour Considerations
669	Floating Wind Turbines
670	Design Standards for Offshore Wind Farms
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
672	Development of an Integrated Extreme Wind, Wave, Current, and Water Level Climatology to Support Standards-Based Design of Offshore Wind Projects

http://www.boemre.gov/tarprojectcategories/RenewableEnergy.htm

686 Regulating Worker Safety in Renewable Energy Operations on the OCS

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.

618	Comparative Study of Offshore Wind Turbine Generators (OWTG) Standards
627	Assess/Develop Inspection Methodologies for Offshore Wind Turbine Facilities
628	Assess the Design/Inspection Criteria/Standards for Wave and/or Current Energy Generating Devices
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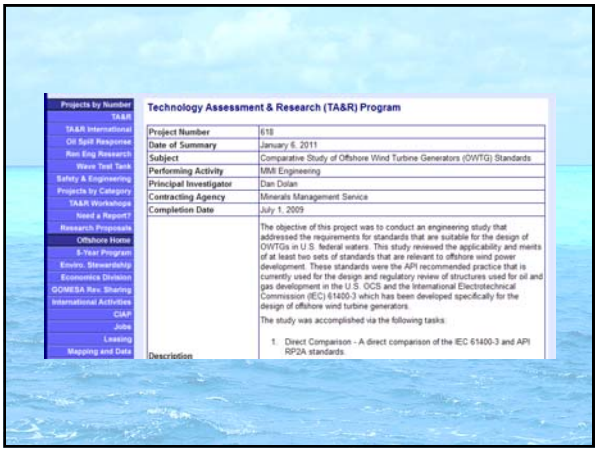
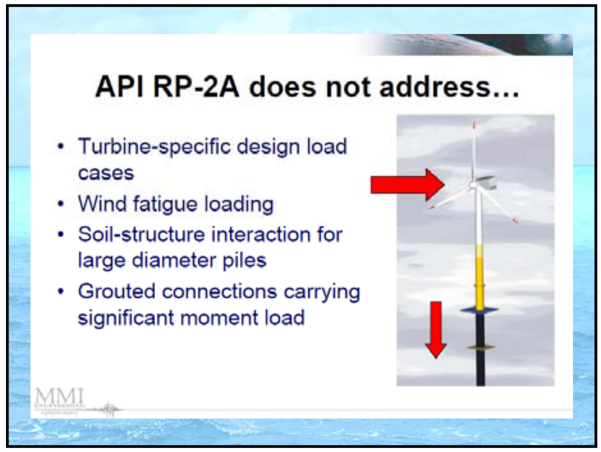
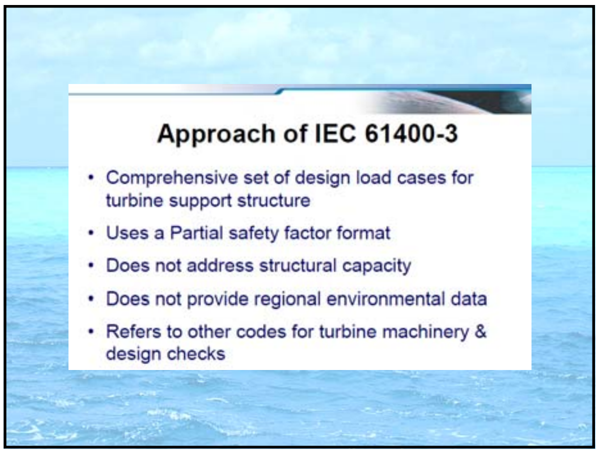
672	Development of an Integrated Extreme Wind, Wave, Current, and Water Level Climatology to Support Standards-Based Design of Offshore Wind Projects

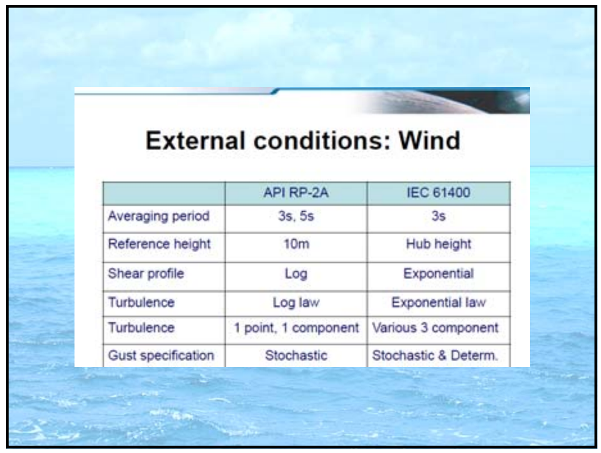
http://www.boemre.gov/tarprojectcategories/RenewableEnergy.htm



Project Number	618
Date of Summary	January 6, 2011
Subject	Comparative Study of Offshore Wind Turbine Generators (OWTG) Standards
Performing Activity	MMI Engineering
Principal Investigator	Dan Dolan
Contracting Agency	Minerals Management Service
Completion Date	July 1, 2009
Description	The objective of this project was to conduct an engineering study that addressed the requirements for standards that are suitable for the design of OWTGs in U.S. federal waters. This study reviewed the applicability and merits of at least two sets of standards that are relevant to offshore wind power development. These standards were the API recommended practice that is currently used for the design and regulatory review of structures used for oil and gas development in the U.S. OCS and the International Electrotechnical Commission (IEC) 61400-3 which has been developed specifically for the design of offshore wind turbine generators. The study was accomplished via the following tasks: 1. Direct Comparison - A direct comparison of the IEC 61400-3 and API RP2A standards.

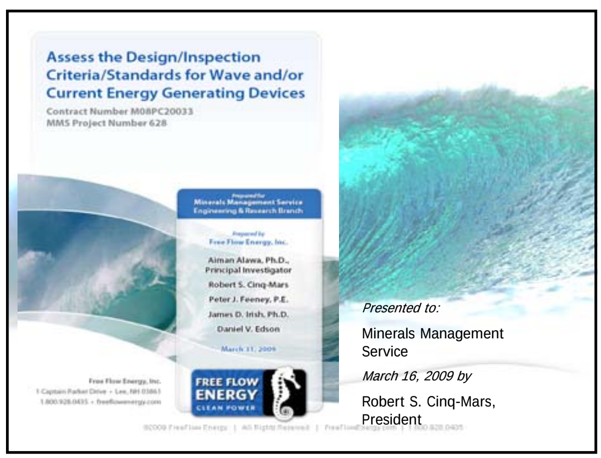






	API RP-2A	IEC 61400
Averaging period	3s, 5s	3s
Reference height	10m	Hub height
Shear profile	Log	Exponential
Turbulence	Log law	Exponential law
Turbulence	1 point, 1 component	Various 3 component
Gust specification	Stochastic	Stochastic & Determ.

628	Assess the Design/Inspection Criteria/Standards for Wave and/or Current Energy Generating Devices
629	Assess the Design and Inspection Criteria and Standards for Wave and Current Energy Generating Devices

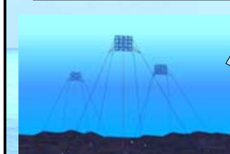


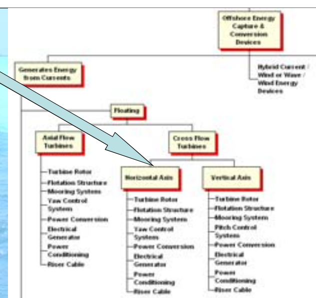
- Standards were reviewed and recommended for further consideration.
- Hardware was investigated and classified into subsystems.
- Gaps were identified and research recommended.
- Existing inspection methodologies applied to oil and gas were identified for their potential application to wave and current energy conversion on the OCS.

Criteria & Standards:
Wave & Current
Energy Generating Devices

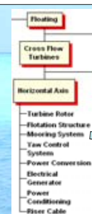
Tom Hudon & Jared Dabling, PCCI
George Hagerman, Virginia Tech ARI

Step 1 – Find Device in Taxonomy





Step 2 – Find Applicable Criteria



APPENDIX B
OCEAN ENERGY DEVICE GUIDELINES
COMPARISON OF EXISTING CODES AND GUIDELINES FOR OCEAN ENERGY DEVICE DESIGN CRITERIA

CRITERIA	GL – Ocean Current Turbines	EMEC – Health and Safety	EMEC – Project Development	EMEC – Performance of Wave Energy
Mooring system	(4.4.8) Addresses mooring dynamics. (6.1(2)) The analysis of anchoring and mooring systems shall be performed according to GL "Guideline for the Construction and Classification/Certification of Floating Productions, Storage and Off-Loading Units".	(8.3.1) Existing design rules may be adopted by the device designer. Examples of existing regulations are listed. Consideration should be given to safe and practical installation and access for maintenance. Design such that construction, assembly, and testing can place onshore as much as is possible. (8.4) HSE publication 2001/063 – Marine risk assessment addresses hazards including: Loss of position keeping (e.g. mooring failure)	(6.4) Evaluation of the different design options should include: Mooring requirements, which will be based on the device, the geomorphology of the sea-bed, and environmental impacts	(7.4) Wave buoys should be moored so that the are free to respond to the waves, but at the same time can survive the highest waves that are likely to occur at the site.

Step 3A – Obtain Details for Design

GL – Ocean Current Turbines
(4.4.8) Addresses mooring dynamics. (6.1(2)) The analysis of anchoring and mooring systems shall be performed according to GL "Guideline for the Construction and Classification/Certification of Floating Productions, Storage and Off-Loading Units".

4.4.8 Mooring dynamics

(1) Non linear dynamics of mooring systems shall be considered in system design.

(2) Interaction of the floating body with mooring and the power producing device shall be considered, especially periodic excitation from the rotor.

(3) Vortex induced vibrations on anchor cables considering current and wave influence have to be analysed.

(4) Mooring and anchor forces have to be determined according to GL Rules for "Offshore structures" [2].

Step 3C – Obtain Details for Operations

EMEC – Certification Schemes
(6.5) Regular surveys should involve a shorter periodic survey and a more comprehensive longer periodic survey (other industries use annual and 5-year periods). The extent of the survey will be dictated by the design. Additional surveys shall be carried out if the device sustains damage or is significantly modified between regular surveys.

6.5 Maintenance and expiration of certificates

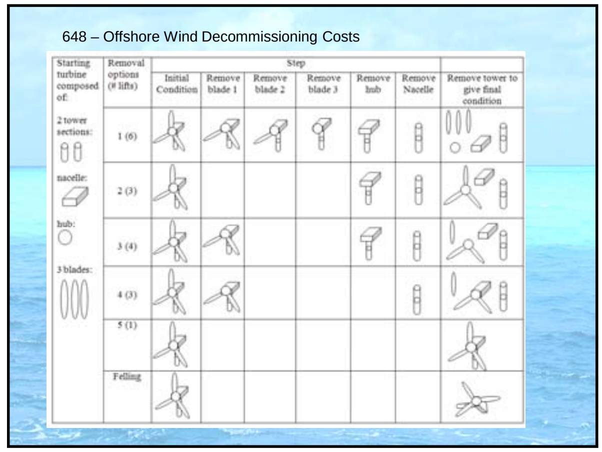
In order to maintain the certification the marine energy converter shall undergo regular surveys.

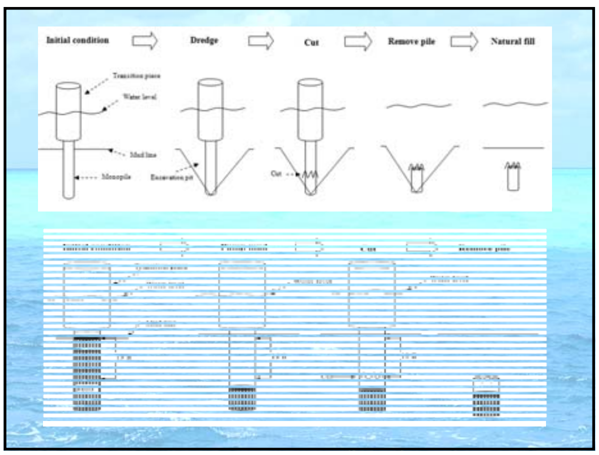
This should involve a shorter periodic survey and a more comprehensive long periodic survey (in other industries annual and 5-yearly survey periods are used). The extent of the survey (areas, methods, frequencies) will normally be dictated by the design life, degradation mechanisms and the consequences of possible failure.

Periodic survey intervals shall be defined in the inspection plan and shall be agreed with the certification body.

NOTE 1 These intervals can vary depending on the condition of the marine energy converter.

Day 1 - 12 July 2011
Presentations/Technology Assessment & Resource (TA&R)





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Atlantic Wind Energy Workshop – July 12-14, Herndon, Virginia

Mitigation of Underwater Pile Driving Noise During Offshore Construction TA&R 634

Dwight Davis
Dr. Ann Stokes
Kevin Cockrell
David Warwick

Hosted by the U.S. Department of the Interior
Bureau of Ocean Energy Management, Regulation, and Enforcement (BOEMRE)

Engineering Solutions Through Science

Slide 2

Outline

- Purpose of Research
- Technical Approach
- Results
  - » Assessment of Sound Transmission Paths
  - » Evaluation of Sound Mitigation Options
- Ongoing Work
- Recommendations to Move Forward

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Slide 3

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

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Slide 4

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

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Slide 5

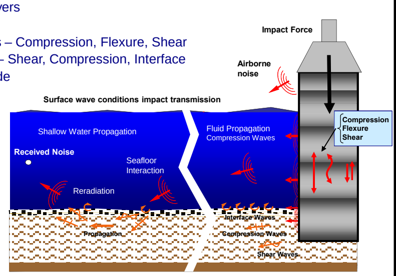
Pile Driving Noise Problem – Significant Complexity

Reduce Noise Transmission to an Observer in the Water Column

- Multiple Layers
  - » Air / Fluid Column / Multiple Bottom Layers
  - » Monopile / Mitigation Layers
- Multiple Wavetypes
  - » Monopile System Waves – Compression, Flexure, Shear
  - » Layered Bottom Waves – Shear, Compression, Interface
  - » Shallow Water Waveguide
- Well Coupled System
  - » Radiation, Scatter and Transmission across Layers

Primary Transmission Paths

- Direct radiation from structure to water
- Air to water transmission
- Seismic transmission and re-radiation



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Slide 6

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 code APS developed 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

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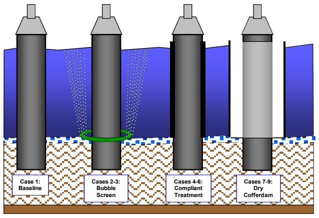
Analysis Cases

Slide 7



Treatment Configurations
Case 1: Baseline monopile representing air, water and soil boundary conditions
Case 2: Baseline with addition of a bubble screen with 2.5% volume fraction
Case 3: Baseline with addition of a bubble screen with 5% volume fraction
Case 4: Baseline with addition of a 2 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

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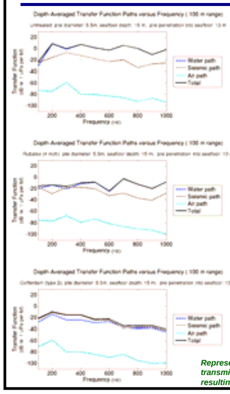
Assessment of Sound Transmission Paths

Slide 8



Representative plots of sound transmission into the water column resulting from individual 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, controlling path at a few 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.

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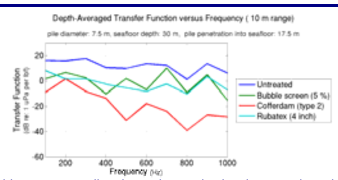
Evaluation of Sound Mitigation Options

Slide 9



Representative plot comparing total sound transmission into the water column resulting from different sound mitigation options

1. Bubble screen: predicted to reduce noise levels approximately 10 dB.
   1. Variation of air volume fraction 2.5% to 5% does not significantly affect this result.
   2. Note that currents will severely degrade bubble screen performance.
2. Compliant surface treatment: predicted to reduce noise levels approx 10 dB.
   1. Varying treatment thickness 2 inches to 8 inches affects performance at some individual frequencies by moving resonances, but does not significantly affect the overall result.
3. Dewatered cofferdam: predicted to reduce noise levels approx 20 dB.
   1. Bulk of the water pumped from the annular region between the cofferdam and pile (may require continuous operation)
   2. Considered to be the upper bound on possible noise mitigation treatment performance.
   3. Cases considered: Free-flooded pile, air filled pile (water pumped out), and pile filled with mud (in an effort to damp sound transmitted to the bottom). No significant difference in performance.

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Ongoing Work

Slide 10

- 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

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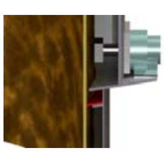
Cofferdam Design

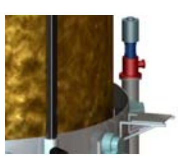
Slide 11

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

Pile and cofferdam assembly showing control struts



Hydraulic centralizer and seal detail



Dewatering pump detail

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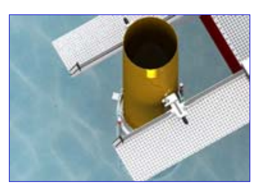
Concept of Operations

Slide 12

Turbine installation vessel (TIV) with dynamic positioning and jack-up capability



Views of pile & cofferdam assembly deployed from false rotary on TIV

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Recommendations to Move Forward

Slide 13

- 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

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Slide 14

Backup Slides

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Outline of Study

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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
  - » Feasible engineering concepts
- Develop recommendations for further development, testing and evaluation of approaches

Assumptions

- Emphasis on large monopile installation scenarios
  - » Dimensions determined as part of tasking
- Shallow water typical of Mid-Atlantic continental shelf
  - » 15m and 30m deep
  - » Sand/silt and sand/clay 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

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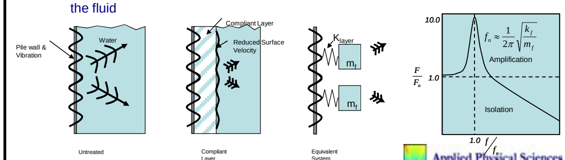
Noise Mitigation "101"

Slide 16

- 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)



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Previous Examples of Mitigation Designs

Slide 17

- 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) reduce levels, varied performance / too high in 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

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Our Overall Approach

Slide 18

- 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

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Day 1 - 12 July 2011
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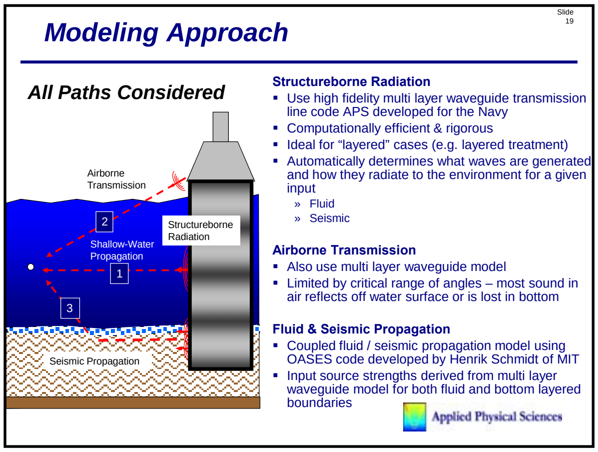
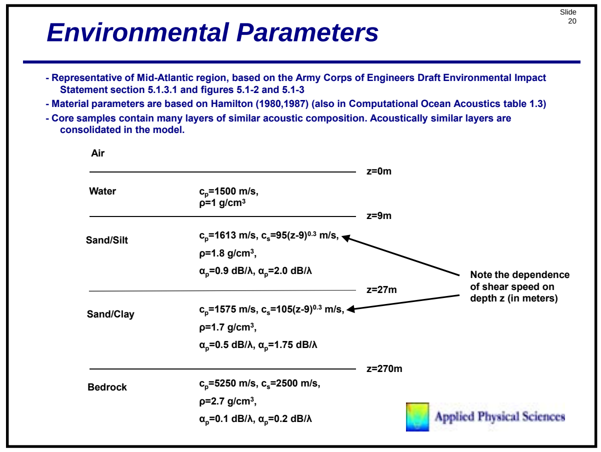
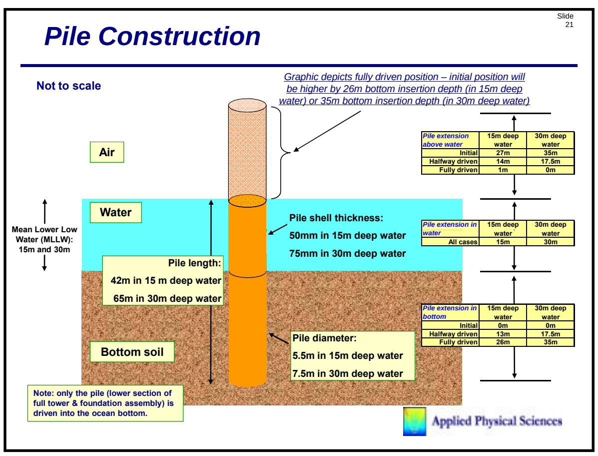
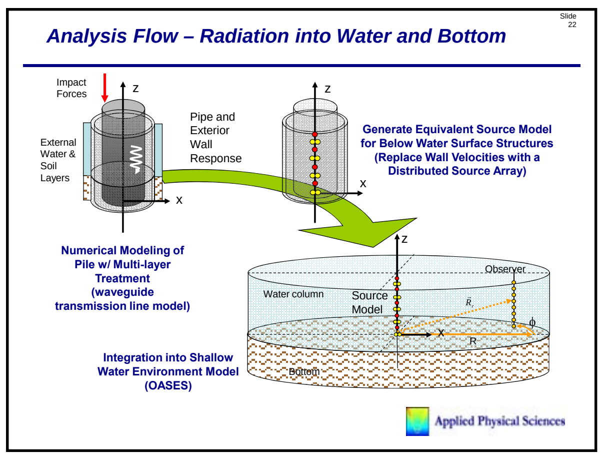
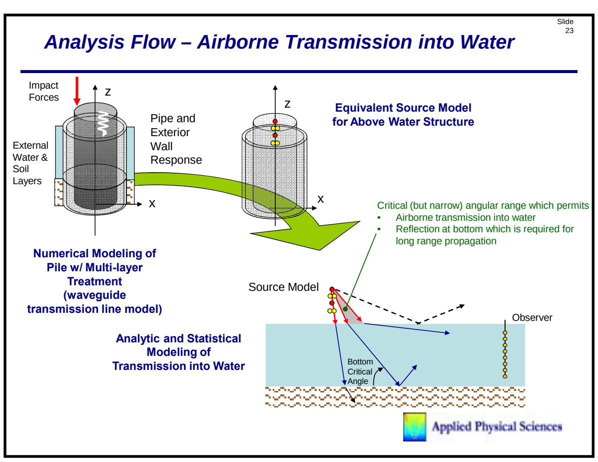
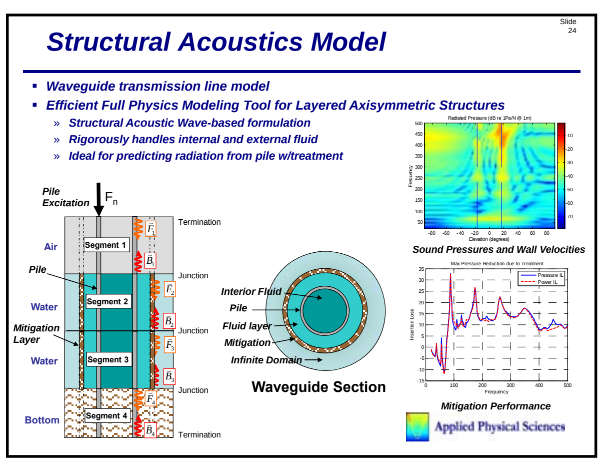








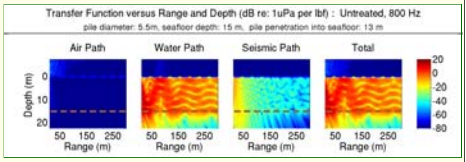




Slide 25

Sound Transmission

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 model
- The narrowband pressure and/or power caused by the acoustic and seismic sources may be compared to determine their relative importance.

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Atlantic Wind Energy Workshop – July 12-14, Herndon, Virginia

Evaluate the Effect of Turbine Period of Vibration Requirements on Structural Design Parameters TA&R 651

Dwight Davis
Dr. Martin Pollack
Brian Petersen

Hosted by the U.S. Department of the Interior
Bureau of Ocean Energy Management, Regulation, and Enforcement (BOEMRE)

Engineering Solutions Through Science

Slide 2

Outline

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

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Slide 3

Green Energy?

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Slide 4

Motivation

Turbines' construction fault found

A construction flaw in the foundations of sea based wind turbines was not discovered by inspectors

ONE OF THE MOST common foundations for sea-based wind turbines had a critical flaw but was nonetheless approved by a Nordic certification company, reports trade journal Ingeniøren.

Certification company Det Norske Veritas put its stamp of approval on several models of wind turbines using the 'single cylinder' construction design, which is entrenched into the sea bed.

But it has been found that the continued pressure on the mounting causes the coupling

Dong has164 turbines in Danish waters similar to the affected ones that were diagnosed in Holland

How can we avoid this for US offshore wind?

Source: The Copenhagen Post, April 7 2010

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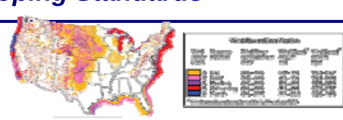
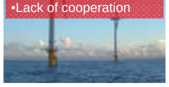
Slide 5

Developing Standards



Developing standards for US Offshore Wind requires careful synthesis of best design practices for similar structures.

European Offshore Wind
- Different soil
- No hurricanes
- Different METOC
- Emerging standards
- Lack of cooperation



Other Offshore Structures
- Different design criteria (fatigue)
- Different loading

Land-Based Wind
- No wave forcing
- Smaller gust forcing
- No scouring
- Shorter structure
- Lack of cooperation

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Slide 6

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?

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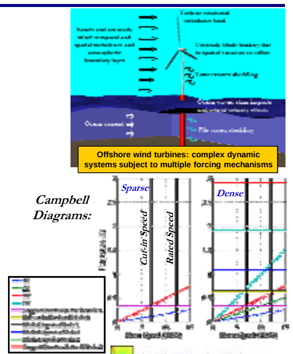
Slide 7

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



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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

Insights help inform vibration mitigation and resonance avoidance strategies

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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
  - » Most promising include magnetic gears and breakwaters
  - » Identified potential issues with novel concepts, such as floating turbines, jacketed foundations, and vertical-axis turbines

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Slide 10

Recommended Continued Work (1)

- APS has roadmapped several potential areas that would benefit from additional analysis and follow-on effort
  - » May be pursued independently but are not mutually exclusive in terms of potential benefit to community and BOEMRE

1. More thorough investigation of promising vibration mitigation and resonance avoidance strategies and novel technologies
   - Potential candidates include breakwaters and magnetic gears
   - Rely 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
   - Provides confidence that models used for design/analysis are appropriate
   - Support those involved in standards-compliance assessment

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Slide 11

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.

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Slide 12

Backup Slides

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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

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Technical Approach (2)

Forcing Functions
- Aerodynamic
- Hydrodynamic
- Machinery

Requires assumptions on wind, ocean, & operating conditions

Coupled Response

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

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

Requires stresses
- *Strength of matls.*
- *FEA models*

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

Design Impact:
- ***Fatigue***
- ***Ultimate strength***
- ***Practical concerns***

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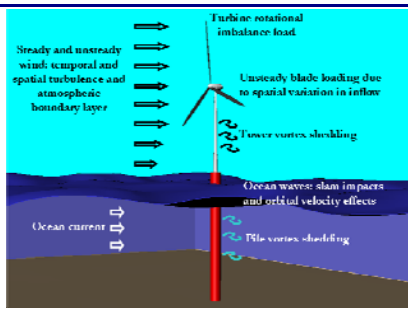
Offshore Wind Turbine System



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

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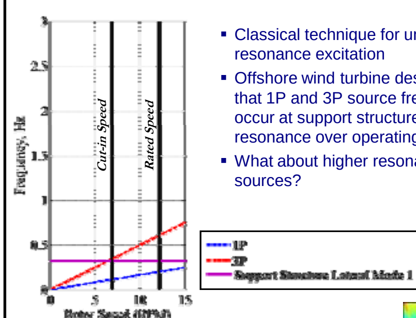
Design Practices (1)

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?

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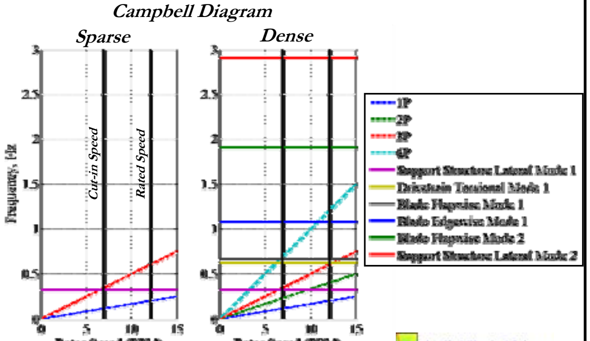
Design Practices (2)

Campbell Diagram



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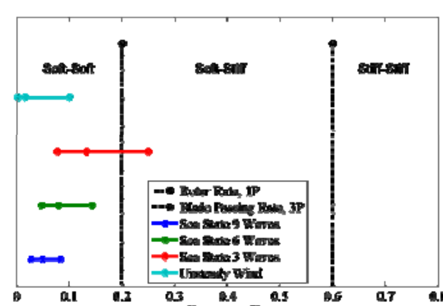
Design Practices (3)

Wind Turbine Resonance Diagram



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Design Practices (4)

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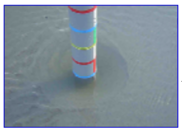
Soft-Stiff Designs Require:

More difficult installation processes

Larger, more expensive piles and towers



Static foundation properties

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Canonical Wind Turbine

Slide 20

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

Description	Value
Tower Length (m)	87.6
Foundation Depth (m)	25
Water Depth (m)	15
Pile Length (m)	40
Support Structure Length (m)	128
Tower Diameter (m)	
At RNA	3.87
At Pile	6
Tower Thickness (m)	
At RNA	0.025
At Pile	0.035
Pile Diameter (m)	6
Pile Thickness (m)	0.06

Description	Value
Design Wind Speed (m/s)	11.4
Rotor Speed (rad/s)	
Design	1.27
Cut-In	0.72
Rotor Diameter (m)	126
Rotor and Hub Mass (tonne)	110
Hub Mass (tonne)	56
Blade Mass (tonne)	18
Tower Mass (tonne)	347
Pile Mass (tonne)	663
Nacelle Mass (tonne)	240
RNA Mass (tonne)	350

Source: Jonkman et al, "Definition of a 5-MW Reference Wind Turbine of Offshore System Development," 2007

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Computational Tool Development (1)

Slide 21

- 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
    - Don't use industry-standard tools to assess deficiencies in state of the art
- 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

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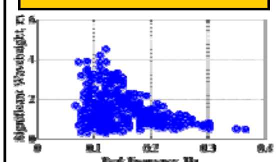
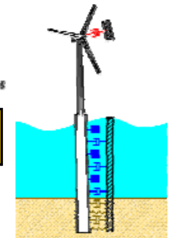
Computational Tool Development (2)

Slide 22

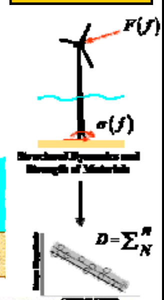
METOC Characterization



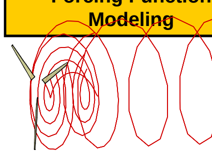
Structural Dynamics Modeling



Fatigue Life Estimation



Forcing Function Modeling

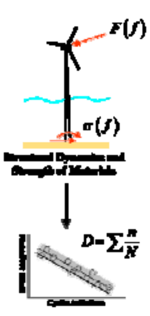


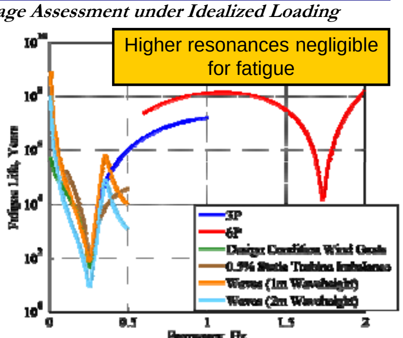
Applied Physical Sciences

Insight 1: Higher Resonances

Slide 23

Fatigue Damage Assessment under Idealized Loading



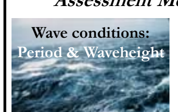


Applied Physical Sciences

Insight 2: Ambient Sources (1)

Slide 24

Assessment Methodology



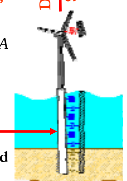
Wave Kinematics

Dynamic Stresses

Morison Equation

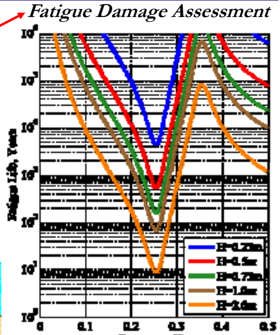
$$f = \rho C_m \alpha \, d\nabla + \frac{\rho}{2} C_d |u| u \, dA$$

Pile Forcing



Structural Dynamics and Strength of Materials

Fatigue Damage Assessment



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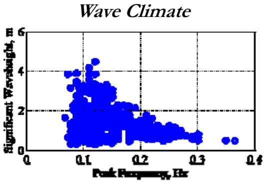
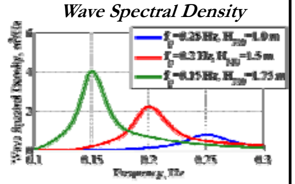
Insight 2: Ambient Sources (2)

Slide 25

Wave Climate



Wave Spectral Density



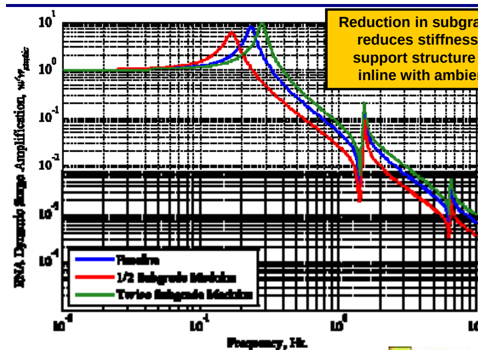
- Wave excitation is extremely important for the fatigue life of the system under certain conditions
- How common are conditions that excite the system into fatigue accumulating vibrations?
- Data collected in NOAA buoy near Block Island

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

Applied Physical Sciences

Insight 3: Reliance on Static Properties

Slide 26



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

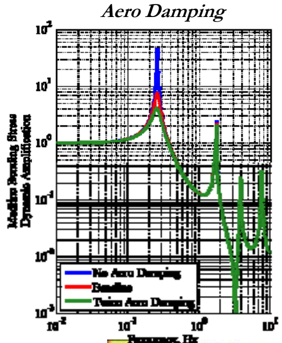
Applied Physical Sciences

Insight 4: Aerodynamic Damping (1)

Slide 27

- 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

Aero Damping



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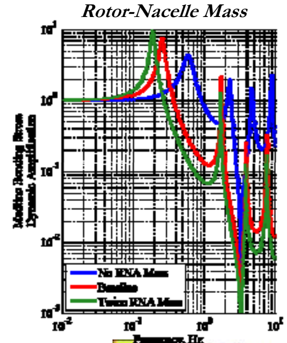
Insight 4: Aerodynamic Damping (2)

Slide 28

- How to maximize aerodynamic damping?
  - » Increase motion at RNA
- Reduce inertia of RNA
  - » Less massive gearboxes, generators, and blades
- Reduce support structure stiffness
  - » Increase length, reduce diameter/thickness
  - » A careful tradeoff study is required because reduction in stiffness can result in higher level excitation by ambient sources

Rotor-Nacelle Mass



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Strategies and Advanced Designs

Slide 29

- 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

Novel Turbines

Vertical Axis

Direct-Drive

Applied Physical Sciences

Gearbox-less Turbines

Slide 30

Concept

The mechanical gearbox is a component that requires ongoing maintenance and results in a large number of failures. It also contributes significantly to nacelle weight. Potential gearbox-less turbine concepts might improve the system design. These designs include direct-drive systems and magnetic gears.

- 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

Characteristic	Mechanical Gearbox	Direct Drive	Magnetic Gear
Stator Diameter, m	0.84	5.0	5.0
Total System Weight, tonne	5.25	45.1	24.1
Total Cost, million USD	2.4	2.7	2.5
Total Losses, MWh	763	739	513

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Vertical Axis Turbines

Slide 31

Concept

Use of vertical axis turbine might ease period of vibration requirements by eliminating 3P source. Significant research into these systems for land-based application was conducted at SANDIA in the latter part of the 20th century.

- 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, so
  - » 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

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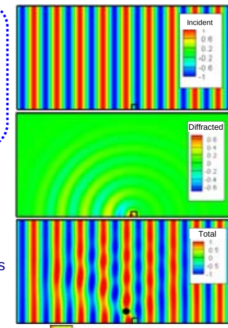
Breakwaters

Slide 32

Concept

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.

AEGIR Simulations



- 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

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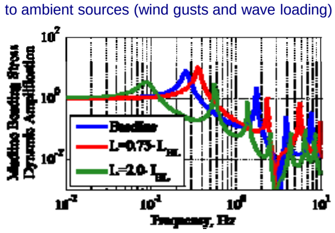
Jacketed Foundations

Slide 33

Concept

The use of a jacketed foundation can significantly increase the stiffness of the support structure, resulting in higher natural frequencies and significantly changing the structural dynamics and the excitation levels.

- 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)



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Ducted Turbine Designs

Slide 34

Concept

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

- 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
- Increase nacelle mass suggests reduction in aerodynamic damping effect

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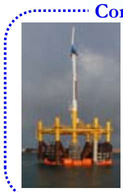
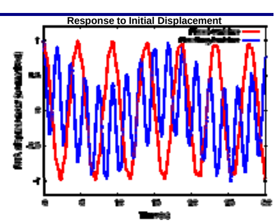
Floating Turbine

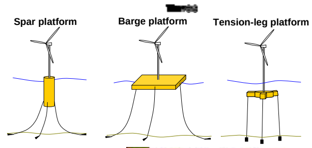
Slide 35

Concept



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 0.06Hz platform natural frequency
- Additional platform-dominated resonances complicate avoidance
- Multiple design approaches complicates general guidelines

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Regulatory Issues on Safety & Structural Assurance of Offshore Wind Farms on the OCS

TA&R 633 & TA&R 671

Bureau of Ocean Energy Management, Regulation and Enforcement

Offshore Risk & Technology Inc.
Malcolm Sharples

BOEMRE Requirements for Offshore Wind Projects

30 CFR 285 – "Renewable Energy & Alternate Uses of Existing Facilities on the OCS"

- Subpart A – General Provisions
- Subpart B – Issuance of Leases
- Subpart C – Rights of Way Grants/Easements
- Subpart D – Lease & Grant Administration
- Subpart E – Payments & Financial Assurance
- Subpart F – Plans & Information Requirements
- Subpart G – Facility Design, Fabrication, & Installation
- Subpart H – Env. & Safety Management, Inspections, & Facility Assessments

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 Management System

30 CFR 285.810

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 …..etc.…
  - Associated Procedures e.g. Marine Procedures for Jack-up Vessels on site
  - A Performance Monitoring and Auditing System
    Including Signatures by Snr Responsible Management
- Safety Design of Equipment

Safety Management System

- Policies: Importance of Safety
- Organization, Responsibilities and Resources
- Evaluation of Selection, Competence and Training of personnel
- Procedures for handling Change (MOC), energy isolation, fall protection, confined space, investigating accidents, PTW/ JSA, down to detail: testing potable water etc.
- Safety Meetings involving workforce
- Management Review
- How outstanding safety items get recorded and closed out
- BRIDGING DOCUMENTS for Multiple Vessels in field

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
- Communications
- Competence of personnel to safely operate the equipment
- Rescue from heights
- The following of Manufacturer's procedures when operating the turbines

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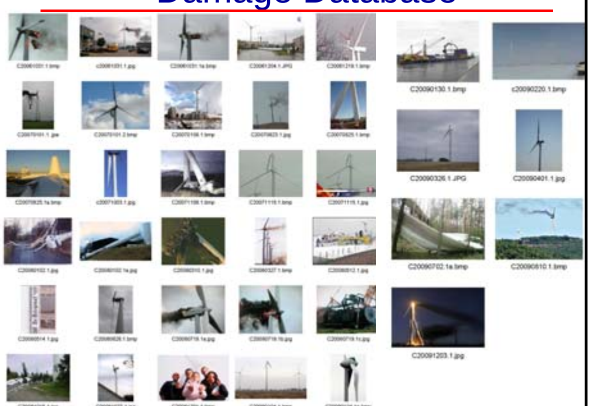
Oregon
1 Fatality
1 Injury

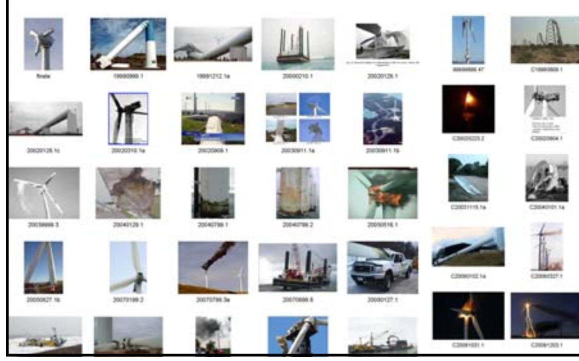
Follow Manufacturer's Instructions;
Experience
Training;
Lone Working

8

Damage Database



Damage Database



Overspeed III. Mechanical damages.

Root causes. Bad workmanship. Pitch system.

Notice the marks on the tower from one of the blades. When the nacelle crashed to the ground it was totally destroyed.

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.

Estimated costs. 1.300.000 Euro. Plus business interruption.

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Fire Protection: Mandatory?

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Lightning Protection: Mandatory?

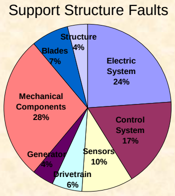
Pioneers – some of the issues

Offshore Denmark W.D. 6-14m.

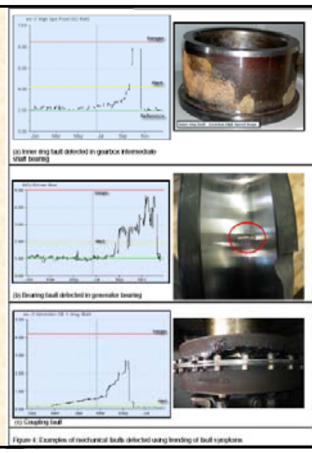
- Since 2002
- Issues with:
  - Cables
  - Lightning
  - Software & Control System (overspeed damaged blades)
  - Standstill marks (8) gearboxes
  - Transformers (insulation defect)
  - Defective Generators (production defects)
  - Quality (blades/ gears etc.)
  - Hydraulic System
  - Secondary Construction
  - Corrosion Protection
  - Terminal Strips (HR 2)

Condition Monitoring

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."

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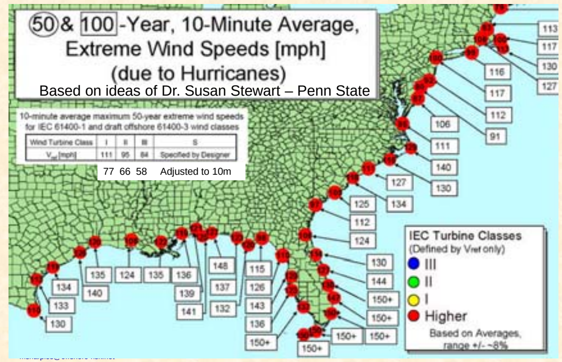
S-Class Turbines – 50 or 100 yr?



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?

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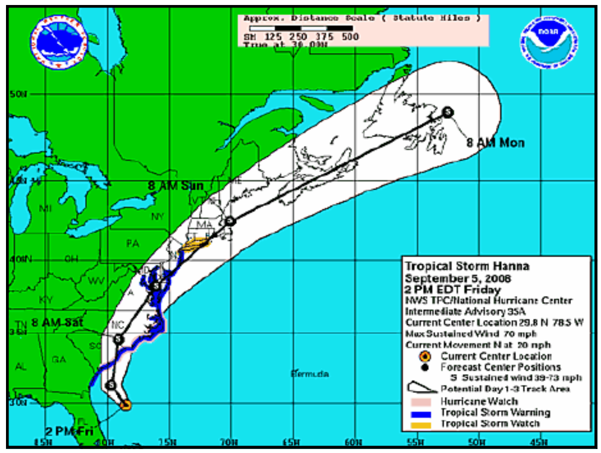

Provide: Design of Facility

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

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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.

The Devil is in the Details

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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 to).
- Design Verification–repeating calculations is costly: must accept Type Approval
- Assumptions are Critical; Competence in Certification is Critical
- Control Monitoring /Software mandatory for Structure survival?
- Corrosion Evaluation – should be part of the process

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HAZID:
Determine Site-Specific Load Cases

1. Parked with Fault

- 1- year return period storm? -Battery Life 6 hrs?
- (Japanese Guidelines?)

2. Other Conditions

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

Attendance of all Stakeholders required

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CFR Guidance to Design CVA

285.707

- 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 Req'ts
- Environmental Loads
- Load Determinations
- Stress analysis
- Material Designations

IEC Covers Load NOT Resistance

- Soil and Foundations
- Safety Factors and

Ensure USCG conditions are met for Floating Systems:

- Stability
- Foundations/ Anchorings (285.701)

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Surveillance Activities

Option 1 - Fabrication Check: (Type Cert.- accredited org.)	**Option 2 - Fabrication Check: (No Type Cert.)**	**Loadout/Transportation & Lifting Check:**	**Installation Check:**	**Commissioning Check:**
- Ensure per Facility Design Report -Type Certification for specific mfct location (Check Certification paperwork to ensure no exclusions in certs)	- Ensure per Facility Design Report. - Certified welder; Certified materials; Quality, Traceability, Weld Specs.; - Review of records, NDT and FAT as applicable (Check visually 10% - 15%: ramp % up or down with experience) - Repair per Spec.	- Ensure sign-off by Fabrication CVA - Attend first loadout/transport at marshalling area & offshore lift (10% - 15% thereafter) Visual 10% -15% at marshalling area prior to & during offshore loadout. - Conduct first batch site arrival survey & lift arrangement; (Ramp % up or down with experience) - Inspect before installation. (Verify mfct. lifting arrangements match the site situation)	- Final fitup and dimensional control (mainly tower and transitional pieces) checks; - Attend/witness first Installation and subsequently 10-15%; ramping up or down as appropriate (Welding Connection: 10% - 15% Visual inspection; ramp % up or down with experience) (Bolting Connection - see below) - Review of NDT records. - Ensure no damages or repaired to spec. - Ensure Records are kept (e.g. pile driving, bolt torque, grouting records etc.)	Attend first and then 10% of Commissioning tests or as per discretion of CVA.

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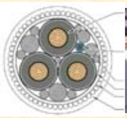
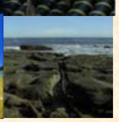
Submarine Cables for Windfarms

TA&R 671

The World Offshore Wind Database, Douglas-Westwood: 192 projects with a total of 69GW of capacity, 17000 turbines and US$108 billion of expenditure, including **40,000km of subsea cabling.**





Vattenfall UK Offshore Wind Power The Ormonde Wind Farm:
Construction Process For The UK"s First Full Scale 5 MW Offshore Wind Project
20th - 21st October 2010
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
- What don't investors like?
  - Uncertainty
- We are in control of
  - Foundations
  - WTG'S
  - Offshore Substations
- We are not in control of
  - Cable (confirmed by the insurance companies)

- Cable installation is the big challenge for the business and is where we have to focus
- There have been a tradition in the business for several years – I think it's time for a new tradition

15 VATTENFALL

Historical Incidents with Cables

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

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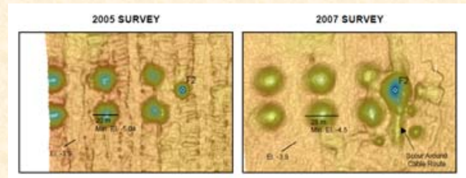
Scour from Jack-up Leg Holes



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

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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.

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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?

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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

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Cables: AC, HVAC, HVDC

Water depth: Armor size
Armor direction:
cable coil direction
Double armor:
maybe non-coiling
Armor: Rocky areas
Diameter of cable:
must fit vessel
Bending radius:
no damage for install
Bending radius:
J-tube constraint
Sheath: prevents moisture

Mainly Length and Power to be transmitted– determines AC ,HVAC or HVDC

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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.

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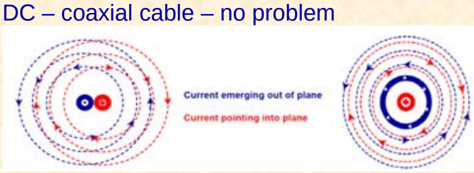
Target Cable Burial

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

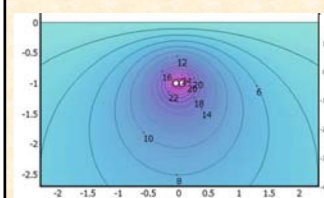
Electro-Magnetic Fields (EMF)

- 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

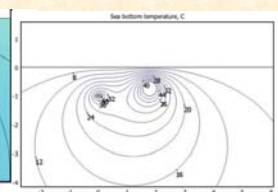


Ref: Greenpeace : Offshore Wind Energy - Implementing a New Powerhouse for Europe,

Cables and Heat



Temperature contours HVDC Cables



Cables and 50[0] pipeline- Ref Worzyk

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Seismic Risk in USA

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Norsok Marine Soil Investigation

APPLICATION	PERTINENT SOIL PARAMETERS (Properties required for S=Sand, C-clay, R=Rock)													
	Shear Strength	Friction angle	Relative Density	Particle size distribution	Permeability	Compressibility	Sensitivity	Cyclic Strength	Liquefaction Resistance	Rock Quality	Chemical Analysis	Electrical Conductivity	Thermal Conductivity	Backfill Properties
Scour/erosion	C	S	S	S			C		C/S					
Slope stability[1]	C	S	S	C/S										
Liquefaction	C	S	S	C/S	S	C/S								
Settlement	C	S	S			C/S								
Free span assessments[2]	C	S	S	S		S								
Dropped objects	C	S	S											
Shore approaches[3]	C	S	S	S			C	C/S	S	R	C/S		C/S	C/S
Corrosion											C/S	C/S		
Thermal insulation													C/S	
Plowing	C	S	S	S	S	S	C		C/S					
Jetting [1]	C	S	S	S	S	S	C		C/S					
Self-bury potential/ natural backfill	C	S	S	S	S	S	C		C/S			C/S		
Lateral resistance	C	C/S	S	S										

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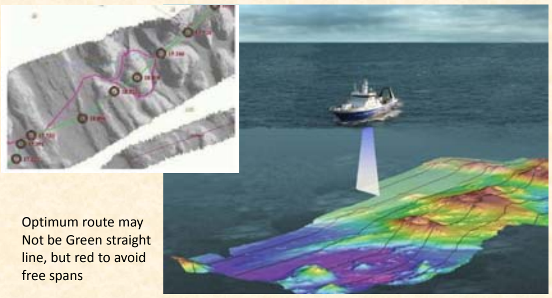
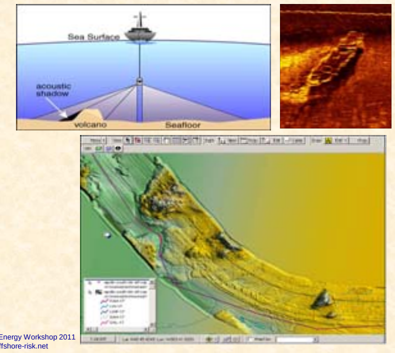
Tools to Determine Route



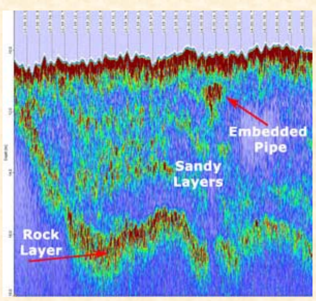
Optimum route may Not be Green straight line, but red to avoid free spans

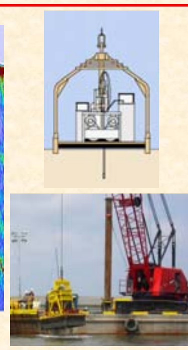
Multi-beam Echo sounder

Side Scan Sonar



Sub-Bottom Profiler + Soil Boring





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).

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?

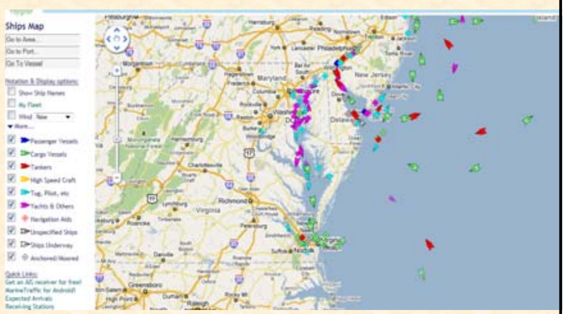
Navigation Risk Assessment

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 -

AIS Example of Information

http://www.marinetraffic.com/ais July 1, 2011



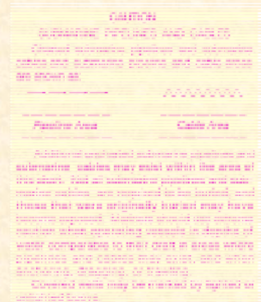
Cable Protection

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



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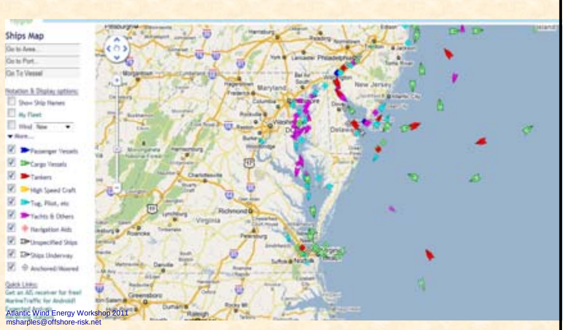
Monitor and Warn Ships

http://www.marinetraffic.com/ais July 1, 2011



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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""

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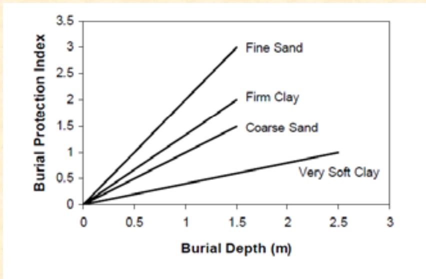
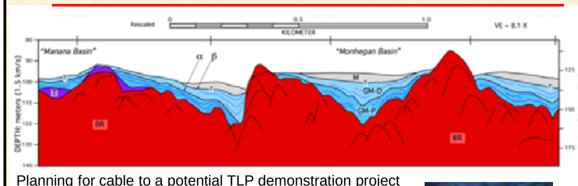
Burial Protection Index

Mole et al. 1997 SubOptic '97 Conference: Equivalent Reliability?



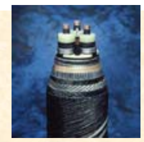
Rocky Terrain Offshore Maine:

Heavy Armoring required for Cable Protection



Planning for cable to a potential TLP demonstration project
(Courtesy Team Megan – Texas A & M University Student Project).

Double armor power cables
Courtesy ABB (via Worzyk)



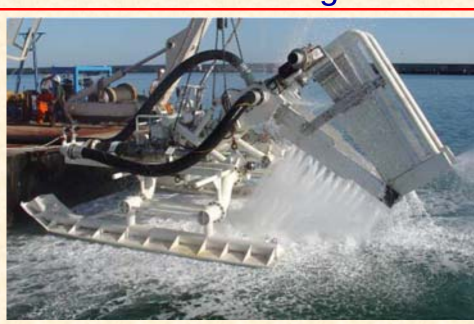
Vessel Selection is a Big Deal

- Weather capability/motions for local seastate
- Maneuvering - for inter-array cable
- Speed to complete in weather window
- Accommodation – so can stay out
- Warning 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 calcarite

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

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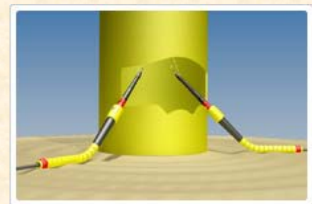
J-Tube or Teklink?



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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%

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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

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Installation Methods Improve

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IEC Code – Minimum in Green

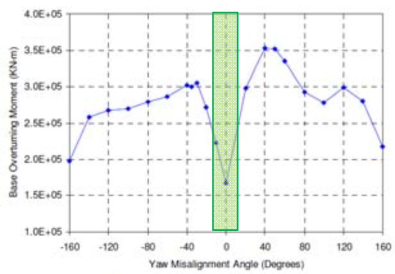


Figure 6: Effect of Yaw Misalignment under the 100-year Storm Conditions at a TX Offshore Site

Annotated from OTC Paper 21870 by Qing Yu, Lars Samuelsson and Pao-Lin Tan, ABS

SEABED SCOUR CONSIDERATIONS for Offshore Wind Development

TA&R Study 656

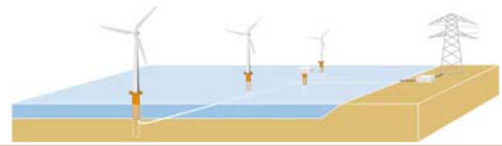
Fugro:
Tom McNeilan & Kevin Smith

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.



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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

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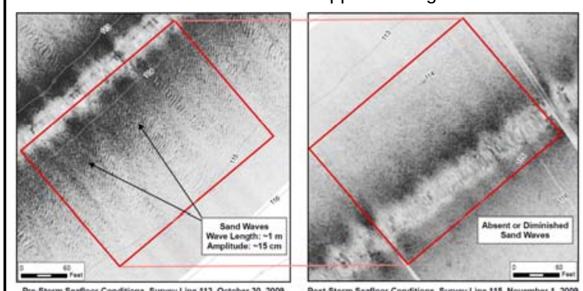
Small Scale Example of Sediment Trasport in Atlantic OCS

Documented obliteration of sand ripples during small storm



No surveying was performed on October 31, 2009 due to strong wind and rough-sea state.

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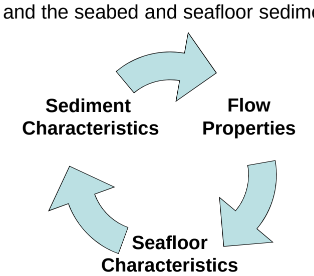
Sediment Mobility – a Natural Process

- Sediment Mobility - the interrelationship between the bottom currents (produced by oceanographic conditions) and the seabed and seafloor sediments



Bottom Currents (Flow Properties)
•Flow velocity (maximum and average)
•Forcing from tidal, wave, circulation, or mixed
•Fluid density, temperature, etc.
•Flow induces bottom stress that mobilize particles

Seafloor Characteristics
•Bottom roughness (skin friction and drag coefficient)
•Seafloor relief (cause eddies or channelized flow)

Sediment Characteristics
Particle size and geotechnical properties (e.g. cohesion)

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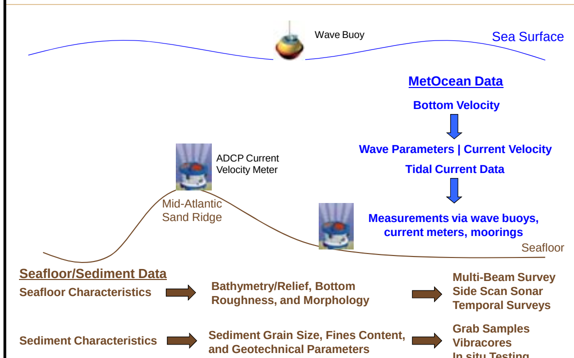
Requirements for Predicting Sediment Mobility



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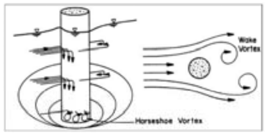
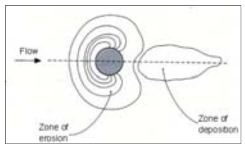
Scour

- 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.



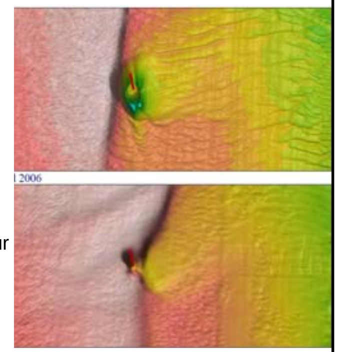


Scour Examples from Europe

Scour around a mono-pile

Trick question:
Which is earliest and which is latest survey?

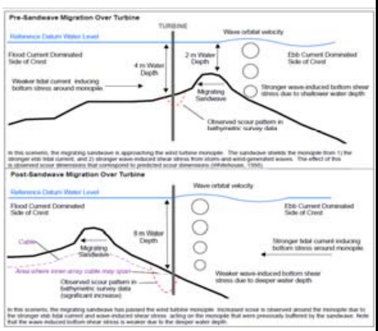
Answer:
Bottom Survey is last
And shows the former scour hole being infilled by a passing sand wave



Morphology and Migratory Bedforms

May be a positive or negative influence:

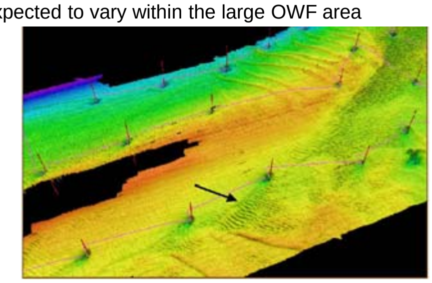
- Alter flow conditions and either promotes scour or protect foundation from strong flow causing scour
- Can infill scour pits, if feature migrates into scoured area
- But infilling may only be temporary as feature migrates away



Scour Examples from Europe

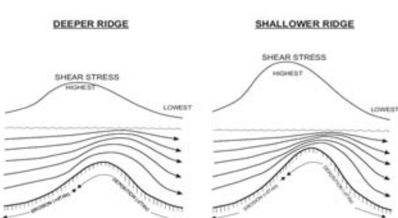
Scour within a windfarm area

Note: Offshore Wind Farms cover large areas – conditions should be expected to vary within the large OWF area



Seafloor Morphology and Water depth

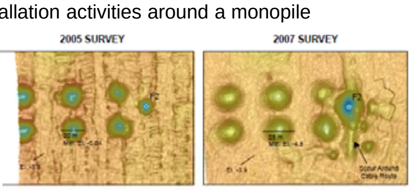
- Decrease in water depth can lead to higher velocity currents over seafloor features like sand ridges
- Processes that can change water depth
  - Erosion, accretion, or shifting of sand ridges and banks
  - Migrating sand waves and dunes

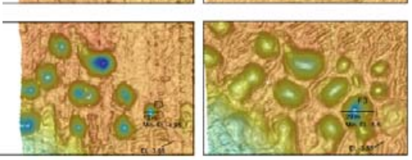


Scour Examples from Europe

Scour due to installation activities around a monopile

Note:
Spud can depressions have infilled but widened
Monopile scour has increased



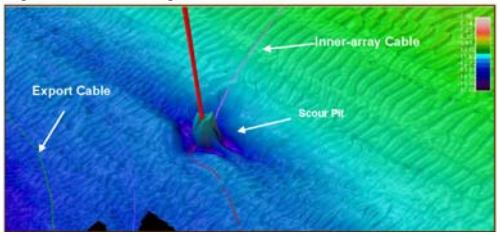


Scour Examples from Europe

Scour around a monopile

Note: potential for undermined cable at exit from J-tube

Undermining >> Spanning >> Vibrations (Strumming) >> chaffing >> cable damage



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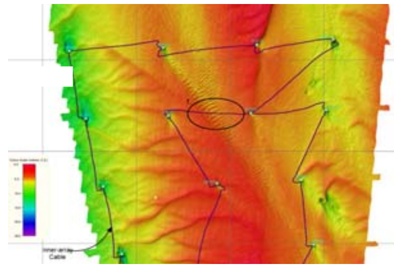
Scour Examples from Europe

Scour within a widfarm

Note: Sand waves in wake of monopile are affecting nearby inner array cables



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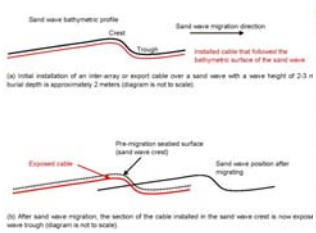
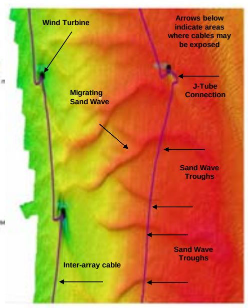
Scour Examples from Europe

Migrating Bedforms and Cable Hazards





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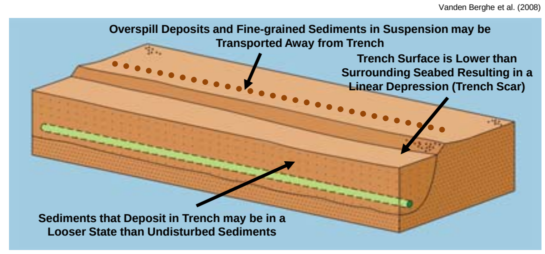
Jet-Trenching Mechanism and Scour

- Jet-trenching
  - Sediments infilled in trench are in a looser state
  - Modifies seafloor topography

Vanden Berghe et al. (2008)



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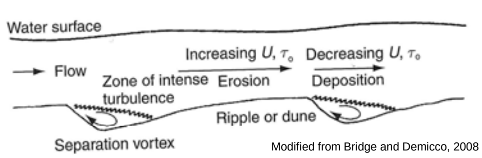
Seafloor Character and Flow Velocity



Modified from Bridge and Demicco, 2008

U = flow velocity
τ_o = bed shear stress

Flow over uneven surface may produce vortices that can concentrate erosion in depressions or trenches, depending on the flow strength and sediment characteristics

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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

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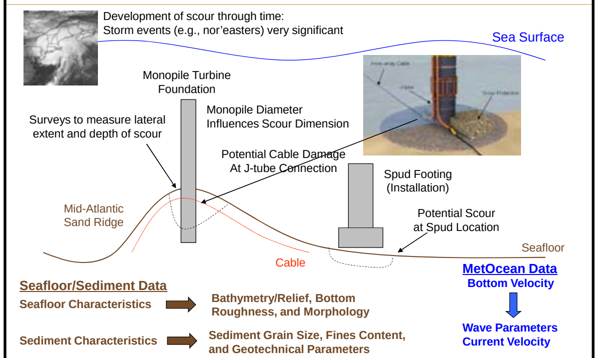
Requirements for Scour Assessment



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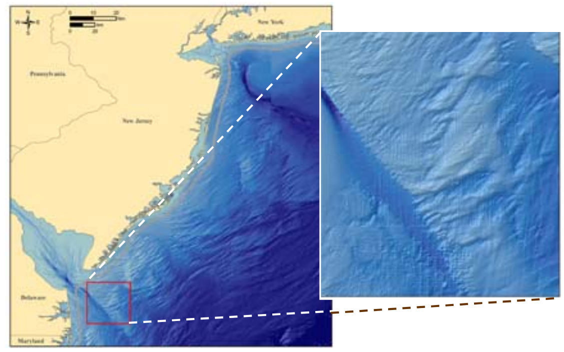
Seafloor Conditions in Mid-Atlantic



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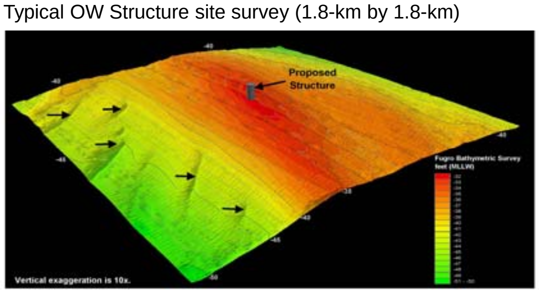
Seafloor Conditions in Mid-Atlantic

Typical OW Structure site survey (1.8-km by 1.8-km)



Note: At least 3 different scales of bottom topography (geomorphology)

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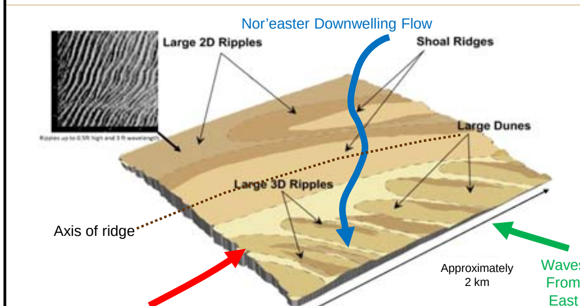
Seafloor Conditions in Mid-Atlantic



3 scales of bedforms indicate 3 different flow conditions of varying direction, duration, and magnitude

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Implications for US Offshore Wind Development

- Sediment transport & scour are complex phenomina
  - Changes in the seafloor are due to the complex interactions between the ocean and the seafloor
  - Require intgration of oceanographics and geosciences
  - Occur on spatial scales that vary across a OWF
  - Both normal and event-driven considerations
- The Atlantic OCS is conditins are not uniform
  - Wave-driven phenomina and tidal forces can both be important
  - Broad knowledge is available, but site- and project-specific data are limited – BOEMRE's *Fronteer Area* designation is appropriate

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Recommendations

- Define spatial and temporal variation of bottom currents at (and within) the OWF site (and export cable route)
  - Both normal equilibrum 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

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TA&R 656 Report

- 50 pages, 40 figures, 3 Apendices
- 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

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Thank You

MMS TA&R 627 and 650

Inspection Methodologies for Offshore Wind Turbine Facilities

Offshore Wind Turbine Inspection Refinements

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July 12, 2011

Atlantic Wind Energy Workshop

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

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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**

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TA&R 627 Work Scope Summary

Task 1

Survey Existing Data
- Public data
- Guidelines, codes
- Frame scope and approach

Task 2

Subject Matter Experts
- Highlight current practice
- Define differences from offshore oil and gas practice

Task 3

Recommended Inspection Guidelines
- Frequencies
- Critical Areas
- Inspection techniques

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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

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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.

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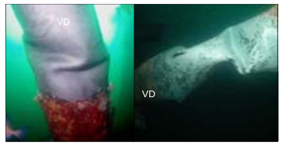
Recommended Inspection Guidelines
Subsea Structure

- 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 survey of critical areas such as connections and seabed scour



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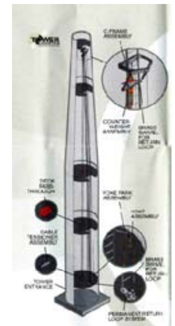
Recommended Inspection Guidelines
Above water structure and access systems

- 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



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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

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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

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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

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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

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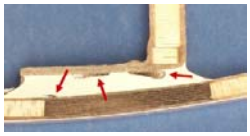
Blade Inspection – Types of Degradation

- **Manufacturing-related degradation**
  - Delaminations
  - Bond failures
  - Cracks



Bond Voids

- **In-Service degradation**
  - Lightning
  - Leading edge erosion
  - Other impact damage

Leading Edge Erosion

Lightning Strike

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

Traditional Rope Access

Asmus® Suspended Platform

Inspection Refinements
Blade Inspections

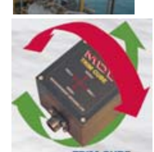
- Expert consensus is that external blade damage is the most prevalent in-service damage
  - lightning strikes, edge erosion, etc.
  - can generally be identified by visual inspection.
- Internal blade damage identified based on
  - abnormal power performance data or condition monitoring data
  - through 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

Tower Inclination Measurement

- Visual inspection of the facility may provide an indication of the extent of facility lean
- Capturing this data and quantifying the inclination with photographs is challenging due to:
  - Inability to accurately project a 3-D structure onto a 2-D image
  - Photographic effects make accurate measurements difficult
- Techniques exist that would provide a direct measurement of the facility lean
  - Acoustic positioning systems
  - Magnetic level bubbles
  - Trim Cubes – Measure inclination via electrolytic gravity sensors
  - Bi-Axial inclinometers – Can be permanently mounted (tower or nacelle) and read remotely via existing data systems on facilities



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

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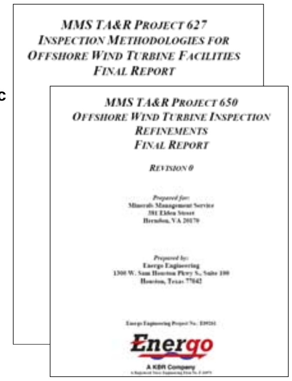
TA&R 627 and 650 Summary

- 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


MMS TA&R PROJECT 627
INSPECTION METHODOLOGIES FOR
OFFSHORE WIND TURBINE FACILITIES
FINAL REPORT

MMS TA&R PROJECT 650
OFFSHORE WIND TURBINE INSPECTION
REFINEMENTS
FINAL REPORT

REVISION 0

Prepared for:
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Energo
A KBR Company

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Atlantic Wind Energy Workshop

Herndon, VA
12 July 2011

TA&R 669 Floating Wind Turbines TA&R 670 Design Standards for Offshore Wind Farms

Qing Yu
Managing Principal Engineer
ABS

1

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

2

TA&R 669 Floating Wind Turbines

3

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

4

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

5

Project Plan

Task No.	Month											
	1	2	3	4	5	6	7	8	9	10	11	12
1												
2												
3												
4												
5												

- **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

6

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

7

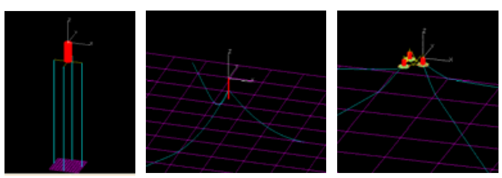
Task 2: Case Study

- 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

8

Task 2: Case Study

Selected Conceptual Designs



NREL TLP | IEA-OC3 Spar | WindFloat Semi

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Task 2: Case Study

Metocean Conditions

- GoM Central Region – API INT MET
- Northern CA and ME – NOAA NDBC Buoy Data

10

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

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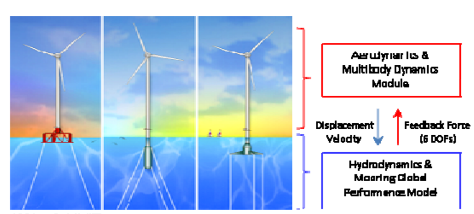
Task 2: Case Study

Coupled Global Responses



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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

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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

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Workshop

- Workshop with attendees from the industry, academia, government and regulatory agencies
- Workshop report
- Recommendations for future study and enhancement of draft design guideline

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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

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Scope of Work & Project Planning

Task No.	Month											
	1	2	3	4	5	6	7	8	9	10	11	12
1	■	■	■									
2			■	■	■	■						
3							■	■	■			
4										■	■	
5											■	■

- **Task 1:** State of the art review
- **Task 2:** Effect of tropical hurricane in US waters
- **Task 3:** Breaking wave slamming loads
- **Task 4:** Draft recommendations
- **Task 5:** Final report

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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

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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

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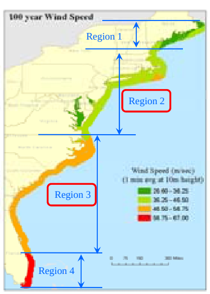
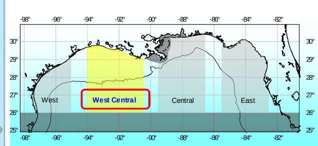
Task 2: Tropical Hurricane Effects

Regional Metocean Conditions





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Task 2: Tropical Hurricane Effects

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

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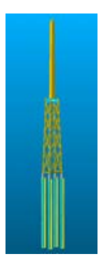
Task 2: Tropical Hurricane Effects

Support Structures


Monopile


Tripod


Jacket

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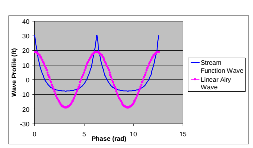
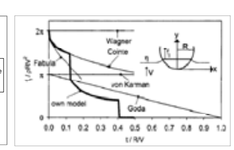
Task 3: Breaking Wave Slamming Loads

- 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





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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

25

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

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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

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Virginia Tech Advanced Research Institute
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Presentation Outline

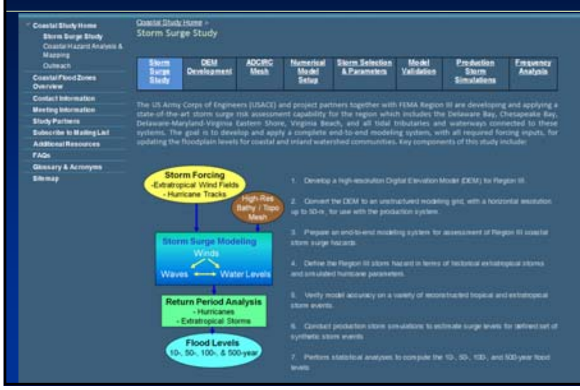
Task by Task overview

- *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*

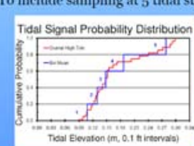
FEMA Region III Storm Surge Study

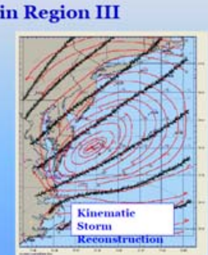


FEMA Region III Storm Surge Study

Objective 1: Identify and reconstruct historical extratropical storms in Region III

- Selection based on water levels at 7 stations
- Total of 31 historical storms 1975-2009
- Kinematic reanalysis of all wind fields
- Empirical Simulation Technique (EST) used for return period calculations
- To include sampling at 5 tidal stages

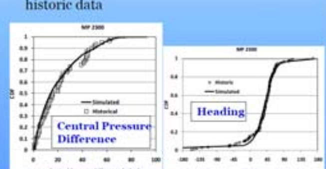


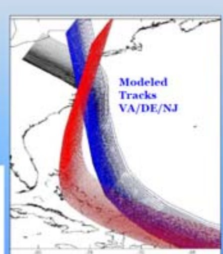


FEMA Region III Storm Surge Study

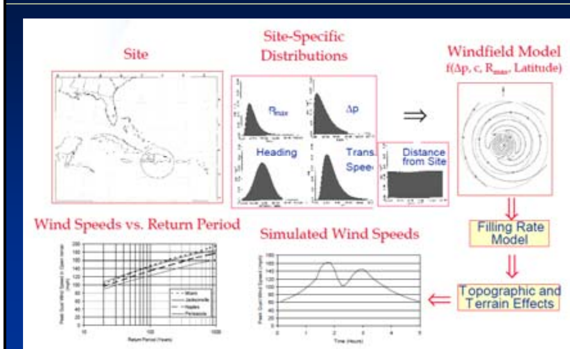
Objective 2: Develop a representative set of synthetic hurricanes

- Record of 20 hurricanes in 60 years insufficient for 100- and 500-yr computations
- Synthetic storm set used to develop landfall frequencies and hurricane parameters
- Demonstrated validity with comparisons to historic data

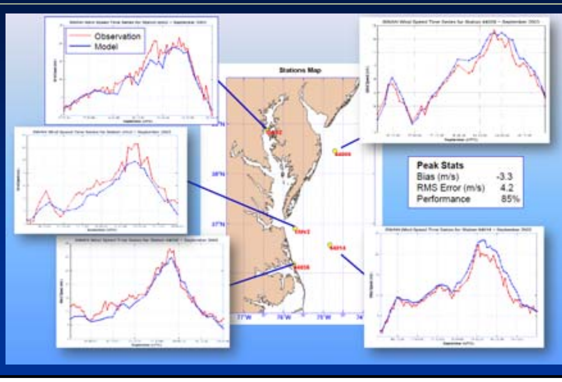




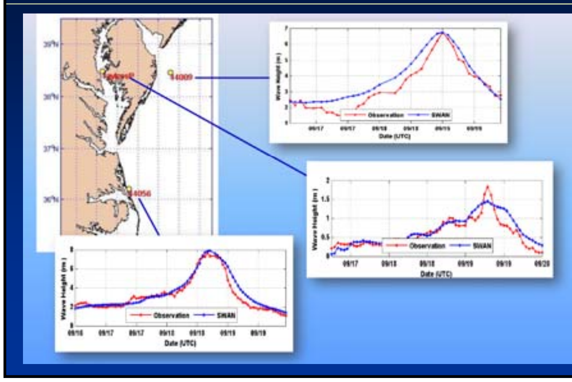
Synthetic Hurricane Wind Hindcasting



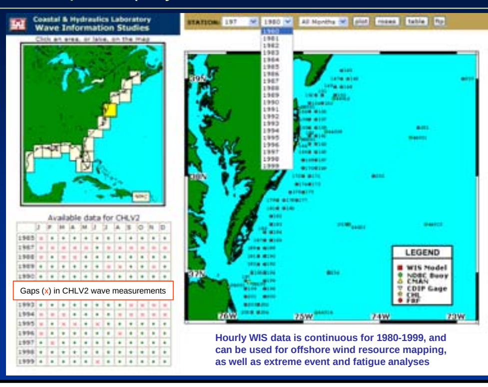
FEMA Region III Storm Surge Study
Preliminary Validation of Mean Wind Speeds



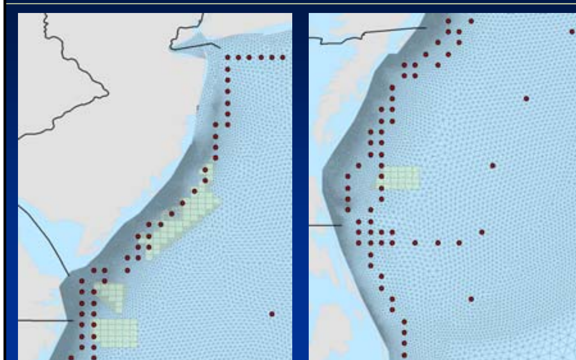
FEMA Region III Storm Surge Study
Preliminary Validation of Significant Wave Heights



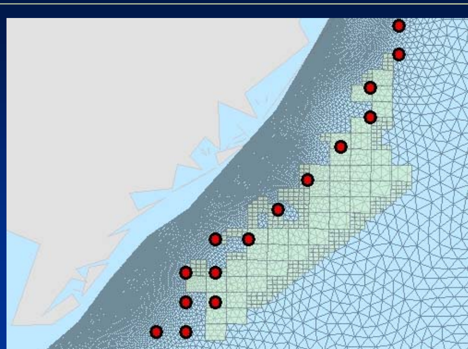
US Army Corps of Engineers Wave Information Studies, WIS (20 years of wind and wave hindcast data)



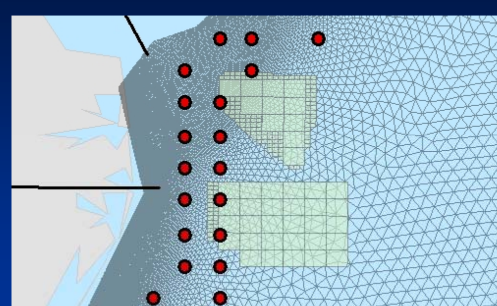
FEMA Region III Storm Surge Study
ADCIRC Mesh and WIS Grid Points



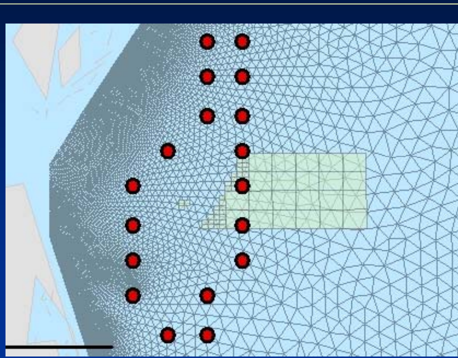
ADCIRC Mesh and WIS Grid Points
– New Jersey Wind Energy Area



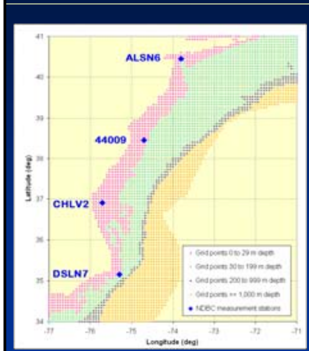
ADCIRC Mesh and WIS Grid Points
– Delaware and Maryland WEAs

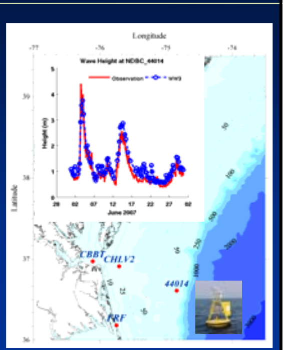


ADCIRC Mesh and WIS Grid Points – Virginia Wind Energy Area



Wavewatch III Offshore Wind and Wave 30-Year Reanalysis (1980 through 2009) by NCEP

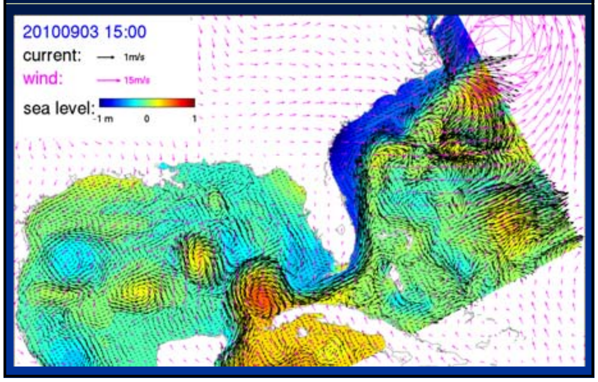




Measured Current Datasets

Mooring	Institution	Instrument	Depth	Extra-tropical Storms from FEMA Region III Storm Surge Study			
COBY	ODU	ADCP	3-32	28-Oct-2006	22-Nov-2006		
Hudson Shelf	USGS	ADCP	2-30	25-Jan-2000			
		ADCP	2-30				
FRONT	UCONN	ADCP	2-30				
		ADCP	2-35				
		ADCP	2-40				
		ADCP	2-50				
		ADCP	2-30				
		ADCP	2-35				
		ADCP	2-40				
		ADCP	2-50				
OMP A	STONYBROOK	ADCP	7,35,61				
		ADCP	10,20,30,35				
		ADCP	16,36,56,71				
OMP B	STONYBROOK	ADCP	10,18,24	09-Oct-1996			
		ADCP	7,35,61				
		ADCP	16,36,56,71				
CMO	WHOI	ADCP	22,129	09-Oct-1996			
MMS-NC	MMS	Current meter	5,15	11-Dec-1992	05-Mar-1993	28-Nov-1993	04-Jan-1994
		Current meter	5,20,30				
		Current meter	5,30,55				
		Current meter	5,15				
		Current meter	5,20,30				
		Current meter	5,30,55				
		Current meter	5,15				
		Current meter	5,20,30				
		Current meter	5,30,55				
		Current meter	5,30,55				

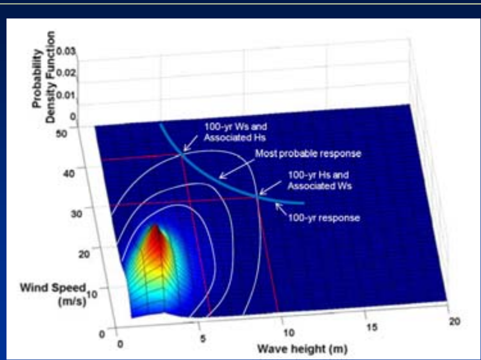
Water Level and Wind-Driven Current Forecasts for Hurricane Earl, 03 Sep 2010



Topics for Expert Group Peer Review and Feedback

Topic A: Science-Based Derivation of Design Load Case Metocean Parameters: Hindcast models yield wind speed and direction as 10-minute averages at 10 m above sea level, whereas the Design Load Cases (DLCs) in IEC 61400-3 require wind speed and direction at turbine hub height, and specify different averaging periods and turbulence characterizations according to the particular DLC. IEC 61400-3 also specifies deterministic heights and periods for individual extreme waves to be derived from hindcast sea state parameters. Our first expert group workshop will review and provide feedback on the project team's proposed application of storm wind shear profiles and gust factors, as well as individual wave probability distributions within a given sea state to derive these DCL parameters. We also will seek feedback on our proposed approaches for obtaining (1) more accurate "reduced" wave heights to be used in combination with extreme wind speeds; (2) more accurate "reduced" wind speeds to be used in combination with extreme wave heights; (3) the severe sea state model to be used for DLC 1.6, when turbines may be normally operating in extreme swell waves generated by approaching hurricanes; (4) derivation of surface current velocities from storm wind velocities and associated sub-surface current speed profiles; and (5) improved definition of wind-wave misalignment scenarios.

"Reduced" Wind Speeds and Wave Heights



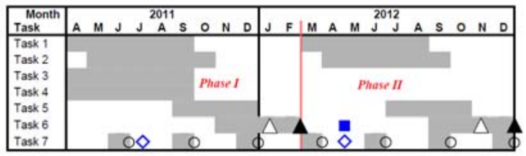
Topics for Expert Group Peer Review and Feedback

Topic B: Incongruity among New and Evolving Standards: By unambiguously assigning appropriate return periods to the DLCs in IEC 61400-3, as modified for consistency with GL and API RP 2MET and acceptable risk for different offshore wind farm components, we propose to eliminate or minimize the use of disparate multipliers such as "load factors" and "exposure factors" and instead use return period as the single factor to characterize exposure and consequence risk for derived metocean parameters. To arrive at consensus for what these return periods should be, we propose to convene two expert group workshops with participants invited from the BOEMRE-funded National Academies study and the AWEA offshore wind standards road-mapping exercise, as well as representation from IEC 61400-3, Germanischer Lloyd, American Bureau of Shipping, and API RP 2MET.

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 its return period over a large region might be less than 100 years. The four Wind Energy Areas of the southern Mid-Atlantic Bight could have multiple projects using the same turbine model, and projects, *area risk* may be more appropriate for type certification, whereas *point risk* may be more appropriate for project certification. By practical necessity, type certification can only cover a few categories, such as the IEC 61400-1 Class I, II, and III, and our second expert group workshop will take up the question of whether new turbine type certification categories should be developed for the southern Mid-Atlantic Bight, based on our interim results.

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!

Email: hagerman@vt.edu

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

2

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

3

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

4

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

5

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)

6

Load Cases: Overview

- Ultimate loads/fatigue loads
- Normal conditions/unusual conditions
- Operating/non-operating

7

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

8

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

9

Example: Power Production DLCs

Design situation	DLC	Wind condition	Waves	Wind and wave directionality	Sea currents	Water level	Other conditions	Type of analysis	Partial safety factor
1) Power production	1.1	NTM $V_{in} < V_{hub} < V_{out}$ RNA	NSS $H_s=E[H_s\| V_{hub}]$	COD, UNI	NCM	MSL	For extrapolation of extreme loads on the RNA	U	N (1,25)
	1.2	NTM $V_{in} < V_{hub} < V_{out}$	NSS Joint prob. distribution of H_s,T_p,V_{hub}	COD, MUL	No currents	NWLR or ≥ MSL		F	*
	1.3	ETM $V_{in} < V_{hub} < V_{out}$	NSS $H_s=E[H_s\| V_{hub}]$	COD, UNI	NCM	MSL		U	N
	1.4	ECD $V_{hub} = V_r – 2$ m/s, V_r, $V_r + 2$ m/s	NSS (or NWH) $H_s=E[H_s\| V_{hub}]$	MIS, wind direction change	NCM	MSL		U	N
	1.5	EWS $V_{in} < V_{hub} < V_{out}$	NSS (or NWH) $H_s=E[H_s\| V_{hub}]$	COD, UNI	NCM	MSL		U	N
	1.6a	NTM $V_{in} < V_{hub} < V_{out}$	SSS $H_s= H_{s,SSS}$	COD, UNI	NCM	NWLR		U	N
	1.6b	NTM $V_{in} < V_{hub} < V_{out}$	SWH $H = H_{SWH}$	COD, UNI	NCM	NWLR		U	N

10

IEC 61400-3 Load Analyses

- Maximum **strength**
- **Fatigue** failure
- **Stability** analysis (e.g. buckling)
- **Deflection** (e.g. preventing blades from striking tower)

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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

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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

$$f_d = \frac{1}{\gamma_m} f_k$$

13

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

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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)

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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

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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

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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

18

Action Items: New Material

11	General review of safety factors (& return period)
12	Use of Charnock rel.
13	Ice loading
14	Vortex induced vibration
15	Review Cd, Cm guidance
16	Review of wind site assessment (including ETM & cyclone / hurricane)

19

Action Items: Review of DLCs

17	Wind-wave misalignment, all DLCs
18	Grid-loss periods - define minimum outage / availability
19	Review ice DLCs
20	Review SSS - provide simpler guidance
21	DLC1.2: currents, methods for wind wave combination
22	Reduce no. Stoch. Simulations with NSS (identify RNA or SS driving)
23	DLCx.x, embedded wave, move definition of X.Xa-c elsewhere
24	DLC for boat impact: O&M vessels

20

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

TRANSPORTATION RESEARCH BOARD
OF THE NATIONAL ACADEMIES

Structural Integrity of Offshore Wind Turbines:

Oversight of Design, Fabrication, and Installation

Presentation by
Walt Musial
Principal Engineer
Manager of Offshore Wind Energy
National Renewable Energy Laboratory

Report dated April 26, 2011

TRB Committee (9 members)

R. Keith Michel, Herbert Engineering Corporation, Alameda, California, *Chair*
Bruce R. Ellingwood, Georgia Institute of Technology, Atlanta
George M. Hagerman, Jr., Virginia Coastal Energy Research Consortium, Virginia Beach
Jan Behrendt Ibsoe, ABS Consulting, Inc., Houston, Texas
Lance Manuel, University of Texas at Austin
Walt Musial, National Renewable Energy Laboratory, Golden, Colorado
Robert E. Sheppard, Energo Engineering, Houston, Texas
Emil Simiu, National Institute of Standards and Technology, Gaithersburg, Maryland
Susan W. Stewart, Pennsylvania State University, State College
David J. Wisch, Chevron Energy Technology Company, Houston, Texas

Staff Madeline G. Woodruff, Study Director

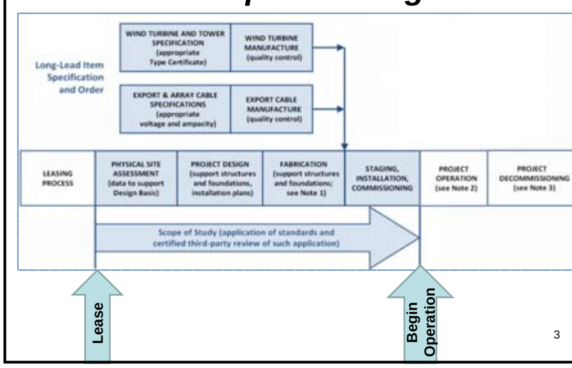
1

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.

2

Scope of Study - Project Development Stages



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Task 1
Standards and Practices

4

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.

5

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

6

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**

7

Comparison of Level of Risk

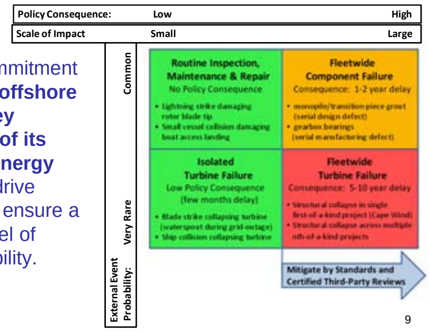
Offshore wind farm pollution and human safety risks are relatively low.

	Level of Risk		
Energy Industry	Liquid Hydrocarbon Release	Life Safety: Normal Operations	Life Safety: Design Conditions
Oil and gas—shelf	M	L	M
Oil and gas—"frontier"	H	M	H
Land fossil (coal and natural gas), Texas	VL	L	M
Land fossil (coal and natural gas), Cook County, Illinois	VL	L	M
Land wind facility	VL	VL	L
Offshore wind[a]—"tower"	L	VL	L
Offshore wind[b]—central platform	L	L, M[c]	M
Offshore liquefied natural gas terminal	VL	H	H
Land liquefied natural gas terminal	VL	H	H

8

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.



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Task 2
Role of Certified Verification Agents (CVAs)

10

CVAs for Oil & Gas Facilities

- A two-tier oversight process administered by BOEMRE.
  - <u>**Lower complexity**</u> facility plans are stamped by a professional engineer and checked by BOEMRE f
  - <u>**Complex structures**</u> **- Certified Verification Agents (CVA) are used** (e.g. deepwater, floating structures).

11

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

12

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.

13

Task 3 CVA Qualifications

14

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.

15

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

16

NJDEP Ocean/Wind Power Ecological Baseline Studies

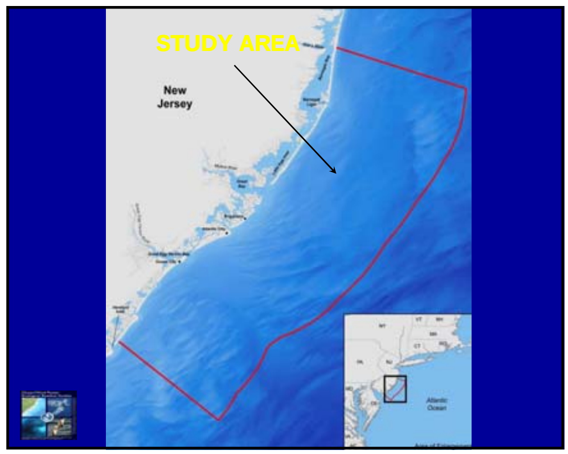
Atlantic Wind Energy Workshop

July 13, 2011

Gary A. Buchanan, Ph.D.
Office of Science
New Jersey Department of Environmental Protection

Specific Objectives – Fill Data Gaps

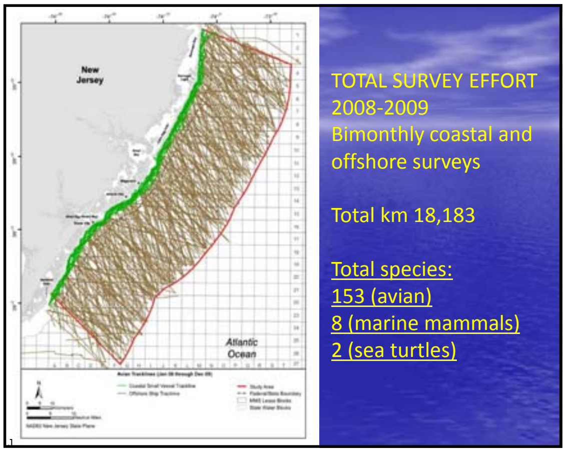
- In the Study Area, what are the abundance, distribution, and utilization of:
  - Bird Species (flight behavior)
  - Marine Mammals
  - Sea Turtles
- What areas are more/less suitable for renewable energy projects based on potential ecological/environmental impacts?
- Two year study (2008-2009): ~$7M



Field Studies & Data Compilation

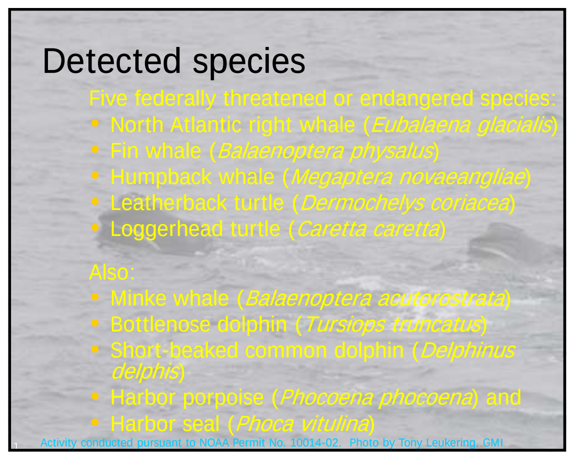
- Three Primary Targets:
  - Avian
  - Marine Mammal
  - Sea Turtle
- Supporting Studies:
  - Oceanographic
  - Fish and Fisheries Data
  - Benthic Mapping
  - GIS & Modeling


Photo by Tony Leukering, GMI

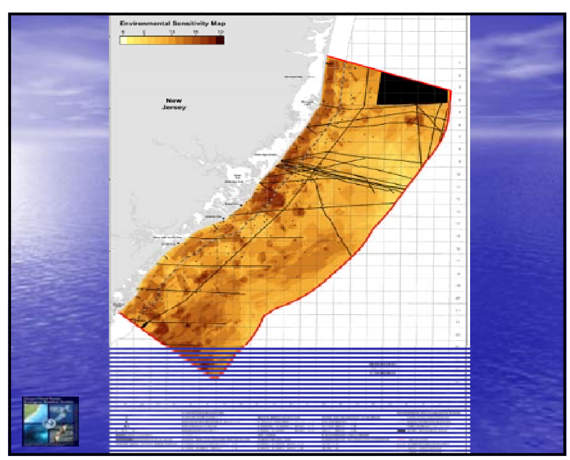

New Jersey
Atlantic Ocean
TOTAL SURVEY EFFORT
2008-2009
Bimonthly coastal and offshore surveys
Total km 18,183
Total species:
153 (avian)
8 (marine mammals)
2 (sea turtles)


Avian Radar

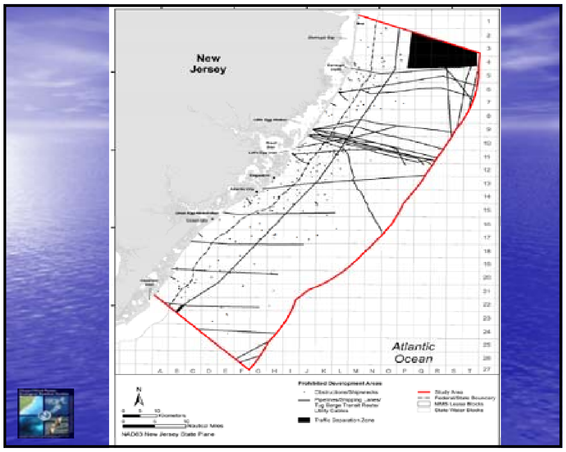

GEO-MARINE INCORPORATED
Mobile Avian Radar System
MARS

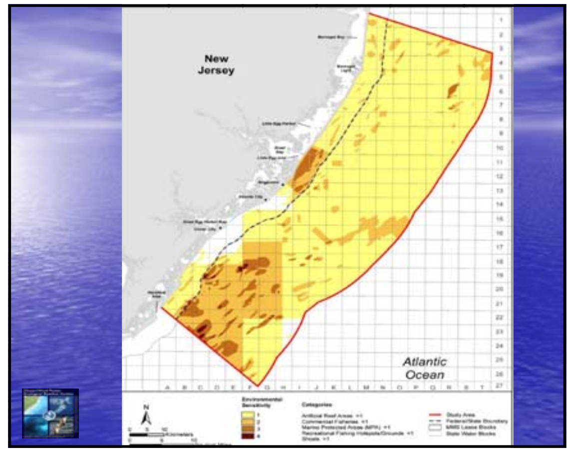

Detected species
Five federally threatened or endangered species:
North Atlantic right whale (Eubalaena glacialis)
Fin whale (Balaenoptera physalus)
Humpback whale (Megaptera novaeangliae)
Leatherback turtle (Dermochelys coriacea)
Loggerhead turtle (Caretta caretta)
Also:
Minke whale (Balaenoptera acutorostrata)
Bottlenose dolphin (Tursiops truncatus)
Short-beaked common dolphin (Delphinus delphis)
Harbor porpoise (Phocoena phocoena) and
Harbor seal (Phoca vitulina)
Activity conducted pursuant to NOAA Permit No. 10014-02. Photo by Tony Leukering, GMI

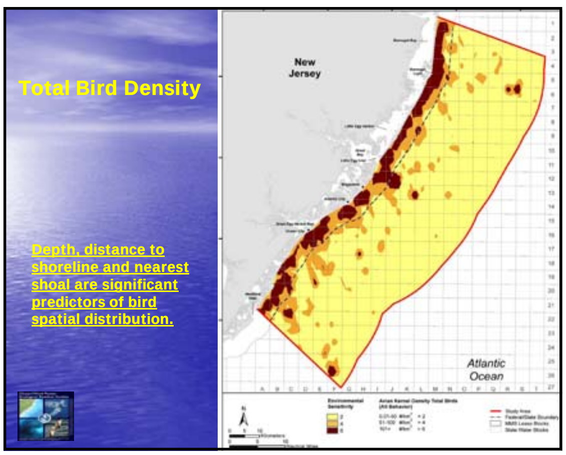

Sensitivity Map
Simple weighting of GIS layers by natural & physical resources
More heavily shaded areas indicate greater potential for impacts
Used for input to BOEMRE for Call for Information and Nominations for Commercial Leasing for Wind Power on the Outer Continental Shelf Offshore New Jersey

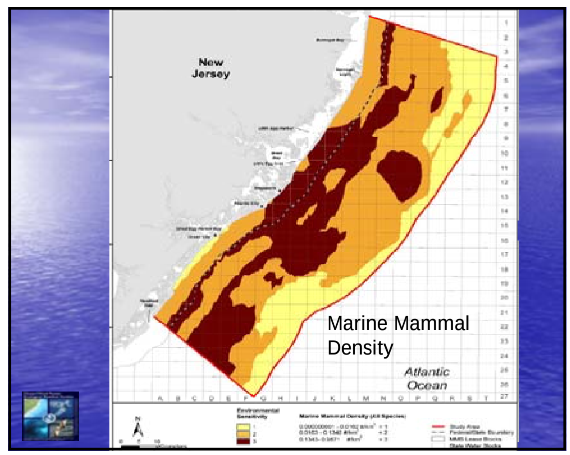

Environmental Sensitivity Map
New Jersey

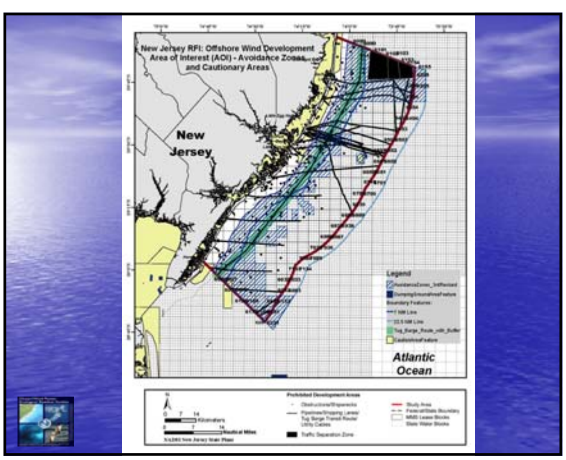
Day 2 - 13 July 2011
Presentations/Environmental/State Planning Panel

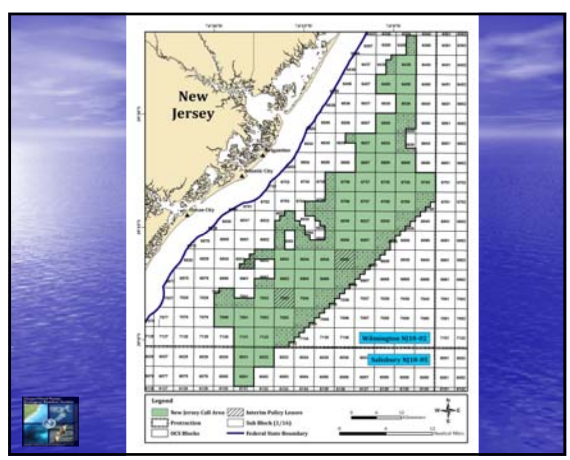












Hurdles

- 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

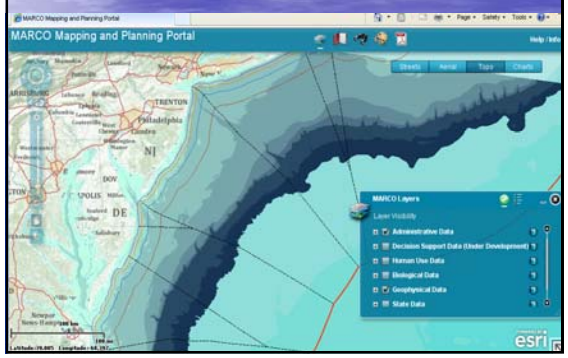
- Site-specific (footprint) studies - radar
- OWPEBS - template to build upon or copy
- U.S. accepted techniques/methods – allows comparison between studies and for comprehensive geospatial analysis
- Migratory nature of protected species indicates the need for regional or coast-wide studies

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/




NJDEP Office of Science website:
www.state.nj.us/dep/dsr/
Activity conducted pursuant to NOAA Permit No. 10014-02
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

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

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

Federal leasing for offshore wind

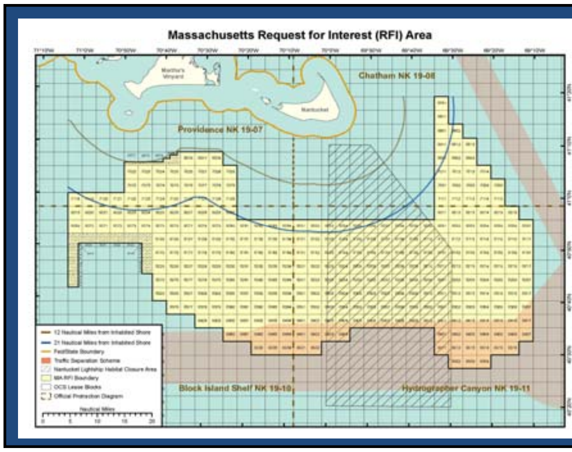
- BOEM issued framework for leasing OCS for offshore renewable projects in April 2009.
- Governor Patrick requested formation of Massachusetts Task Force so that state, tribal, and local elected officials to provide input.
- Beginning in November 2009, BOEM convened 8 meetings to solicit input from Task Force on a Massachusetts Request For Information (RFI).
- Engagement in federal process based on MA Ocean Management Plan

Data, Information & Outreach

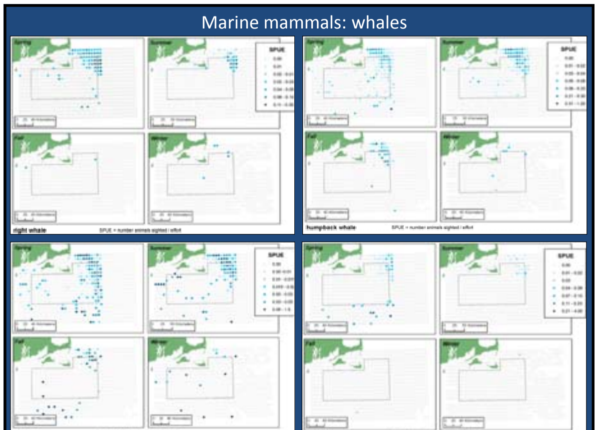
- Significant data and input from MA Ocean Plan informed RFI location.
- In conjunction with BOEM & USCG, EEA convened over 35 public & stakeholder meetings.
  – Martha's Vineyard, Nantucket, New Bedford, Boston
- MA: Extend RFI comment deadline 3 months
- Fisheries Working Group
- Habitat Working Group
- Ongoing data development

Process to date

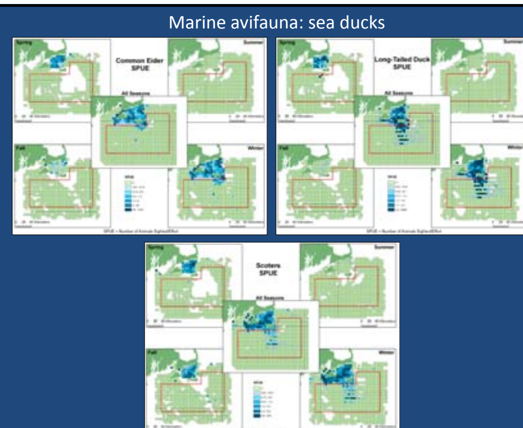
- Stakeholder and public meetings
- Development of two issue-oriented stakeholder groups:
  – Fisheries Working Group
  – Habitat Working Group
- Review available data: fishing, habitat, marine mammals, avifauna, shipping
- As in Massachusetts Ocean Plan, consider potential compatibilities between wind 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



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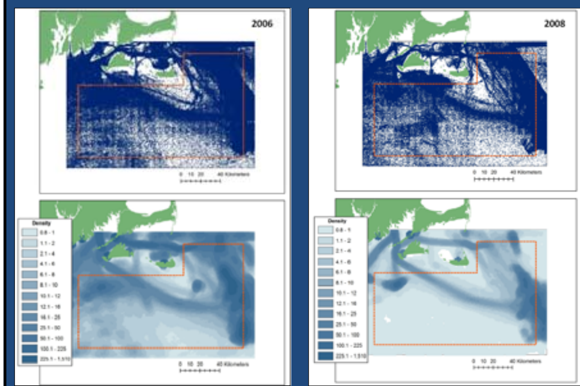
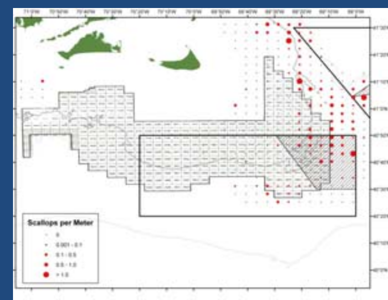
Transportation: commercial fishing



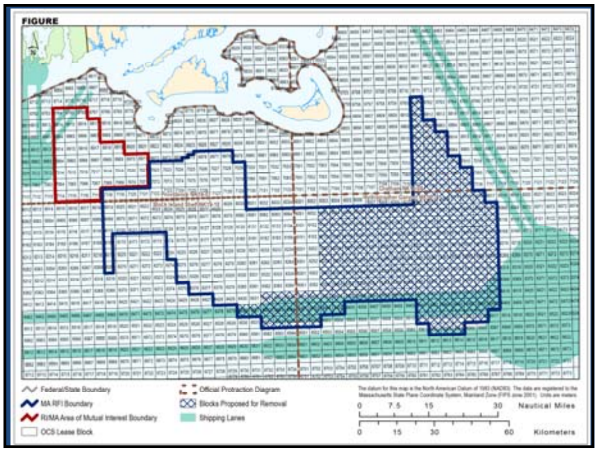
Scallop Data

UMASS Dartmouth's School Marine Science & Technology



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,

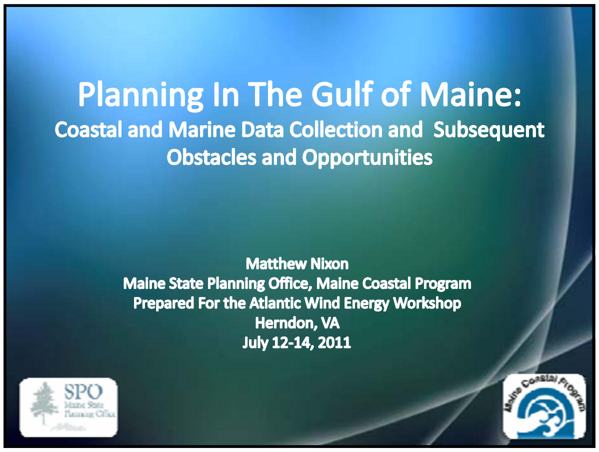
•15,000 nonfatal heart attacks,

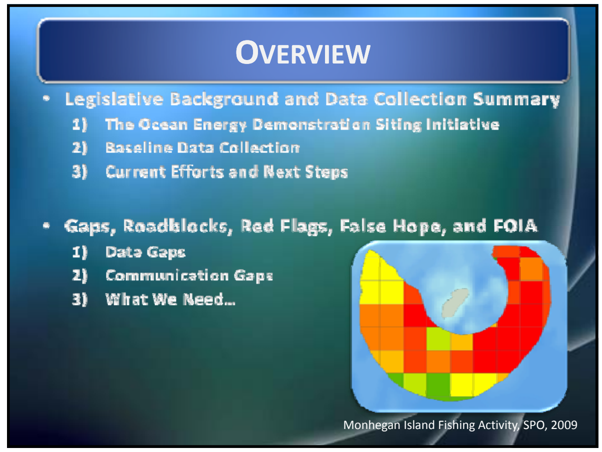
•400,000 cases of aggravated asthma,

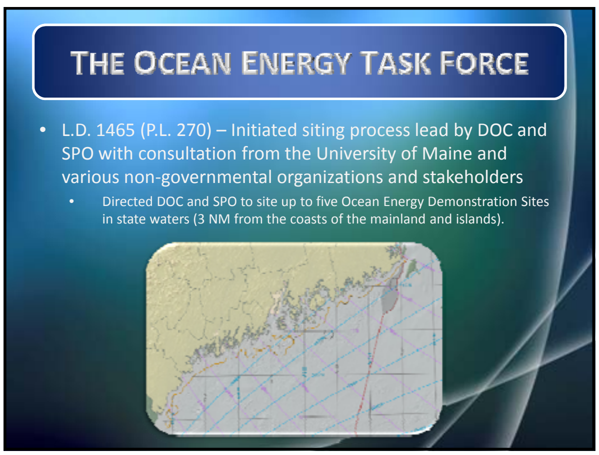
•1.8 million sick days/year beginning in 2014,

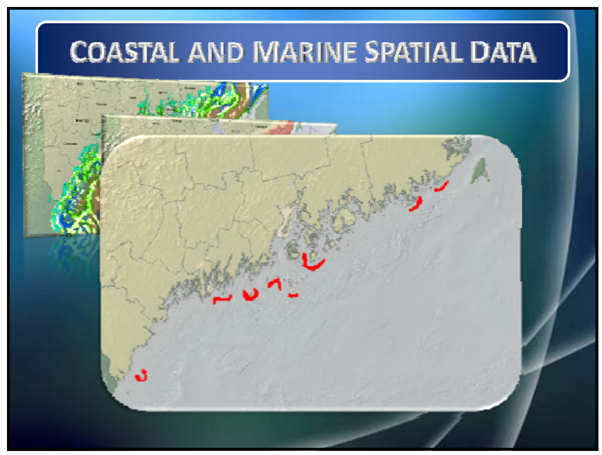
•$280 billion in annual health benefits.

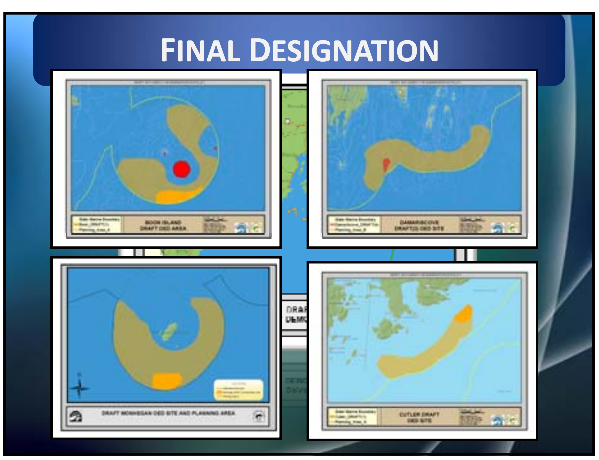

IMAGINE
Displacing Coal with Offshore Wind

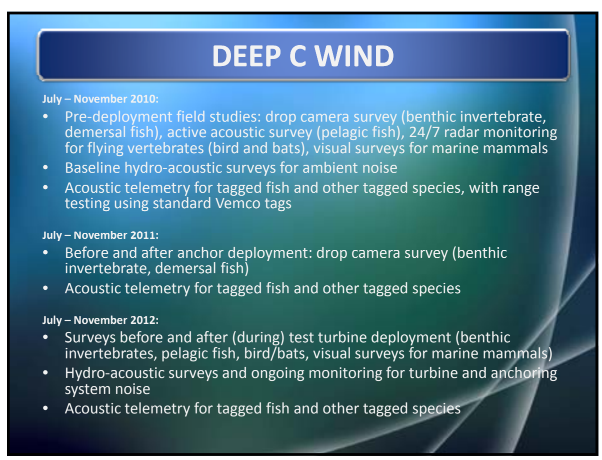

Planning In The Gulf of Maine:
Coastal and Marine Data Collection and Subsequent Obstacles and Opportunities
Matthew Nixon
Maine State Planning Office, Maine Coastal Program
Prepared For the Atlantic Wind Energy Workshop
Herndon, VA
July 12-14, 2011
SPO
Maine Coastal Program


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, False Hope, and FOIA
1) Data Gaps
2) Communication Gaps
3) What We Need…
Monhegan Island Fishing Activity, SPO, 2009


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
July – November 2010:
• 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
July – November 2011:
• Before and after anchor deployment: drop camera survey (benthic invertebrate, demersal fish)
• Acoustic telemetry for tagged fish and other tagged species
July – November 2012:
• 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

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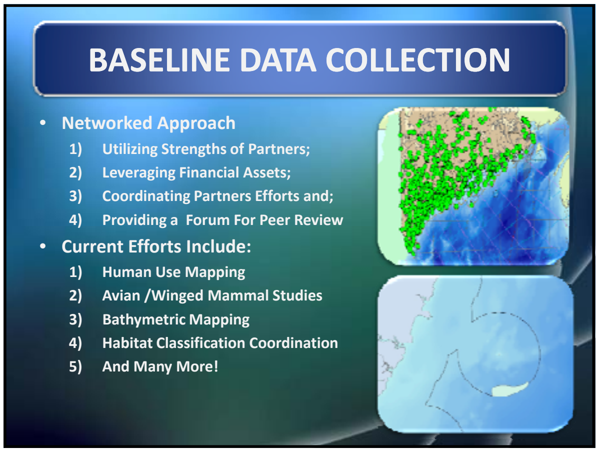

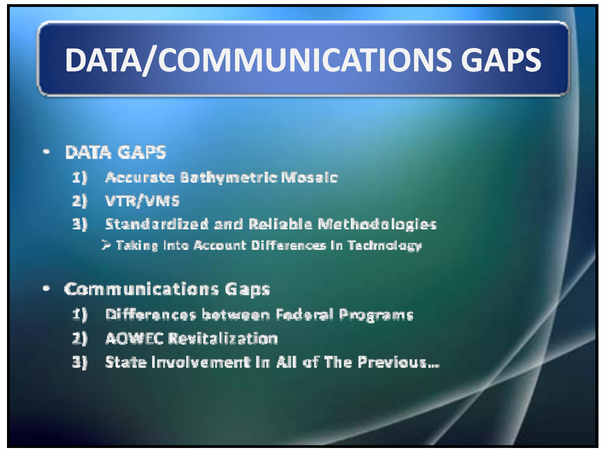

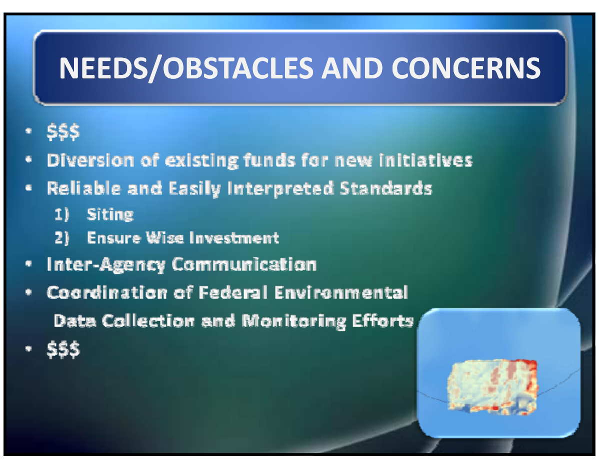

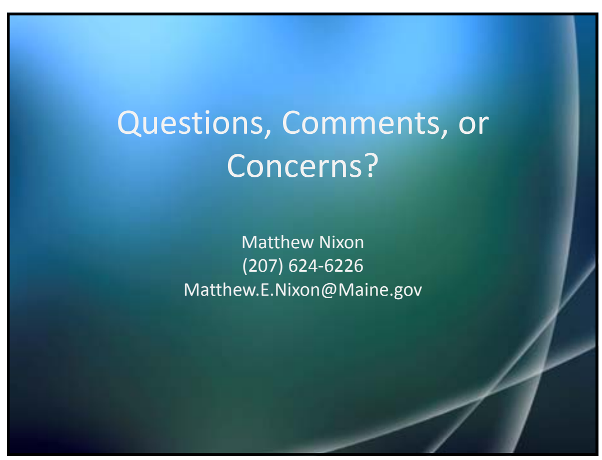

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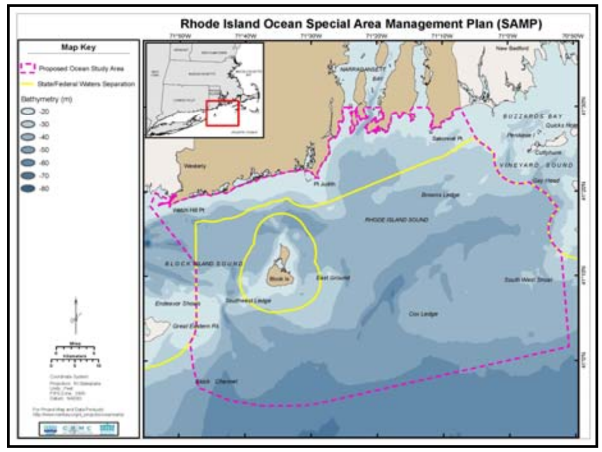
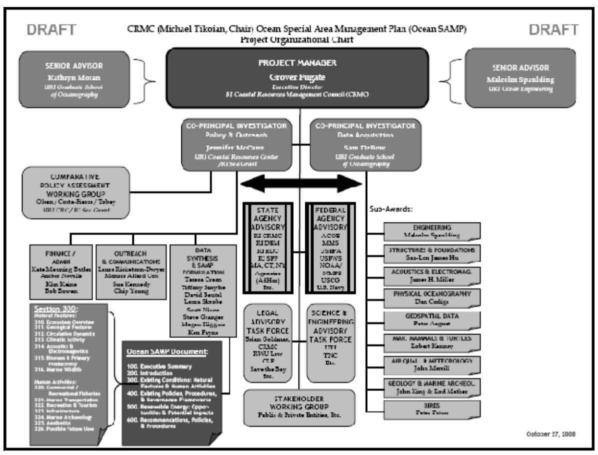
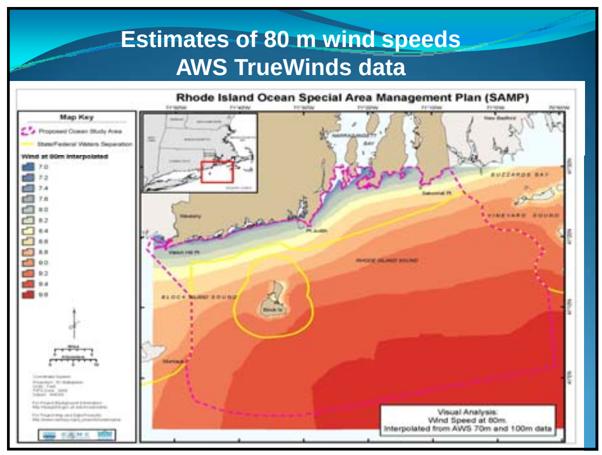
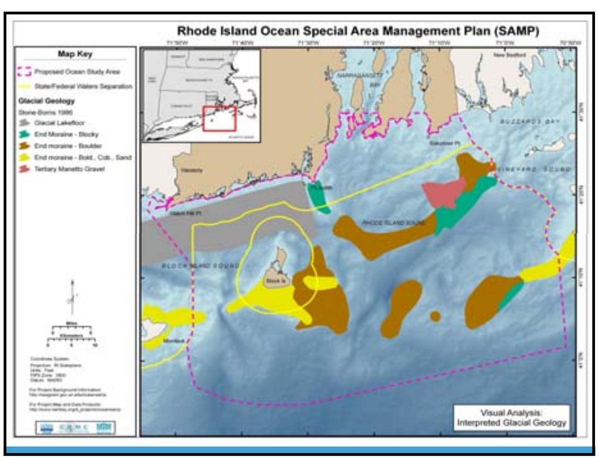
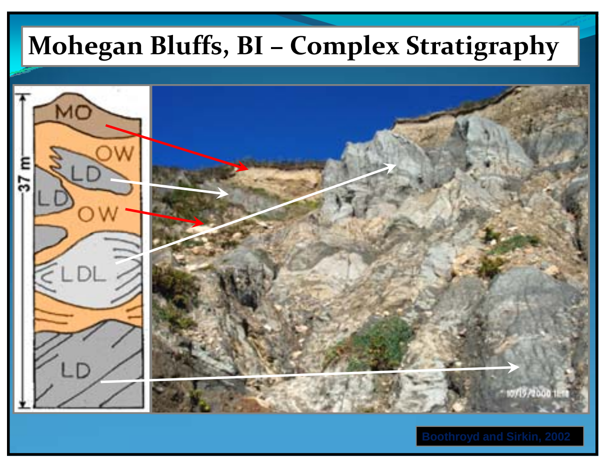
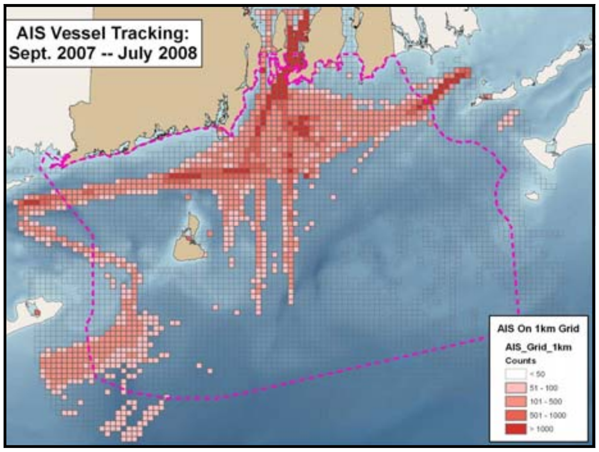


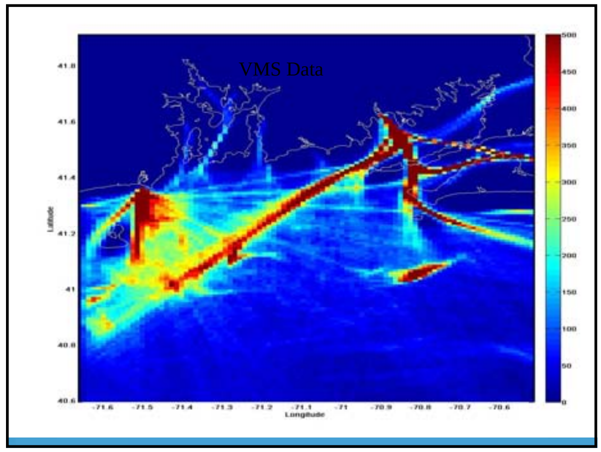












Technology Based Assessment

Objective: Develop a metric based on technical challenge to power production potential to screen for sites.

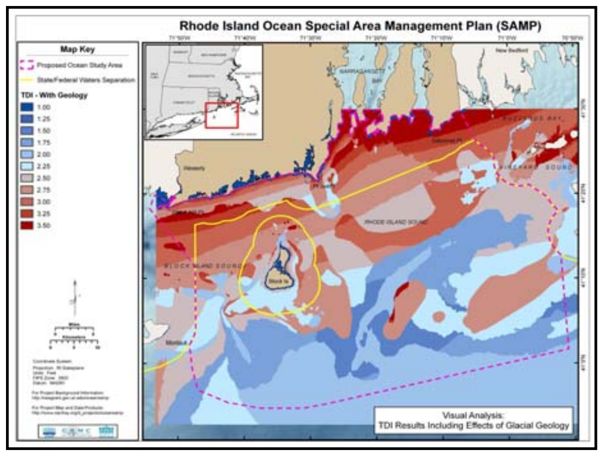
TDI = TCI/PPP

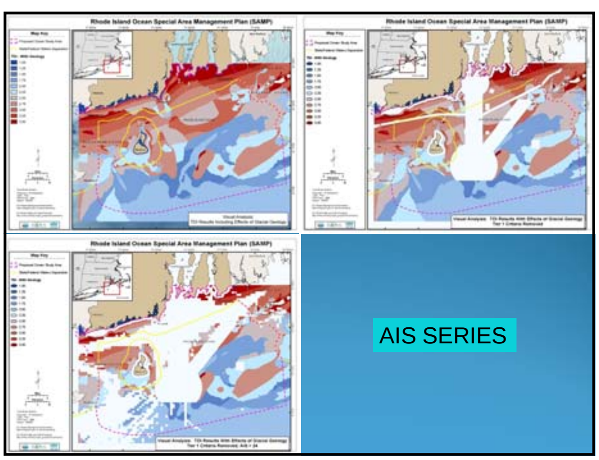
where TDI –Technical Development Index

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

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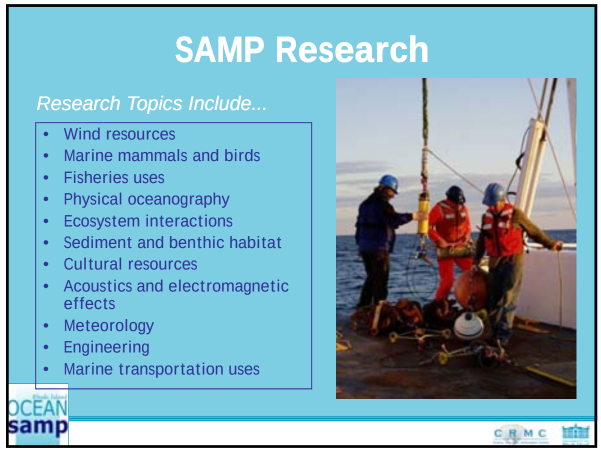

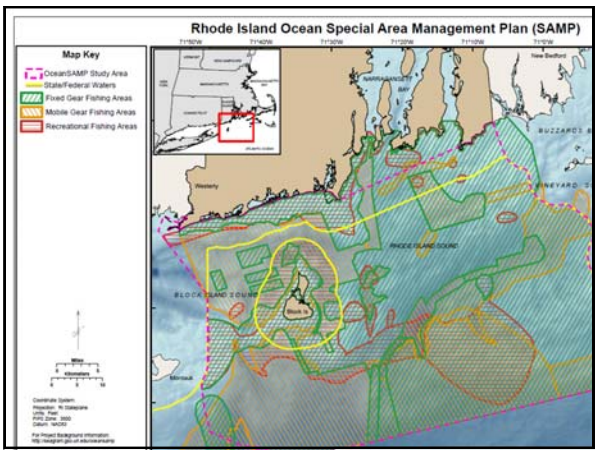

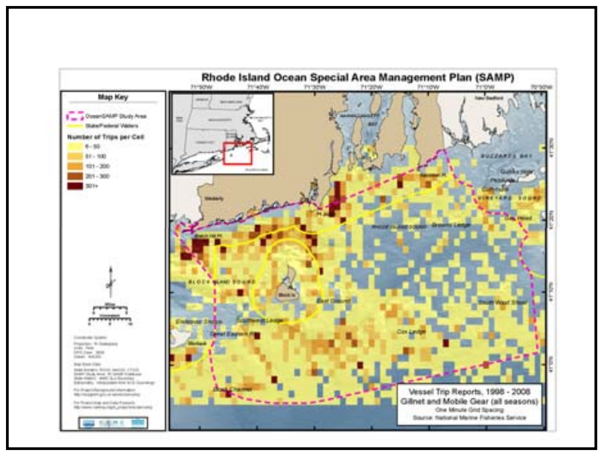

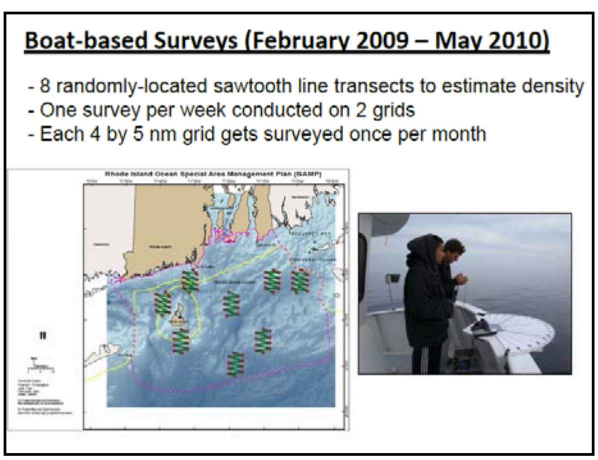

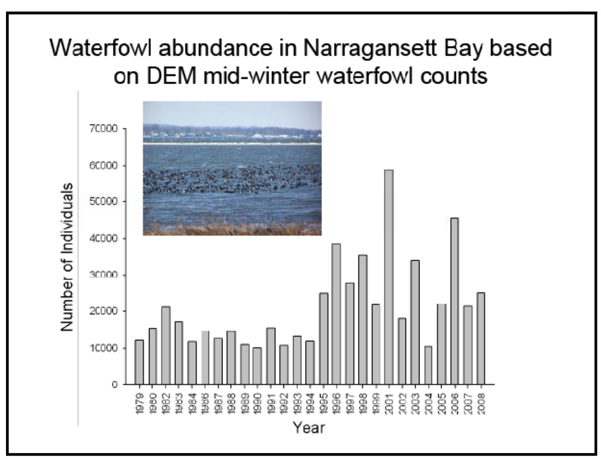

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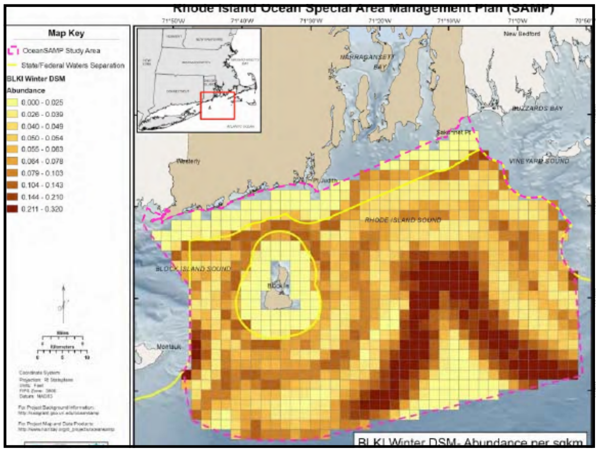

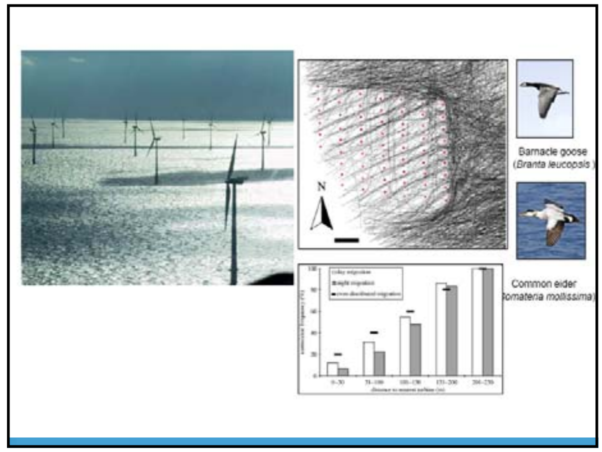

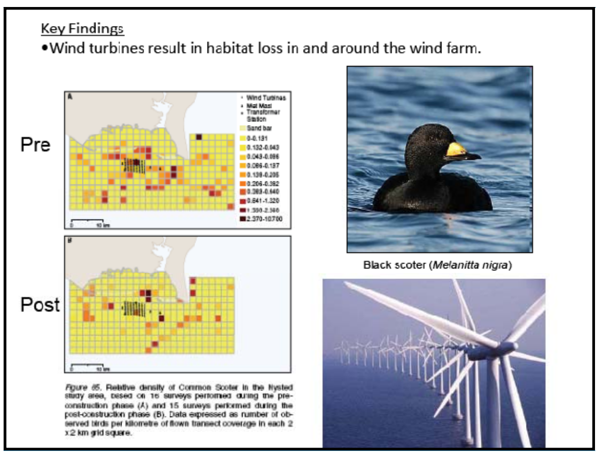

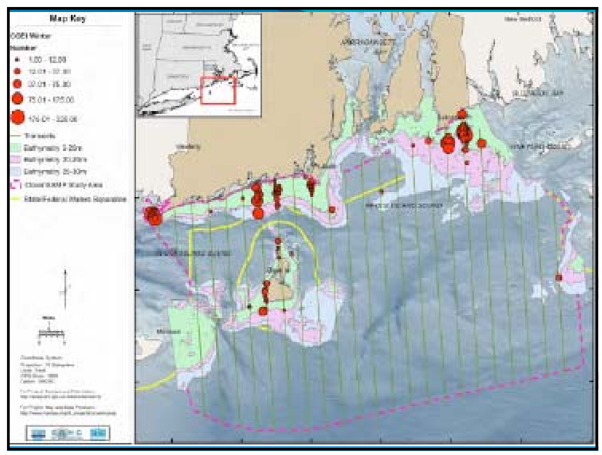

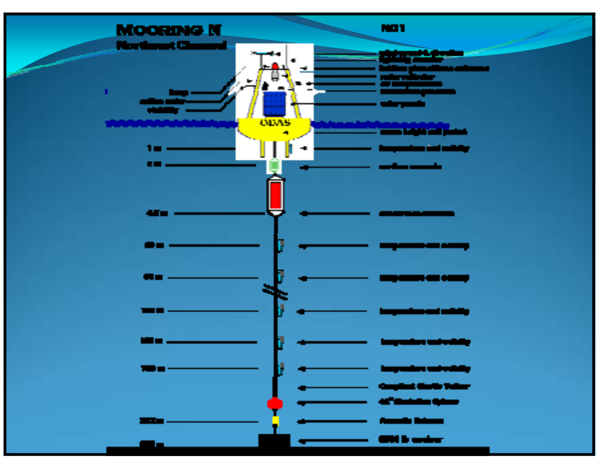

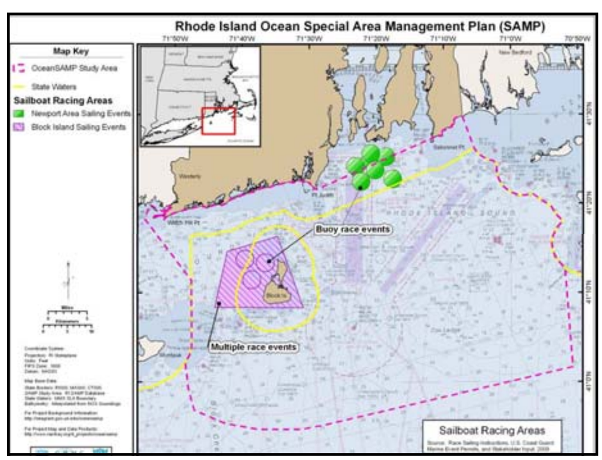

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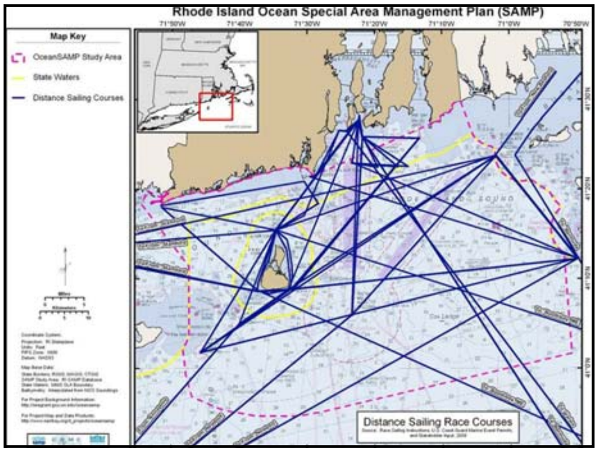

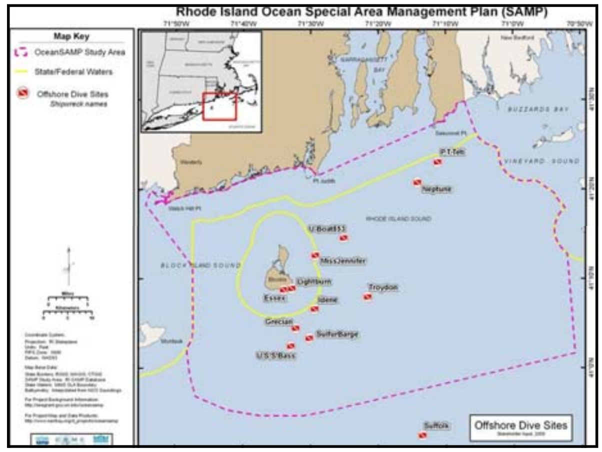

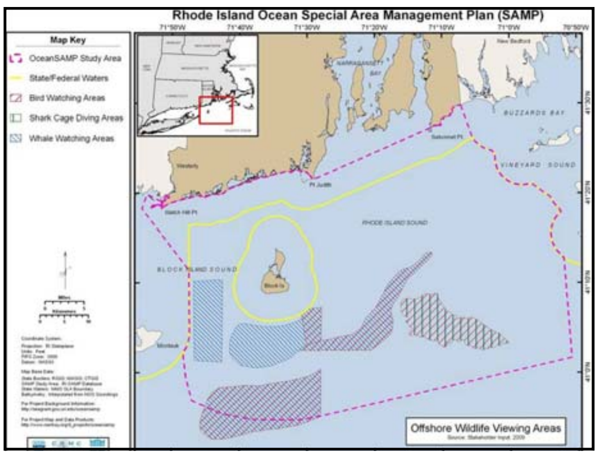

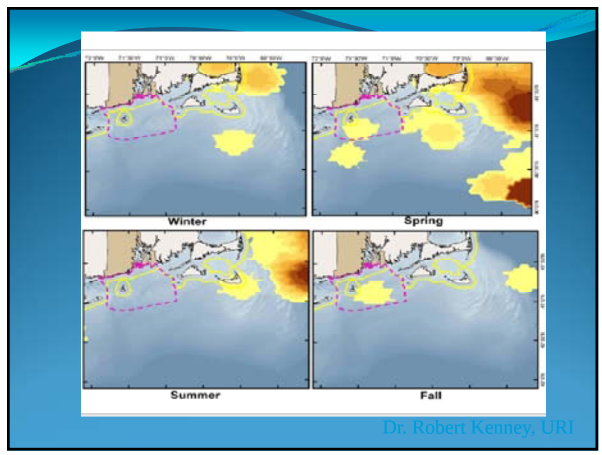

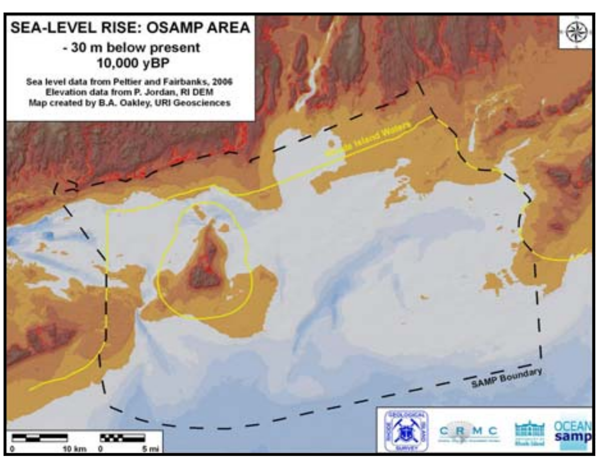

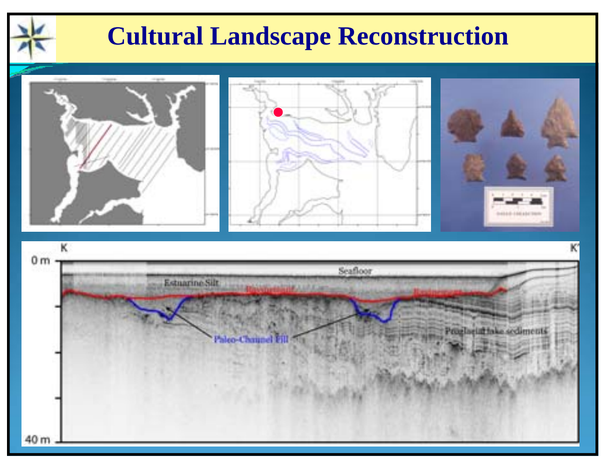

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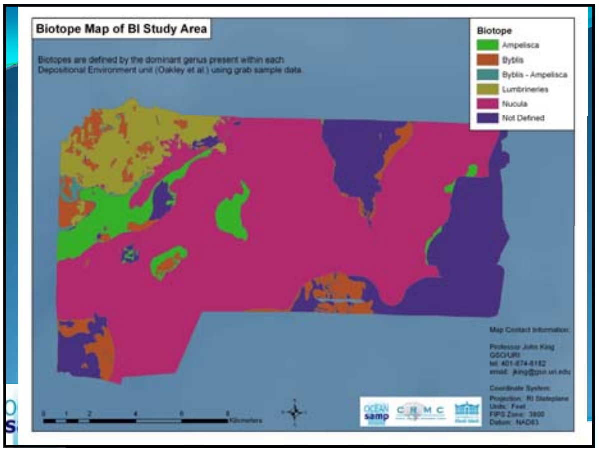
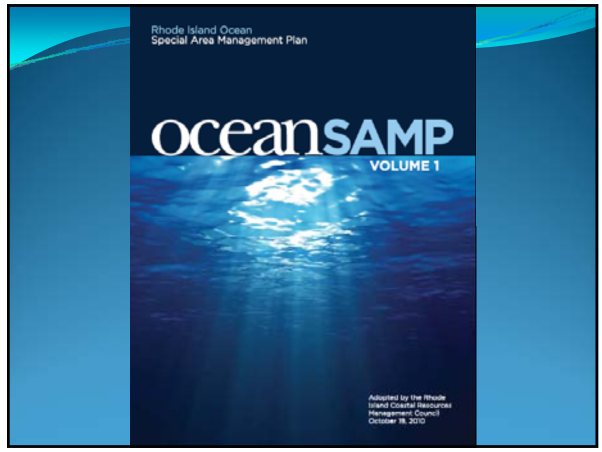
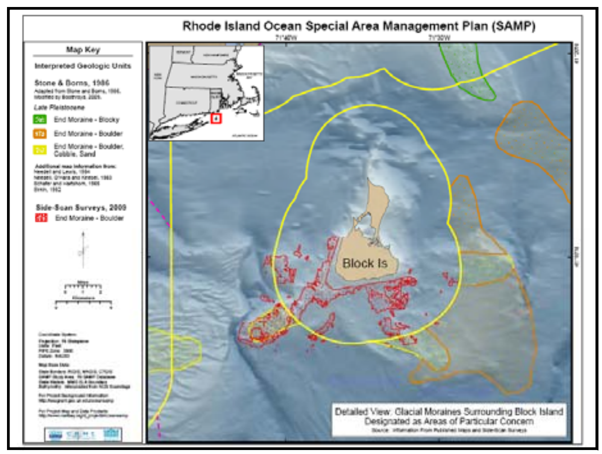
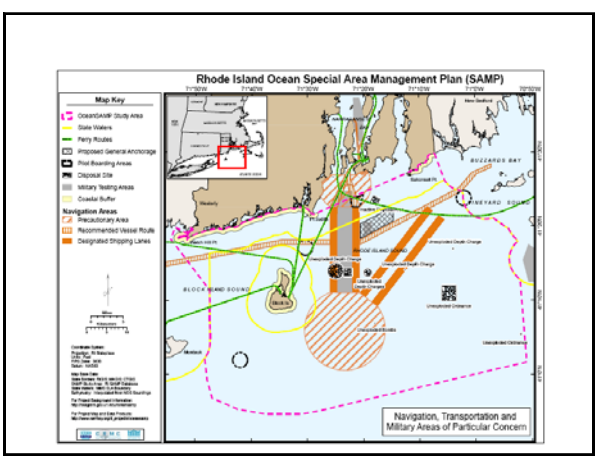
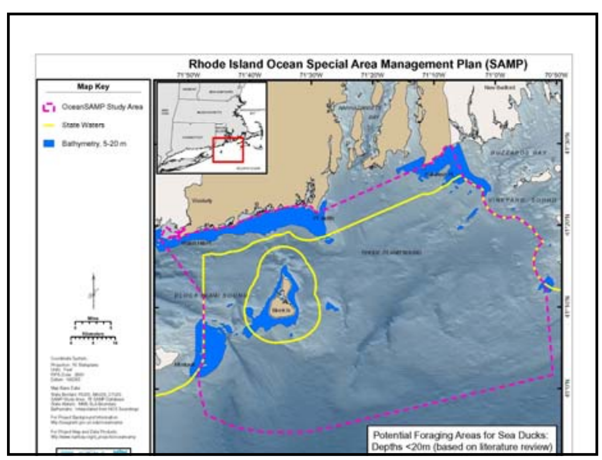
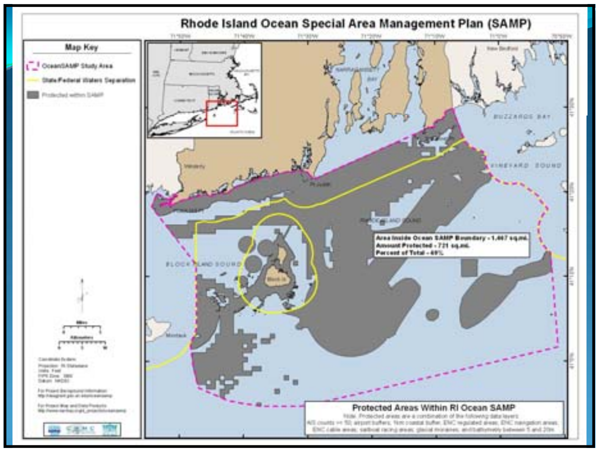


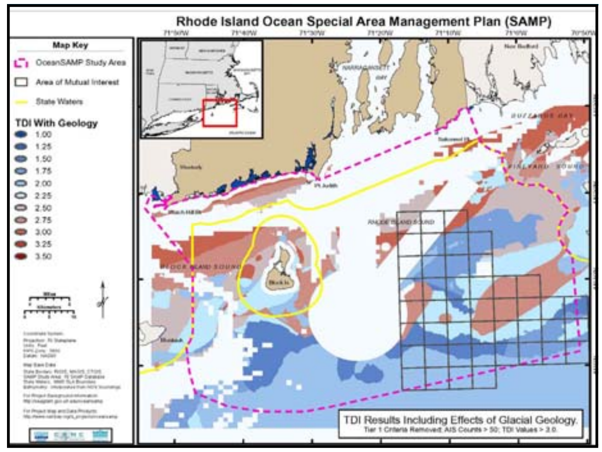












For More Information

- http://seagrant.gso.uri.edu/oceansamp/

Developing Environmental Protocols

September 21, 2010 – September 20, 2012
NOPP Project Number: M10PS00152

Michelle Carnevale, Coastal Manager
University of Rhode Island
Coastal Resources Center

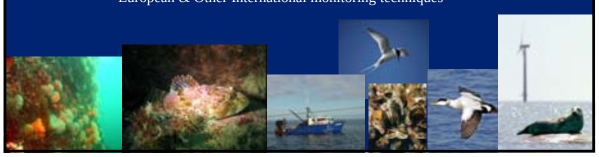
John King, Professor of Oceanography
Graduate School of Oceanography
University of Rhode Island

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



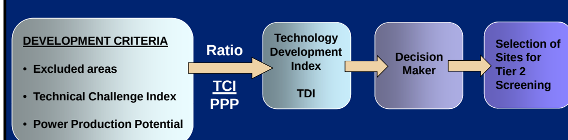
Year 2

- 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 change 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.

Tier 1 Screening



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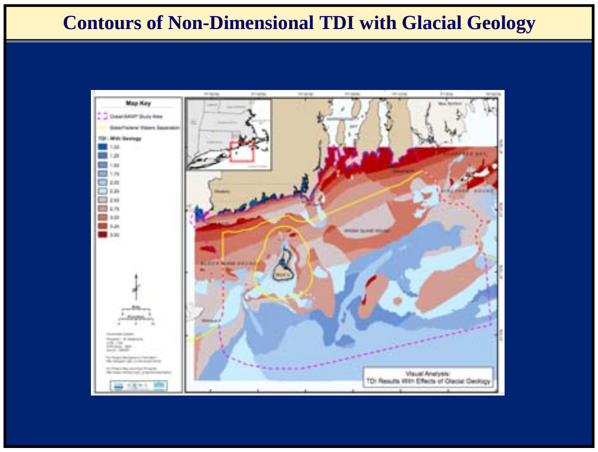
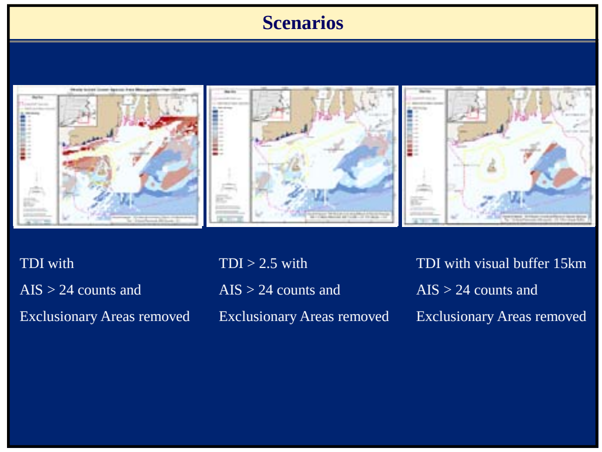
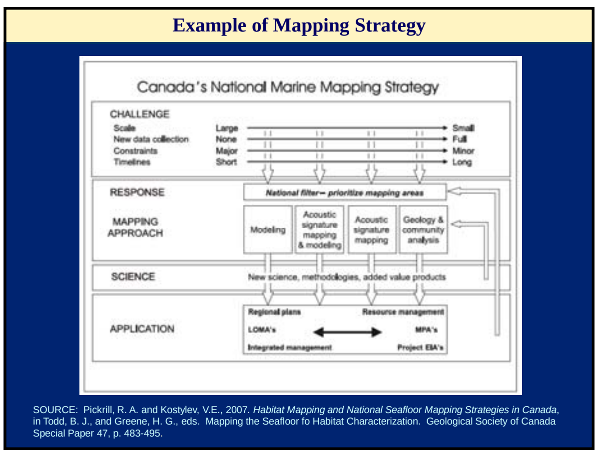
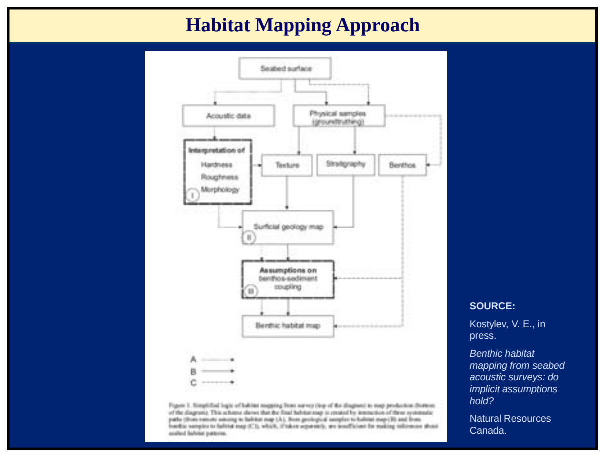
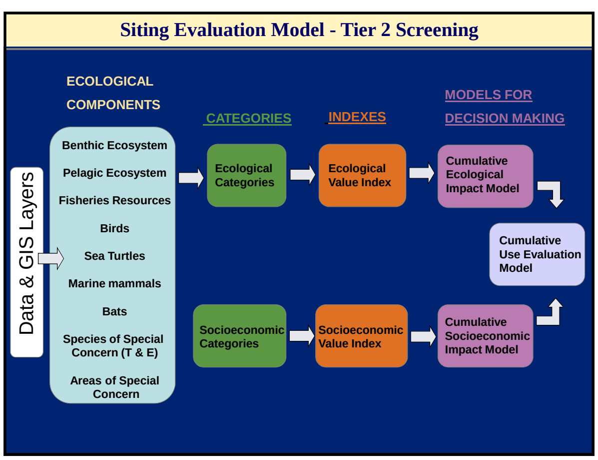
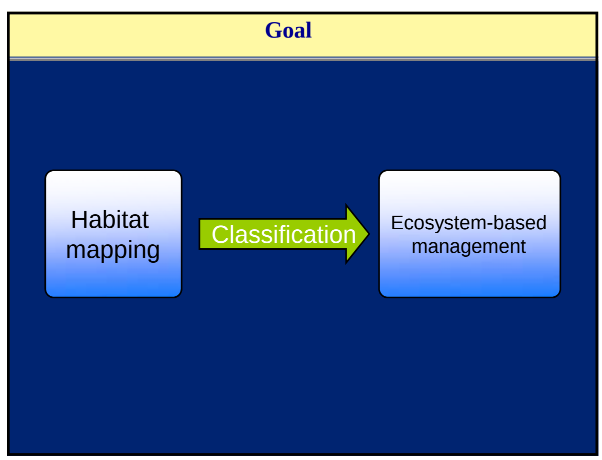


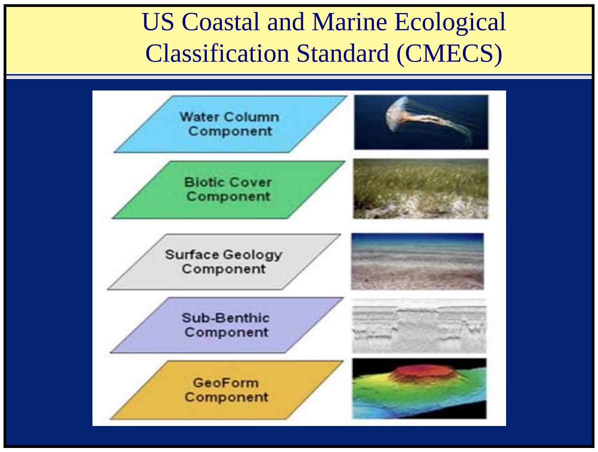


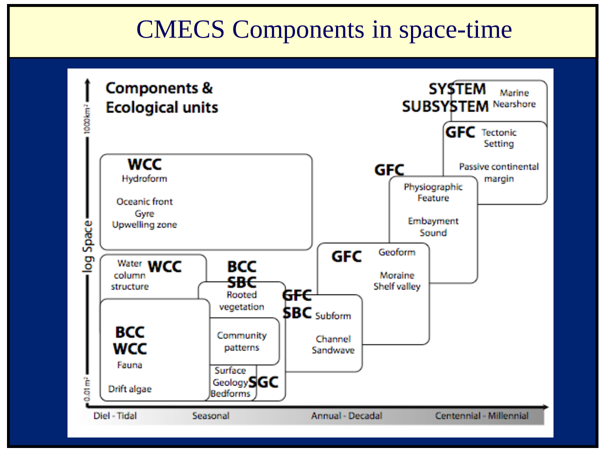


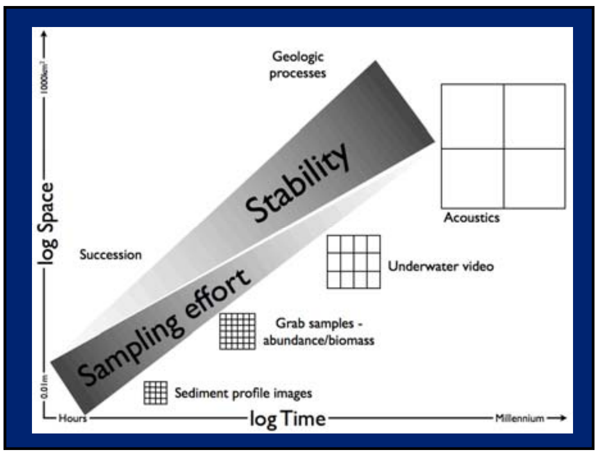


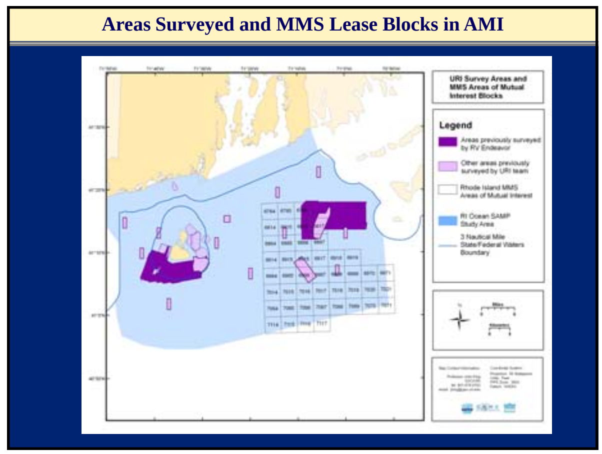


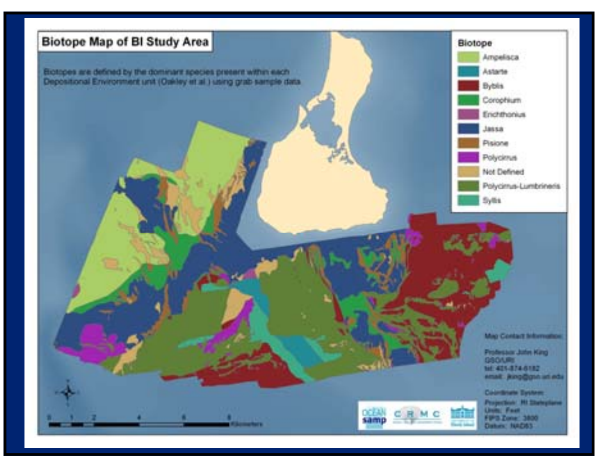


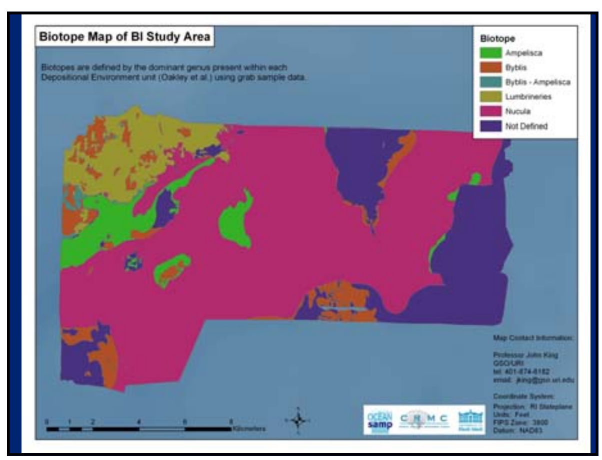

US Coastal and Marine Ecological Classification Standard (CMECS)
Water Column Component
Biotic Cover Component
Surface Geology Component
Sub-Benthic Component
GeoForm Component


CMECS Components in space-time
Components & Ecological units
SYSTEM Marine
SUBSYSTEM Nearshore
GFC Tectonic Setting
Passive continental margin
GFC
Physiographic Feature
Embayment Sound
WCC
Hydroform
Oceanic front
Gyre
Upwelling zone
GFC Geoform
Moraine
Shelf valley
Water column structure WCC
BCC
SBC
Rooted vegetation
GFC
SBC Subform
Channel
Sandwave
BCC
WCC
Fauna
Drift algae
Community patterns
Surface Geology SGC
Bedforms
log Space
Diel - Tidal
Seasonal
Annual - Decadal
Centennial - Millennial


Geologic processes
Stability
Sampling effort
Succession
Acoustics
Underwater video
Grab samples - abundance/biomass
Sediment profile images
log Space
Hours
log Time
Millennium


Areas Surveyed and MMS Lease Blocks in AMI
URI Survey Areas and MMS Areas of Mutual Interest Blocks
Legend


Biotope Map of BI Study Area
Biotopes are defined by the dominant species present within each Depositional Environment unit (Oakley et al.) using grab sample data.
Biotope
Ampelisca
Astarte
Byblis
Corophium
Ericthonius
Jassa
Pisione
Polycirrus
Not Defined
Polycirrus-Lumbrineris
Syllis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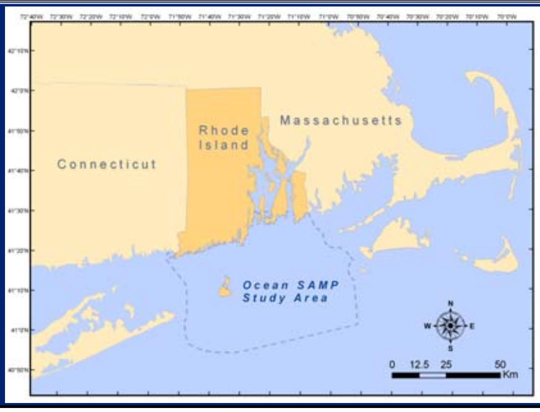
Biotope
Ampelisca
Byblis
Byblis - Ampelisca
Lumbrineries
Nucula
Not Defined

Regional Perspective of Data Layers



Approaches to Monitoring

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. Determine baseline conditions before project and then iterate.

- **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.

Science, Service, Stewardship

The Marine Mammal Protection Act
Incidental Take Authorization Process

NOAA FISHERIES SERVICE

Michelle Magliocca
Office of Protected Resources

NOAA FISHERIES SERVICE

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**

2

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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…

3

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Sections 101(a)(5)(A) and (D)

…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

4

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Authorizations

	Letter of Authorization (LOA)	Incidental Harassment Authorization (IHA)
MMPA Section	101(a)(5)(A)	101(a)(5)(D)
What it Authorizes	Harassment or mortality	Harassment only (Level A or B)
Process	• Requires regulations • Regulations valid for 5 years with annual LOAs • Two comment periods for rulemaking	• No rulemaking • Valid for up to 1 year • One 30-day comment period
Processing Time	12-18 months	4-6 months

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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

6

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Acoustic Criteria

Criterion	Criterion Definition	Threshold
Level A	PTS (injury)	180 dB_{rms}, re: 1 μPa 190 dB_{rms}, re: 1 μPa
Level B	Behavioral disruption for impulse sounds	160 dB_{rms}, re: 1 μPa
Level B	Behavioral disruption for continuous/non-impulse sounds	120 dB_{rms}, re: 1 μPa

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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

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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

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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

10

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Compliance

- National Environmental Policy Act (NEPA)
- Endangered Species Act (ESA)
- National Marine Sanctuaries Act
- Magnuson-Stevens Fishery Conservation and Management Act

11

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Contact Information

http://www.nmfs.noaa.gov/pr/permits/

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Science, Service, Stewardship

Endangered Species Act and Section 7 Consultation

Atlantic Wind Energy Workshop

Kellie Foster Taylor

August 4, 2011

NOAA FISHERIES SERVICE

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Purpose of the Endangered Species Act

Purposes – "…to provide a means whereby the ecosystems upon which endangered species and threatened species depend may be conserved"

Section 2(b) of the ESA

Congress charged the Secretary of the Interior and the Secretary of Commerce with administering the Endangered Species Act.

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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

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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.

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Selected Definitions

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.

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Types of Section 7 Consultation

Type of Consultation	Purpose of Consultation	Trigger for Consultation	Participants in the Consultation	Timing of Initiation of Consultation	Requirement s to Start 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 programs	Initiation package
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 process	Initiation package
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	Certifications and Initiation package with information described to the extent possible
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 process	Initiation package

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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

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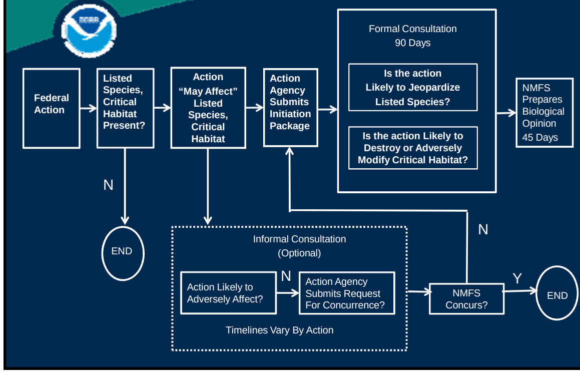
Generalized Consultation Process



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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

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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.

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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.

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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

NOAA FISHERIES SERVICE

NOAA Fisheries Contacts

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Northeast Region
Julie Crocker (978-282-8480)

Southeast Region
Kyle Baker (727-824-5312)
Greg Schweitzer (904-491-1400)

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Extra Slides

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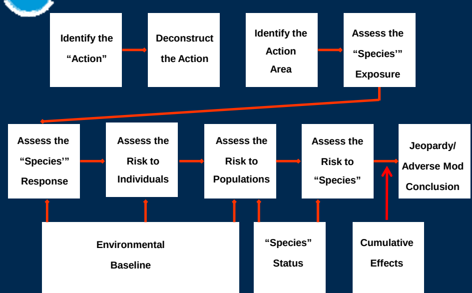
Section 7 Assessment Structure



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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

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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

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Applicant's Role in the Consultation Process cont'd

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

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

Section 7 – Interagency Cooperation

- 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 Cooperation

- 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

Section 7 – Interagency Cooperation

- 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

Section 7 – Interagency Cooperation

- 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

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Section 7 – Interagency Cooperation

Formal consultation concludes with the Service issuing a "biological opinion" evaluating the action and providing options, where 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**

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Section 7 – Interagency Cooperation

- 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

9

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

NEW ENGLAND FISHERY MANAGEMENT COUNCIL

Atlantic Wind Energy Workshop

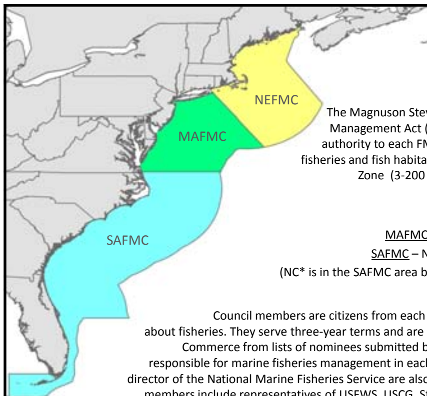
July 12-14, 2011 - Herndon, VA

Environmental Breakout Session: Broad scale Habitat, Abundance & Distribution – Baseline Data

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

Management authority and structure



The Magnuson Stevens Fishery Conservation and Management Act (reauthorized 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 – NY, NJ, DE, PA, MD, VA, NC*
SAFMC – NC, SC, GA, east FL to Key West
(NC* is in the SAFMC area but also serves on 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, USCG, State Department, and ASMFC.

Introduction to Fishery Management Councils

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.)

Introduction to Fishery Management Councils

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

Council Data and Information for Offshore Wind

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), scallops, 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 pelagics*, coral, coral reef and live/hard bottom habitat, dolphin/wahoo, golden crab, shrimp, snapper grouper, spiny lobster, pelagic sargassum habitat, comprehensive ecosystem amendments supported by the fishery ecosystem plan

Council Data and Information for Offshore Wind

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

Council Data and Information for Offshore Wind

Essential Fish Habitat

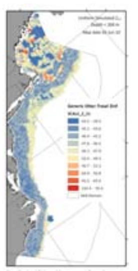
- "Those waters and substrate necessary for spawning, breeding, feeding, and growth to maturity" (MSA)
- Requirements (in brief; see EFH Final Rule issued by NMFS):
  - Describe/identify and designate EFH for all managed species
  - Minimize, to extent practicable, adverse effects of fishing
  - Identify 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.

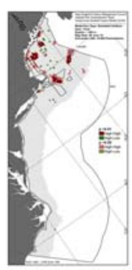
Council Data and Information for Offshore Wind

Which specific FMC programs, areas, or activities would be of interest to BOEMRE and related parties?

NEFMC – The Swept Area Seabed Impact Approach

- The SASI approach was developed to estimate the <u>magnitude, location, and duration of adverse effects of fishing</u> on EFH across gears types and FMPs, and to evaluate the <u>cumulative impacts</u> of management alternatives to minimize those effects
- The SASI model itself is a geo-referenced analytical tool that estimates the adverse effects (*Z*) of fishing on geological and biological seabed structures (inferred based on substrate)
- Other components include a vulnerability assessment, vulnerability clustering analysis, cost-efficiency analysis, area closure analysis
- Approach could be extended to state waters or to estimating other types of impacts





http://www.nefmc.org/habitat/index.html

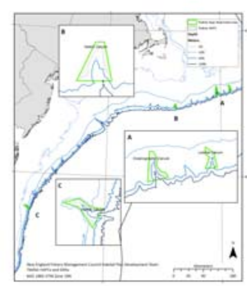
Specific Council Initiatives of Interest

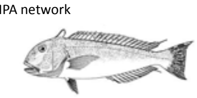
MAFMC – Tilefish FMP – GRAs and HAPCs

Amendment 1 to the tilefish FMP designated four Habitat Areas of Particular Concern and associated gear restricted areas in four submarine canyons: Veatch, Lydonia, Oceanographer, and Norfolk.

The HAPCs are intended to protect clay outcrop habitats in which tilefish construct burrows. The GRAs apply to all trawl gears.

Areas are now part of the national MPA network





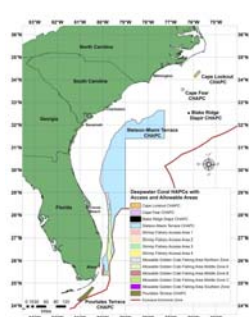
Specific Council Initiatives of Interest

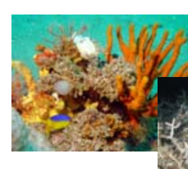
SAFMC: Spatial management beyond EFH

<u>Snapper Grouper FMP:</u>
•Deepwater Marine Protected Areas (MPAs)
•Special Management Zones (SMZs)
•Deepwater Species Closure

<u>Coral, Coral Reef and Live/Hard Bottom Habitat FMP:</u>
•Coral HAPCs (Oculina and Deepwater Coral)

SAFMC – Coral Habitat Areas of Particular Concern





- Implemented by CEBA1
- Five HAPCs
- Access areas for specific fisheries/gears

Specific Council Initiatives of Interest

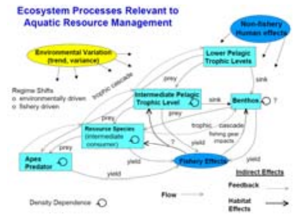
SAFMC – Online Habitat and Ecosystem Support Tools

- South Atlantic Habitat and Ecosystem Webpage
- 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

Specific Council Initiatives of Interest

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



Need to be measuring, mapping and monitoring for variables that will be useful for ecosystem models

Specific Council Initiatives of Interest

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**

Introduction to Fishery Management Councils

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)

Science, Service, Stewardship

NMFS surveys – past and present

Sofie Van Parijs
National Marine Fisheries Service
Northeast Fisheries Science Center

NOAA FISHERIES SERVICE

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 hierarchical 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

Scientific Name	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	NODES_GUILD	Duke_GUILD
Balaena mysticetus	NoData	NoData	NoData	NoData	NoData	NoData	NoData	NoData	NoData	NoData	NoData	NoData		
Balaenoptera	31	20	34	100	247	180	HAB	HAB	HAB	HAB	HAB	85		Baleen whales
Balaenoptera acutorostrata	DENS	DENS	DENS	DENS	DENS	DENS	DENS/HAB	DENS/HAB	DENS/HAB	DENS/HAB	DENS/HAB	DENS	Minke whale	Baleen whales
Balaenoptera borealis	DENS	DENS	DENS	DENS	DENS	DENS	DENS/HAB	DENS/HAB	DENS/HAB	DENS/HAB	DENS/HAB	DENS	Sei whale	Baleen whales
Balaenoptera brydei	NoData	NoData	NoData	NoData	NoData	NoData	NoData	NoData	NoData	NoData	NoData	NoData		
Balaenoptera edeni	NoData	NoData	NoData	NoData	NoData	NoData	HAB	HAB	HAB	HAB	HAB	NoData		Baleen whales
Balaenoptera musculus	NoData	1	NoData	3	4	1	HAB	HAB	HAB	HAB	HAB	NoData		Baleen whales
Balaenoptera physalus	DENS	DENS	DENS	DENS	DENS	DENS	DENS/HAB	DENS/HAB	DENS/HAB	DENS/HAB	DENS/HAB	DENS	Fin whale	Baleen whales
Balaenopteridae	7	6	29	51	89	93	95	146	74	49	44	18		
Berardius bairdii	NoData	NoData	NoData	NoData	NoData	NoData	HAB	HAB	HAB	NoData	NoData	NoData		Beaked whales
Cetacea	120	167	203	345	856	610	659	614	248	271	203	178		
Delphinapterus leucas	NoData	NoData	NoData	2	1	1	2	NoData	NoData	NoData	NoData	NoData		
Delphinidae	56	83	103	126	247	1012	3844	400	92	78	83	60		
Delphinus	NoData	NoData	NoData	NoData	NoData	NoData	HAB	HAB	HAB	NoData	NoData	NoData		Delphinus
Delphinus capensis	NoData	NoData	NoData	NoData	NoData	NoData	HAB	HAB	HAB	NoData	NoData	NoData		Delphinus
Delphinus delphis	DENS	DENS	DENS	DENS	DENS	DENS	DENS/HAB	DENS/HAB	DENS/HAB	DENS	DENS	DENS	Common dolphin	Delphinus
Eschrichtius	NoData	NoData	NoData	NoData	NoData	NoData	NoData	NoData	NoData	NoData	NoData	NoData		
Eschrichtius robustus	NoData	NoData	NoData	NoData	NoData	NoData	NoData	NoData	NoData	NoData	NoData	NoData		
Eubalaena glacialis	DENS	DENS	DENS	DENS	DENS	DENS	DENS/HAB	DENS/HAB	DENS/HAB	DENS	DENS	DENS	North Atlantic right whale	Right whales
Eubalaena japonica	NoData	NoData	NoData	NoData	NoData	NoData	NoData	NoData	NoData	NoData	NoData	NoData		
Feresa	NoData	NoData	NoData	NoData	NoData	NoData	NoData	NoData	NoData	NoData	NoData	NoData		
Feresa attenuata	NoData	1	NoData	NoData	NoData	NoData	3	1	NoData	NoData	NoData	NoData		
Globicephala	DENS/HAB	DENS/HAB	DENS	DENS	DENS	DENS	DENS	DENS	DENS	DENS	DENS	DENS/HAB	Pilot whales	Pilot whales
Globicephala macrorhynchus	HAB	HAB	2	2	2	5	3	16	5	1	NoData	HAB		Pilot whales
Globicephala melas	HAB	HAB	16	17	36	21	22	63	24	39	22	HAB		Pilot whales
Grampus griseus	DENS	DENS	DENS	DENS	DENS	DENS	DENS	DENS	DENS	DENS	DENS	DENS	Risso's dolphin	
Hyperoodon ampullatus	NoData	NoData	NoData	NoData	NoData	2	HAB	HAB	HAB	1	NoData	NoData		
Indopacetus pacificus	NoData	NoData	NoData	NoData	NoData	NoData	HAB	HAB	HAB	NoData	NoData	NoData		
Kogia	DENS	DENS	DENS	DENS	DENS	DENS	DENS	DENS	DENS	DENS	DENS	DENS	Kog	
Kogia breviceps	1	4	2	2	1	NoData	2	4	6	3	1	1		
Kogia sima	4	1	NoData	1	NoData	NoData	1	2	NoData	NoData	NoData	NoData		
Lagenodelphis hosei	NoData	NoData	NoData	NoData	NoData	NoData	NoData	NoData	1	NoData	NoData	NoData		
Lagenorhynchus	NoData	NoData	1	9	5	2	HAB	HAB	HAB	2	NoData	NoData		
Lagenorhynchus acutus	DENS	DENS	DENS	DENS	DENS	DENS	DENS/HAB	DENS/HAB	DENS/HAB	DENS	DENS	DENS	Atla	
Lagenorhynchus albirostris	NoData	6	3	17	17	3	HAB	HAB	HAB	1	1	1		
Lagenorhynchus obliquidens	NoData	NoData	NoData	NoData	NoData	NoData	NoData	NoData	NoData	NoData	NoData	NoData		
Lagenorhynchus obscurus	NoData	NoData	NoData	NoData	NoData	NoData	NoData	NoData	NoData	NoData	NoData	NoData		
Lissodelphis borealis	NoData	NoData	NoData	NoData	NoData	NoData	NoData	NoData	NoData	NoData	NoData	NoData		
Megaptera novaeangliae	DENS/HAB	DENS/HAB	DENS	DENS	DENS	DENS	DENS/HAB	DENS/HAB	DENS/HAB	DENS/HAB	DENS/HAB	DENS/HAB	Hum	
Mesoplodon	NoData	1	1	2	3	3	HAB	HAB	HAB	NoData	NoData	NoData		
Mesoplodon bidens	NoData	NoData	NoData	NoData	NoData	NoData	HAB	HAB	HAB	NoData	NoData	NoData		
Mesoplodon carlhubbsi	NoData	NoData	NoData	NoData	NoData	NoData	NoData	NoData	NoData	NoData	NoData	NoData		
Mesoplodon densirostris	NoData	NoData	NoData	NoData	NoData	NoData	HAB	HAB	HAB	NoData	NoData	NoData		
Mesoplodon europaeus	NoData	NoData	NoData	1	NoData	2	HAB	HAB	HAB	NoData	NoData	1		
Mesoplodon mirus	NoData	NoData	NoData	NoData	NoData	NoData	HAB	HAB	HAB	NoData	1	NoData		
Mesoplodon peruvianus	NoData	NoData	NoData	NoData	NoData	NoData	HAB	HAB	HAB	NoData	NoData	NoData		

CetMap project

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 seas for all times/species with available data.

West Coast – robust density estimates already exist for most species/areas/times; however, multiple smaller datasets are being considered for new density modeling to fill known gaps in species (e.g., harbor porpoise, gray whales, and coastal bottlenose dolphins) and seasons

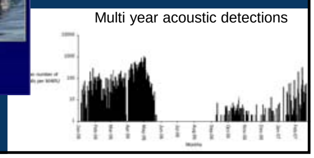
Inland Waters – many different cetacean survey datasets that have been analyzed using different methods exist for both Washington Inland Waters and Cook Inlet. WG participants are exploring the possibility of finding external experts that could assist in analyzing these data more comprehensively

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.

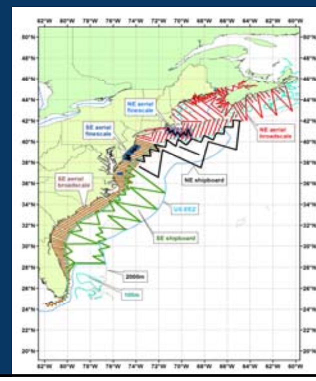
CetMap project

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



AMAPPS – Western Atlantic surveys

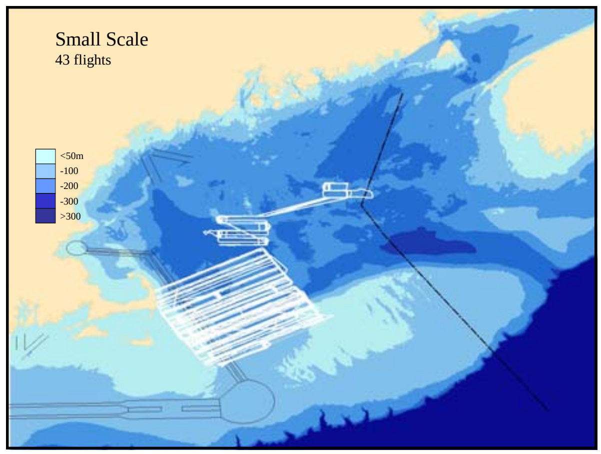


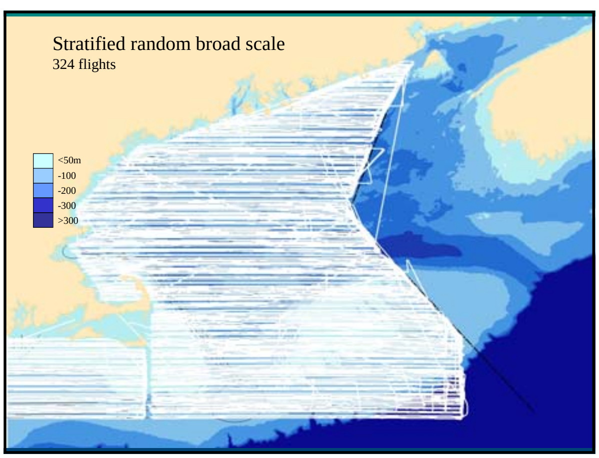
NEFSC Long term multi year surveys for marine mammals

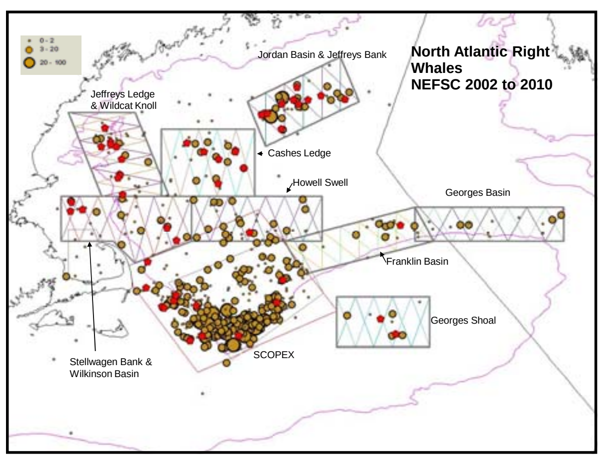
Aerial, ship board and passive acoustic occur year round and target endangered species relevant to each region.

We now have decade long seasonal surveys from aerial. Targeted vessel surveys with specific objectives.

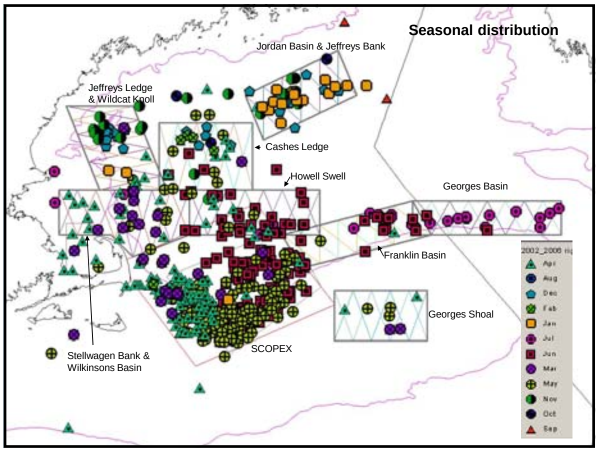
Building passive acoustic capacity to improve detectability of certain species

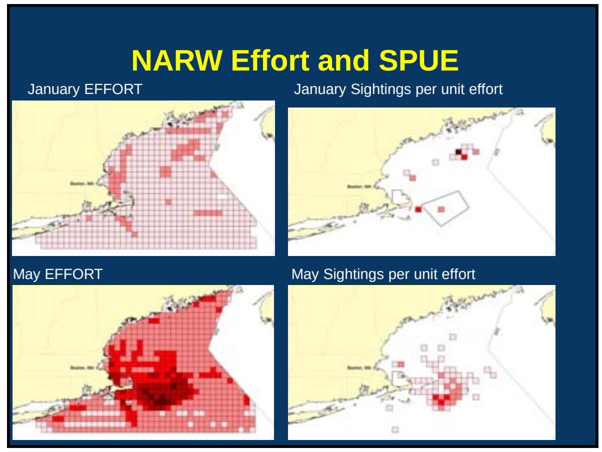


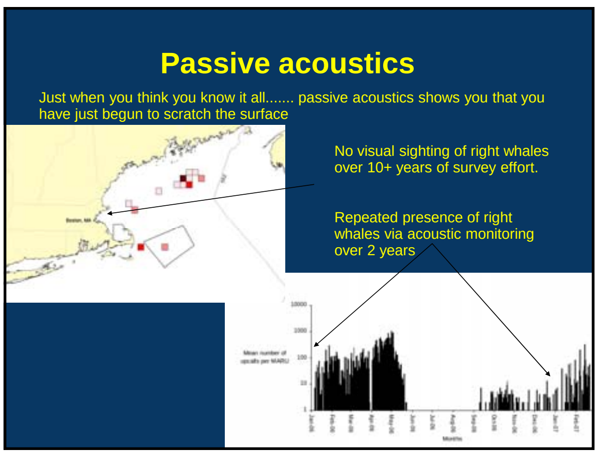


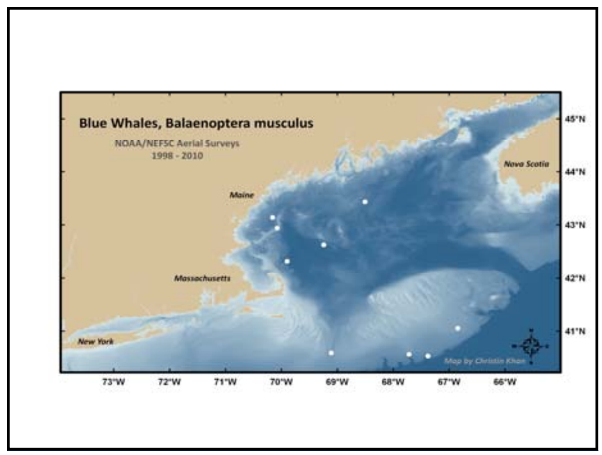


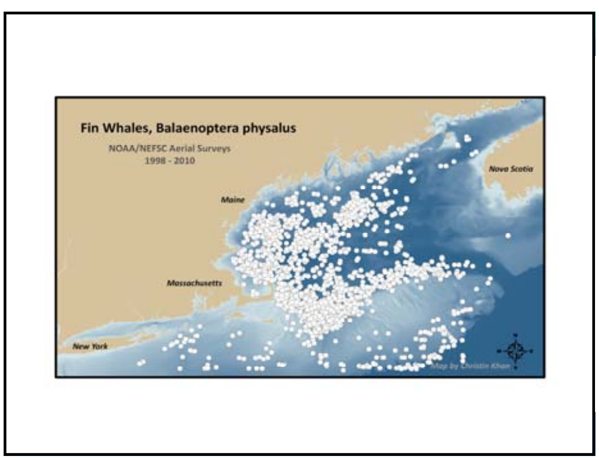
Day 2 - 13 July 2011
Presentations/Environmental/
Broad Scale Habitat, Abundance & Distribution/Baseline Data

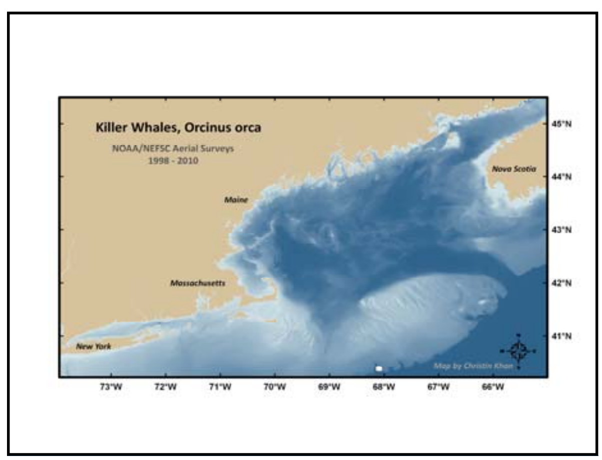


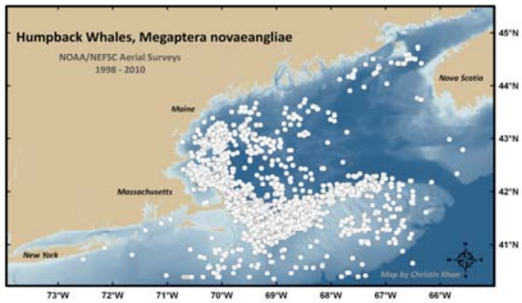


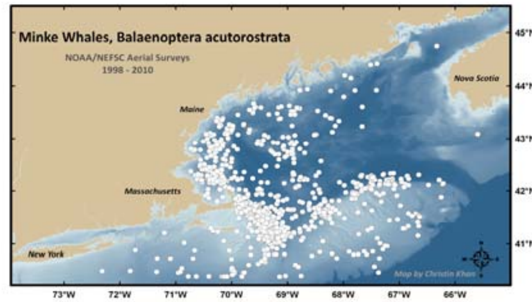












NFMS NE and SE surveys

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

Study Objectives

1. Collect broad-scale data on the seasonal distribution and abundance of marine mammals (cetaceans and pinnipeds), sea turtles, and sea birds.

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.

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

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**

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

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

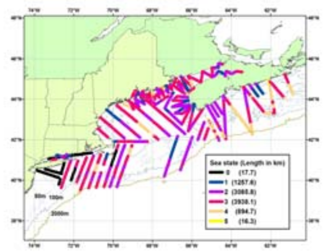
Broad-scale line transect surveys on NOAA Twin Otter

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



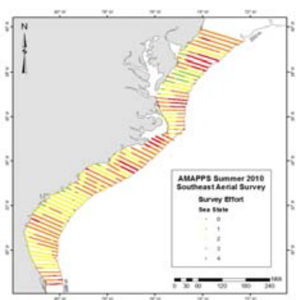
Surveys flown from 17 August to 26 September 2010

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

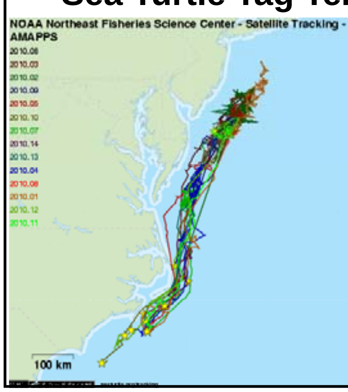
Sea Turtle Tag Telemetry

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

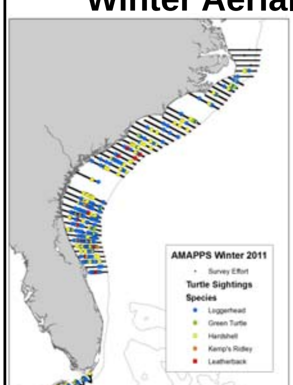


14 loggerhead turtles tagged off of New Jersey and Delaware-2010

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

Day 2 - 13 July 2011
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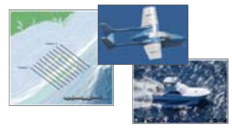
DON/DoD Marine Programs

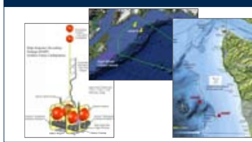
Robin Fitch
Office Deputy Assistant Secretary of the Navy- Environment
13 July 2011

Navy Funded Data Collection

Visual Surveys (aerial and vessel)



Passive Acoustic Monitoring



Behavioral Response Studies

Photo Identification

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.

Navy Training and Test Ranges

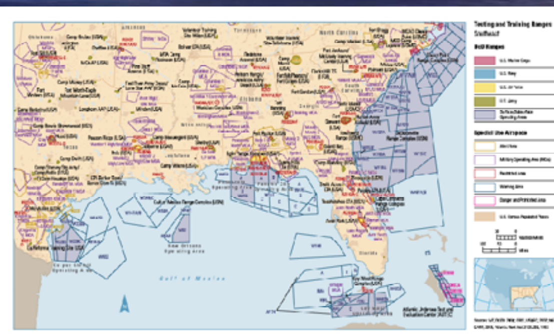
4

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

5

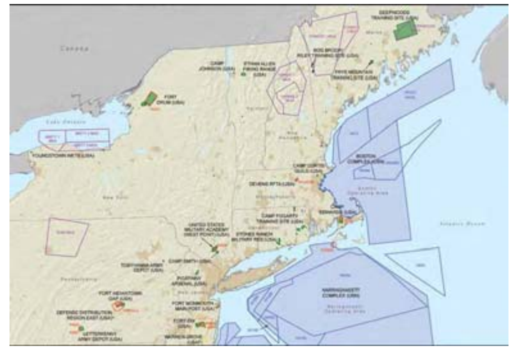
Southeast Region



Mid Atlantic Region

7

Northeast Region



8

JASCO APPLIED SCIENCES

Atlantic Wind Energy Workshop
July 2011

Acoustic Monitoring on the Outer Continental Shelf

Scope and Objectives

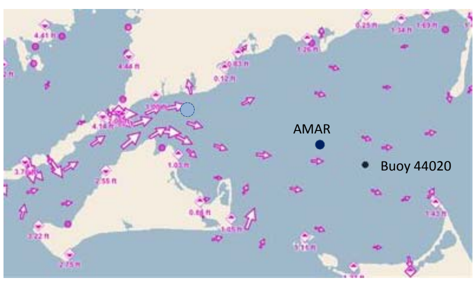
Phase 1
Pre-construction assessment of the ambient acoustic environment

Phase 2 (Optional)
Acoustic monitoring during construction of renewable power generation facility.

- 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

Atlantic Wind Energy Workshop, July 2011

Nantucket Sound



Atlantic Wind Energy Workshop, July 2011

Delaware Bay

Atlantic Wind Energy Workshop, July 2011

AMAR

Geospectrum M15B or M8E hydrophones

24-bit resolution (low noise floor)

32 kHz sampling rate, (5 – 15040 Hz)

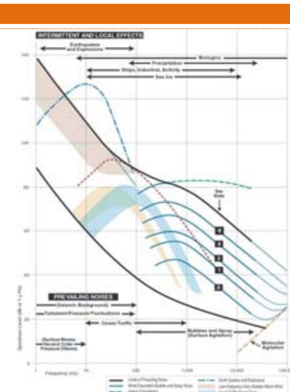
768 GB solid-state storage

Float-on-a-rope style, grapple recovery

Methods - Recorders

Atlantic Wind Energy Workshop, July 2011

Wenz Curves



Wenz (1962) JASA

National Research Council (2003)

Atlantic Wind Energy Workshop, July 2011

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

Atlantic Wind Energy Workshop, July 2011

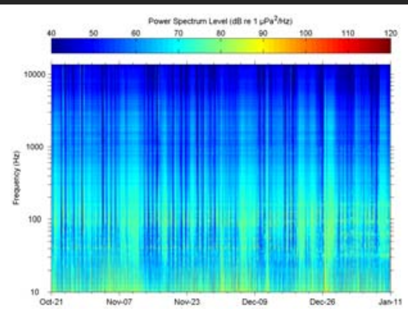
Ambient Analysis Results

NANTUCKET

(OCTOBER 2010– JANUARY, 2011)

Atlantic Wind Energy Workshop, July 2011

Ambient Results - Spectrogram



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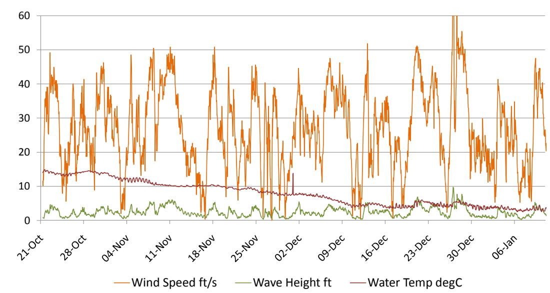
Meteorological Data (Buoy 44020 Oct – Jan)



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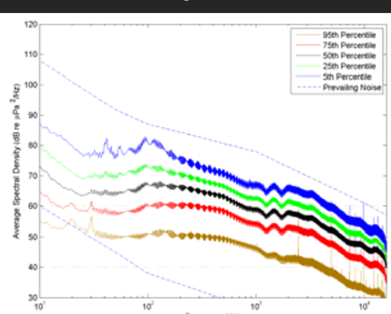
Ambient Results – Quartile Distributions



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Ambient Analysis Results

DELAWARE BAY

(JUNE – OCTOBER, 2010)

(JANUARY –APRIL, 2011)

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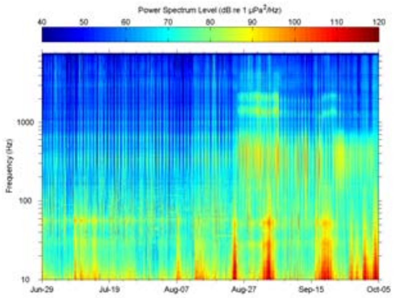
Ambient Acoustic Results - Spectrogram



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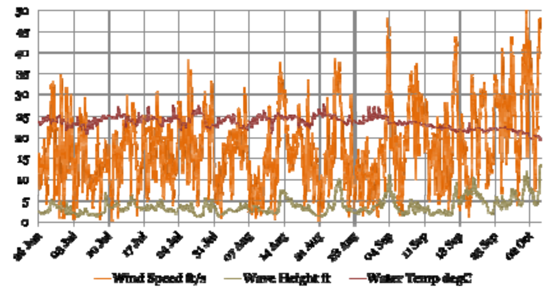
Meteorological Data (Buoy 44009 Jun – Oct)



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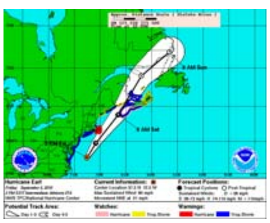
Hurricane Tracks

Hurricane Earl - 3 Sept



Hurricane Igor – 20 Sept

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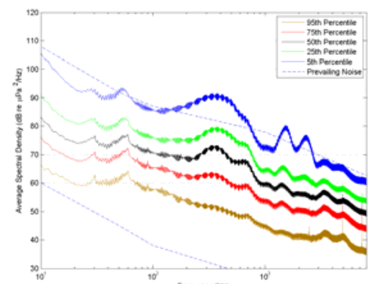
Ambient Results – Quartile Distributions



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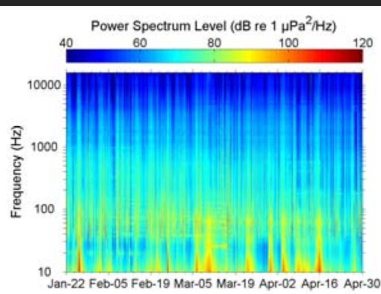
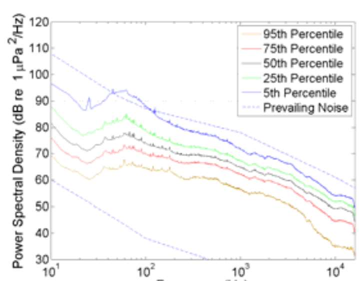
Ambient Acoustic Results - Spectrogram



Atlantic Wind Energy Workshop, July 2011

Ambient Results – Quartile Distributions



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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

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JASCO APPLIED SCIENCES

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July 2011

- Sponsored by BOEMRE
- Thanks to the captains and crews of the *Big Game* (Cape May, NJ) and the *Minute Man* (Falmouth, MA)

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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

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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

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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

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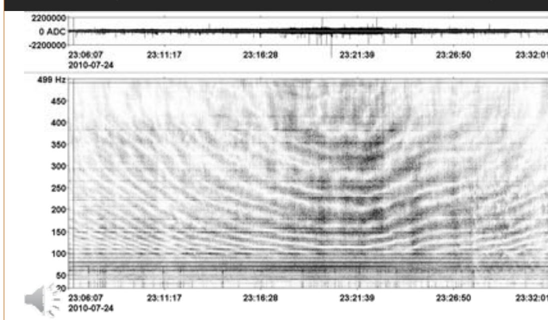
Shipping Sound Sample (at Delaware Bay)



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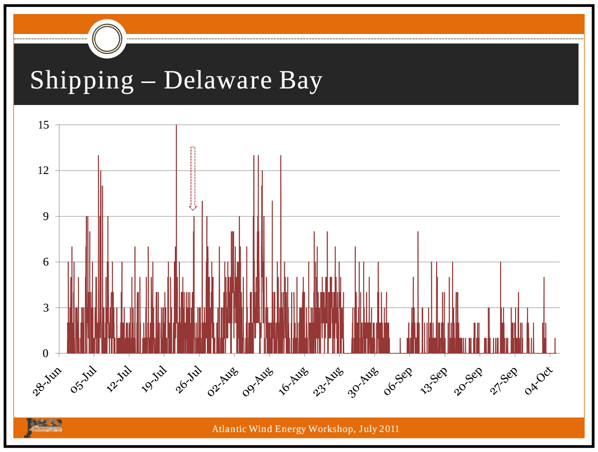
Shipping – Delaware Bay
15
12
9
6
3
0
28-Jun
05-Jul
12-Jul
19-Jul
26-Jul
02-Aug
09-Aug
16-Aug
23-Aug
30-Aug
06-Sep
13-Sep
20-Sep
27-Sep
04-Oct
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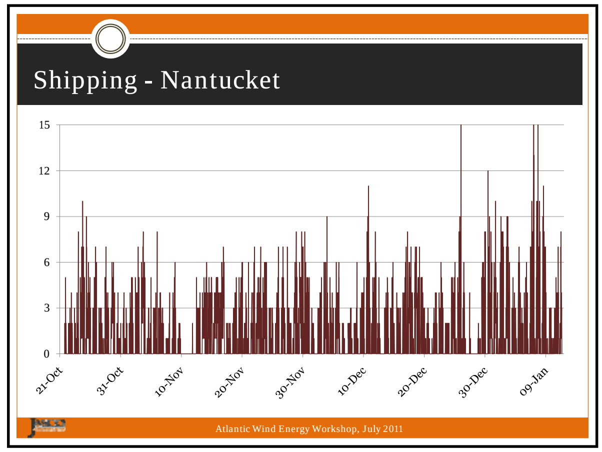
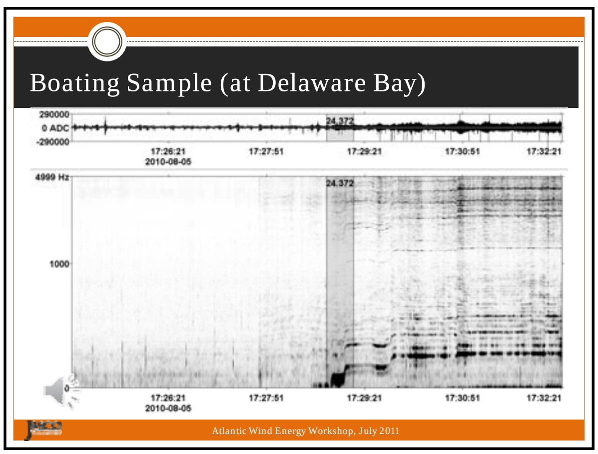
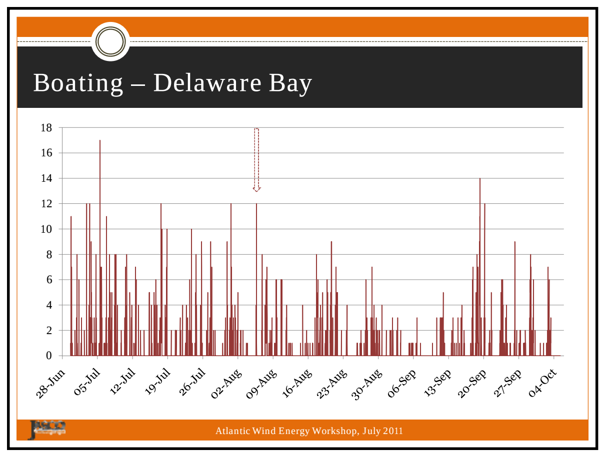
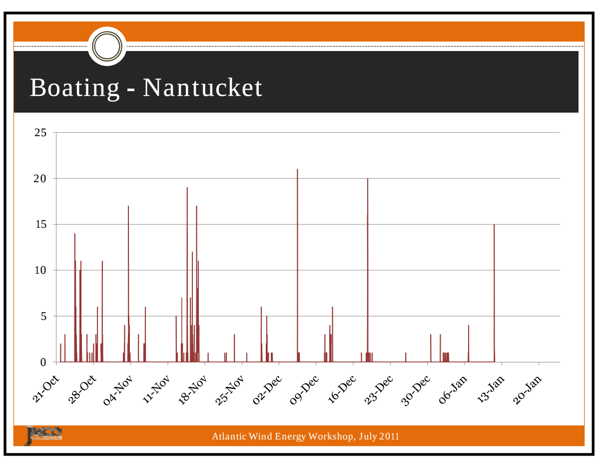
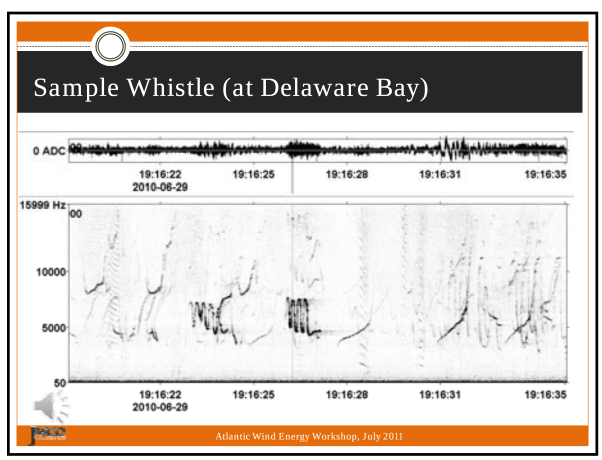
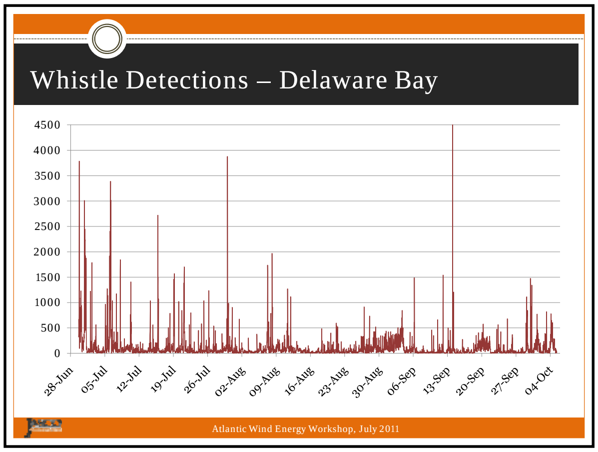

Shipping - Nantucket
15
12
9
6
3
0
21-Oct
31-Oct
10-Nov
20-Nov
30-Nov
10-Dec
20-Dec
30-Dec
09-Jan
Atlantic Wind Energy Workshop, July 2011

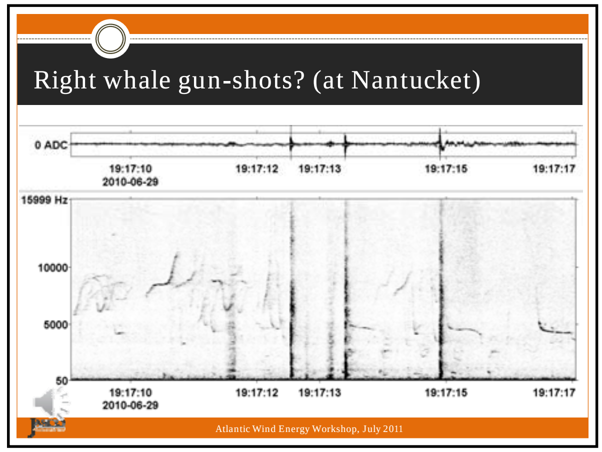

Boating Sample (at Delaware Bay)
290000
0 ADC
-290000
24.372
17:26:21
2010-08-05
17:27:51
17:29:21
17:30:51
17:32:21
4999 Hz
1000
Atlantic Wind Energy Workshop, July 2011

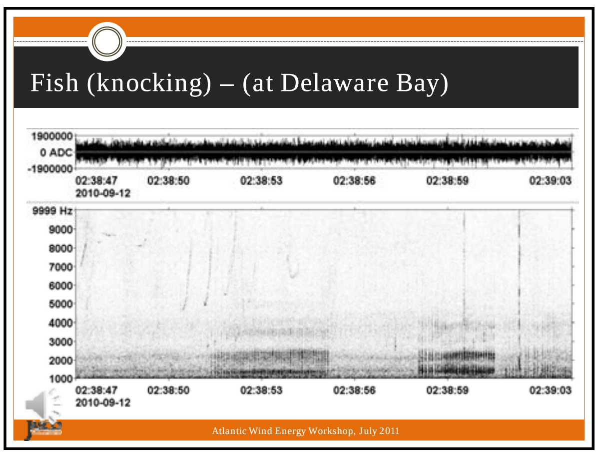

Boating – Delaware Bay
18
16
14
12
10
8
6
4
2
0
28-Jun
05-Jul
12-Jul
19-Jul
26-Jul
02-Aug
09-Aug
16-Aug
23-Aug
30-Aug
06-Sep
13-Sep
20-Sep
27-Sep
04-Oct
Atlantic Wind Energy Workshop, July 2011

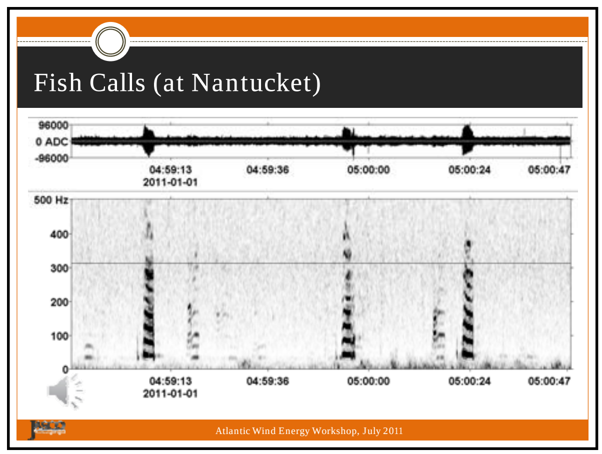

Boating - Nantucket
25
20
15
10
5
0
21-Oct
28-Oct
04-Nov
11-Nov
18-Nov
25-Nov
02-Dec
09-Dec
16-Dec
23-Dec
30-Dec
06-Jan
13-Jan
20-Jan
Atlantic Wind Energy Workshop, July 2011

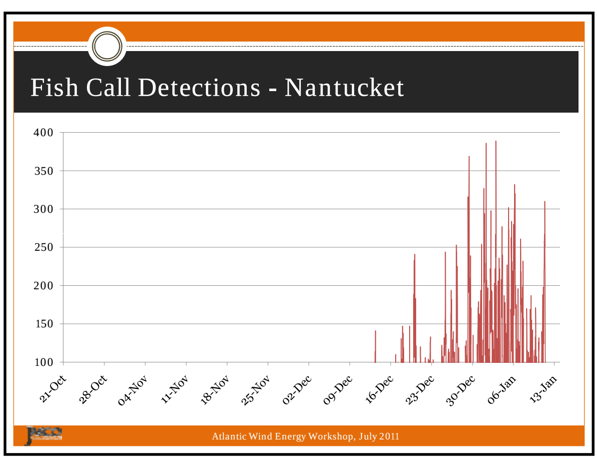

Sample Whistle (at Delaware Bay)
0 ADC
19:16:22
2010-06-29
19:16:25
19:16:28
19:16:31
19:16:35
15999 Hz
10000
5000
50
Atlantic Wind Energy Workshop, July 2011

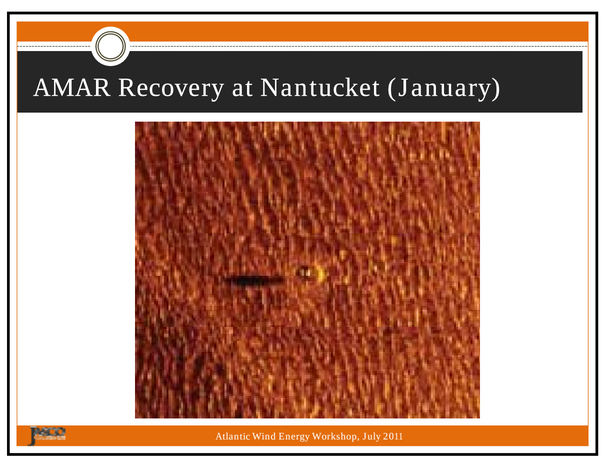

Whistle Detections – Delaware Bay
4500
4000
3500
3000
2500
2000
1500
1000
500
0
28-Jun
05-Jul
12-Jul
19-Jul
26-Jul
02-Aug
09-Aug
16-Aug
23-Aug
30-Aug
06-Sep
13-Sep
20-Sep
27-Sep
04-Oct
Atlantic Wind Energy Workshop, July 2011


Right whale gun-shots? (at Nantucket)
0 ADC
19:17:10
2010-06-29
19:17:12
19:17:13
19:17:15
19:17:17
15999 Hz
10000
5000
50
Atlantic Wind Energy Workshop, July 2011

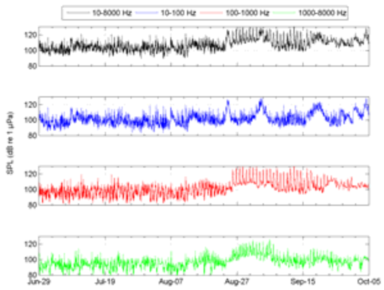

Fish (knocking) – (at Delaware Bay)
1900000
0 ADC
-1900000
02:38:47
2010-09-12
02:38:50
02:38:53
02:38:56
02:38:59
02:39:03
9999 Hz
9000
8000
7000
6000
5000
4000
3000
2000
1000
Atlantic Wind Energy Workshop, July 2011


Fish Calls (at Nantucket)
96000
0 ADC
-96000
04:59:13
2011-01-01
04:59:36
05:00:00
05:00:24
05:00:47
500 Hz
400
300
200
100
0
Atlantic Wind Energy Workshop, July 2011

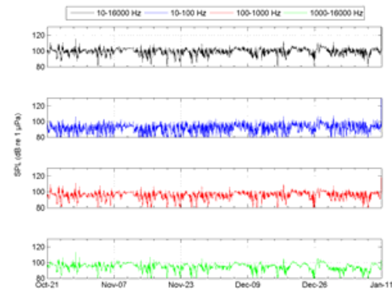

Fish Call Detections - Nantucket
400
350
300
250
200
150
100
21-Oct
28-Oct
04-Nov
11-Nov
18-Nov
25-Nov
02-Dec
09-Dec
16-Dec
23-Dec
30-Dec
06-Jan
13-Jan
Atlantic Wind Energy Workshop, July 2011


AMAR Recovery at Nantucket (January)
Atlantic Wind Energy Workshop, July 2011

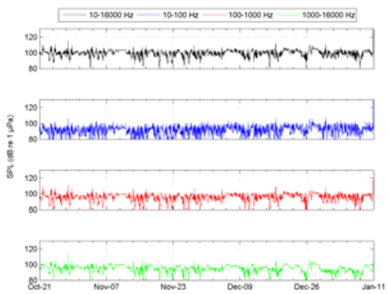
Ambient Acoustic Results – Band Level Plots



Ambient Results – Band Level Plots



Ambient Results – Band Level Plots



Four, three-month deployments:

- June– Oct
- Oct – Jan
- Jan – Apr
- Apr – Jun

Recording Sites in
- Delaware Bay (69')
- Nantucket (55')

NDBC Buoys 44020 and 44009 used for meteorological data.

Methods - Deployments

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

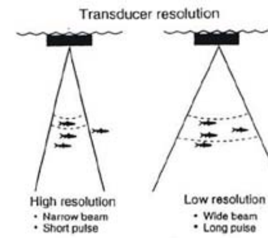
- Delaware Bay
  - Unsuccessful AMAR recovery
    - will attempt recovery in April
- Nantucket
  - Successful AMAR recovery
  - Successful data recovery

Monitoring Technologies and Acoustics

Thomas Carlson
Pacific Northwest National Laboratory
Marine Sciences Laboratory
Sequim, Washington

Application of Acoustic Technologies to Ocean Energy Development

- Reconnaissance
- Site Characterization
- Impact Assessment
- Compliance Monitoring
- Evaluation



Compliance Monitoring

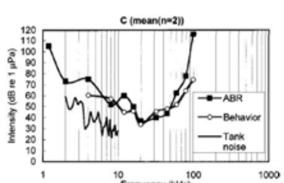
- Operating permits require monitoring to assure that endangered whales are not "taken"
- Challenge: detect and localize endangered killer whales within 200m of a tidal turbine
- Strategies – Passive & Active Acoustics
  - Passive acoustic detection and cross-bearing location estimation using two tetrahedral arrays separated by 20m
  - Active acoustic detection and tracking using multi-beam or fixed aspect array

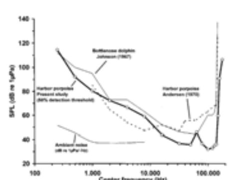
Killer Whale (*Orcinus orca*), or Orca

- Southern Resident Killer Whales
- Adult Males 6-8 m long, weigh >6 tons
- Adult Females 5-7m, weight 3-4 tons

Active Acoustic System Considerations

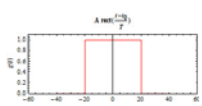
- Frequency of Operation
  - Selected 200 kHz
- Marine Mammal Hearing

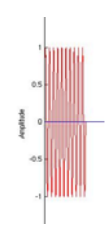




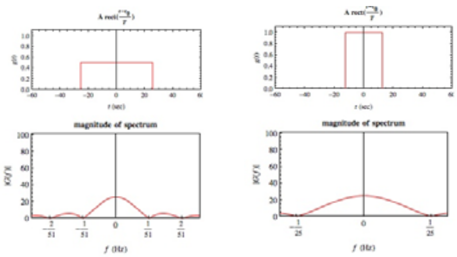
Sonar Pulse Duration

- 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

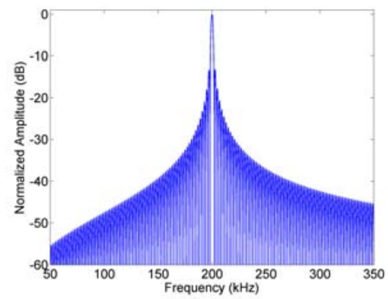




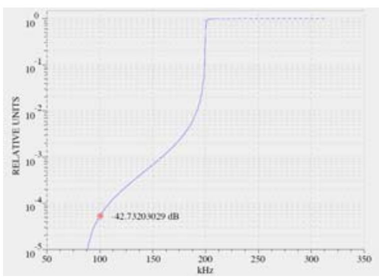
Sonar Pulse Frequency Content in Relation to Pulse Duration



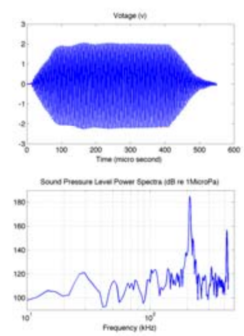
Sinc Function in Log Scale for 200 kHz 0.5 ms Duration Sonar Pulse



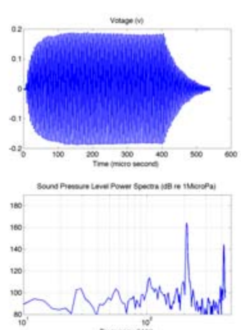
Cumulative integrated spectral energy (About 1% below 100 kHz)



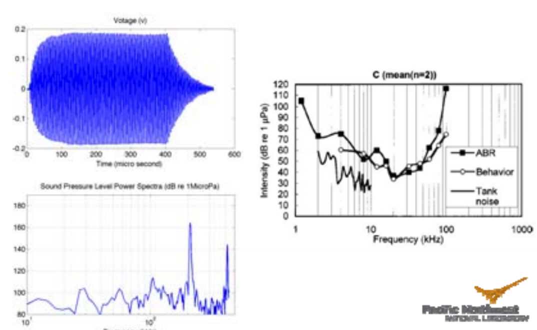
Field Measurement, 200 kHz Echo Sounder, 500 Micro-Second Pulse, 16 m Range



Field Measurement, 200 kHz Echo Sounder, 500 Micro-Second Pulse, 200 m Range

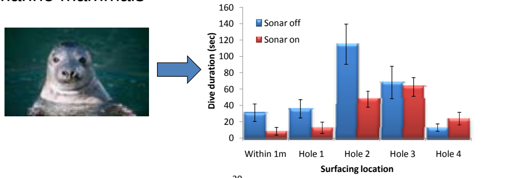


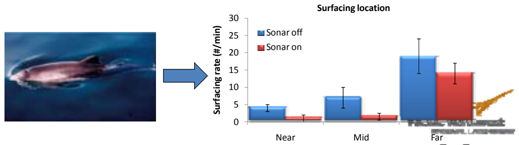
Whales Can Probably Hear the Sonar Pulses



Behavioral Responses To Sonar

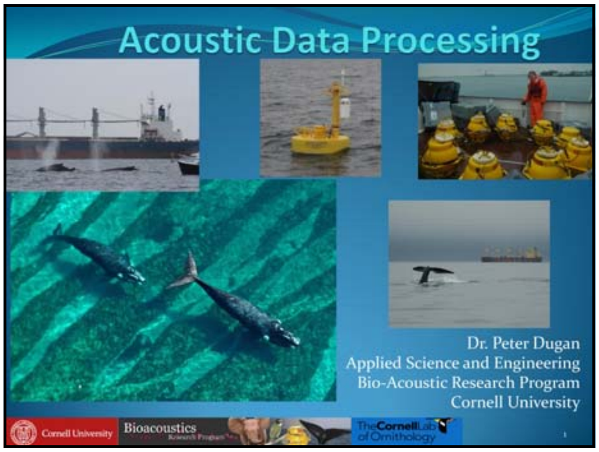
- Many high-frequency (>200Khz) active sonars have off-frequency noise ‘side-bands’ that appear detectable to marine mammals

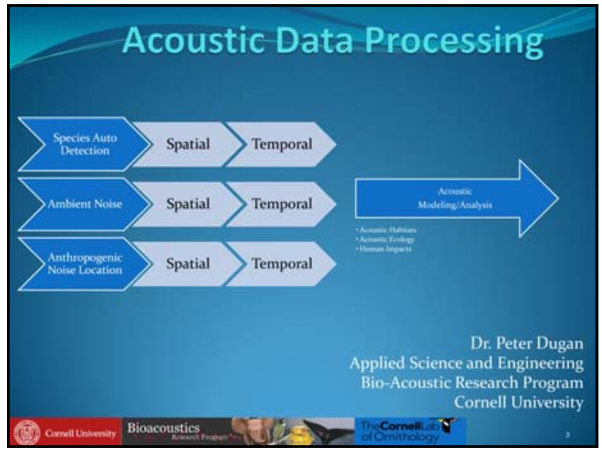


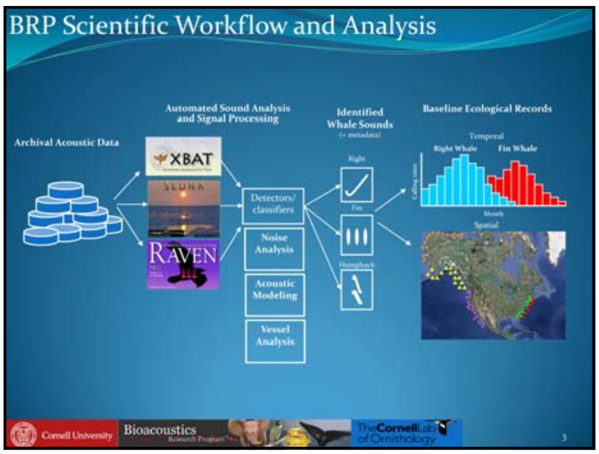


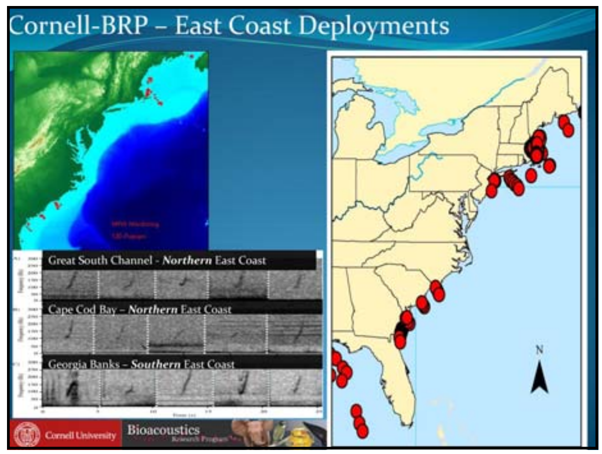
Summary

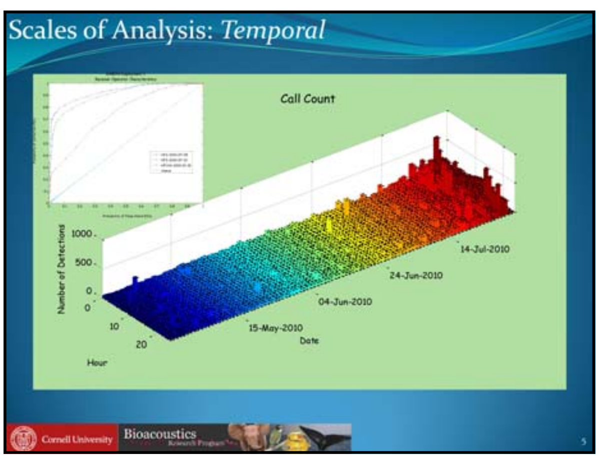
- COTS sonars operating at 200 kHz generate sound within the hearing range of killer whales and many other marine mammals
- Evidence is accumulating that there may be a behavioral response to sonar pulses
- Active acoustics remains in the mix for compliance monitoring but acceptance by regulators is an issue
- Potential upside – 200 kHz sonars may “alert” marine mammals to the presence of a turbine

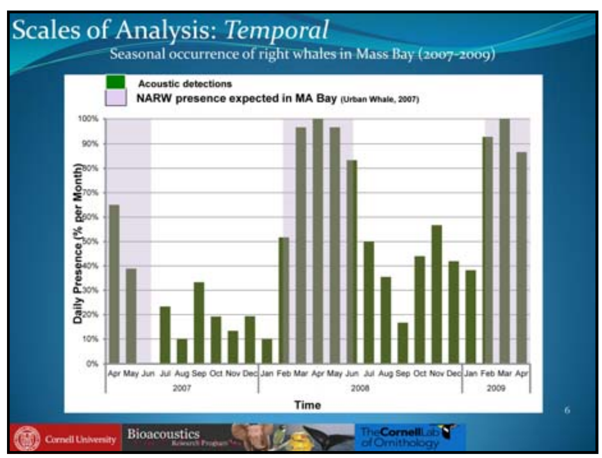

Acoustic Data Processing
Dr. Peter Dugan
Applied Science and Engineering
Bio-Acoustic Research Program
Cornell University
Cornell University
Bioacoustics
The Cornell Lab of Ornithology

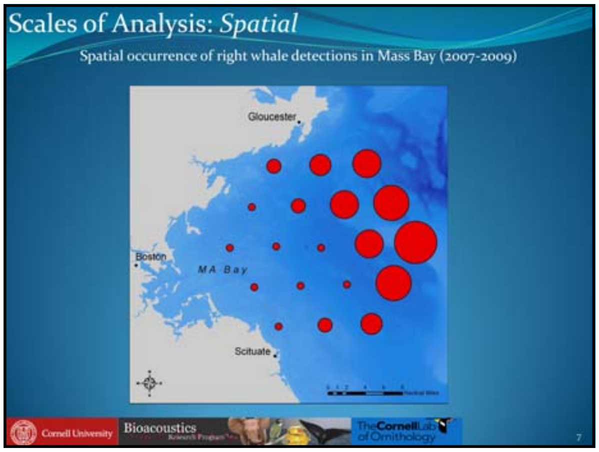

Acoustic Data Processing
Species Auto Detection
Spatial
Temporal
Ambient Noise
Spatial
Temporal
Anthropogenic Noise Location
Spatial
Temporal
Acoustic Modeling/Analysis
Dr. Peter Dugan
Applied Science and Engineering
Bio-Acoustic Research Program
Cornell University
Cornell University
Bioacoustics
The Cornell Lab of Ornithology

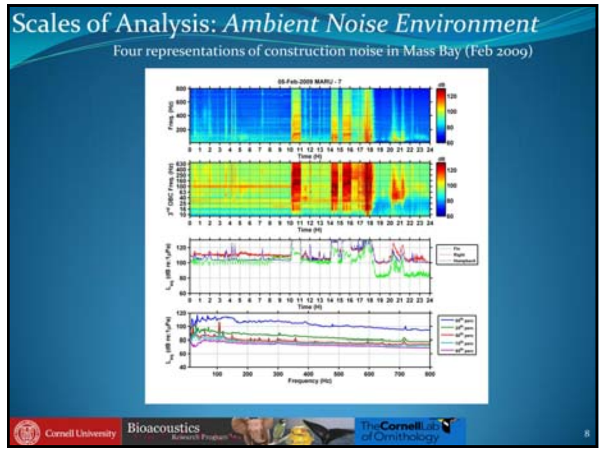

BRP Scientific Workflow and Analysis
Archival Acoustic Data
Automated Sound Analysis and Signal Processing
XBAT
RAVEN
Detectors/ classifiers
Noise Analysis
Acoustic Modeling
Vessel Analysis
Identified Whale Sounds
Baseline Ecological Records
Temporal
Right Whale
Fin Whale
Spatial
Cornell University
Bioacoustics
The Cornell Lab of Ornithology

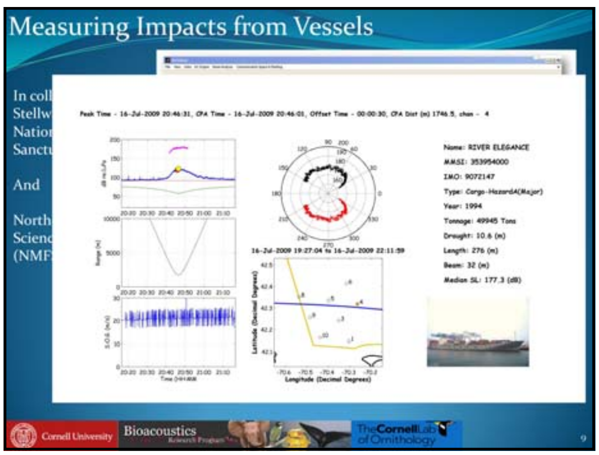

Cornell-BRP – East Coast Deployments
Great South Channel - Northern East Coast
Cape Cod Bay – Northern East Coast
Georgia Banks – Southern East Coast
N
Cornell University
Bioacoustics


Scales of Analysis: Temporal
Call Count
Number of Detections
1000
500
0
0
10
20
Hour
15-May-2010
04-Jun-2010
24-Jun-2010
14-Jul-2010
Date
Cornell University
Bioacoustics


Scales of Analysis: Temporal
Seasonal occurrence of right whales in Mass Bay (2007-2009)
Acoustic detections
NARW presence expected in MA Bay (Urban Whale, 2007)
Daily Presence (% per Month)
100%
90%
0%
Apr May Jun Jul Aug Sep Oct Nov Dec Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec Jan Feb Mar Apr
2007
2008
2009
Time
Cornell University
Bioacoustics
The Cornell Lab of Ornithology


Scales of Analysis: *Spatial*
Spatial occurrence of right whale detections in Mass Bay (2007-2009)
Gloucester
Boston
MA Bay
Scituate
Cornell University
Bioacoustics
Research Program
The Cornell Lab of Ornithology
7


Scales of Analysis: *Ambient Noise Environment*
Four representations of construction noise in Mass Bay (Feb 2009)
Cornell University
Bioacoustics
Research Program
The Cornell Lab of Ornithology
8


Measuring Impacts from Vessels
Name: RIVER ELEGANCE
MMSI: 353954000
IMO: 9072147
Type: Cargo-HazardA(Major)
Year: 1994
Tonnage: 49945 Tons
Draught: 10.6 (m)
Length: 276 (m)
Beam: 32 (m)
Median SL: 177.3 (dB)
Cornell University
Bioacoustics
Research Program
The Cornell Lab of Ornithology
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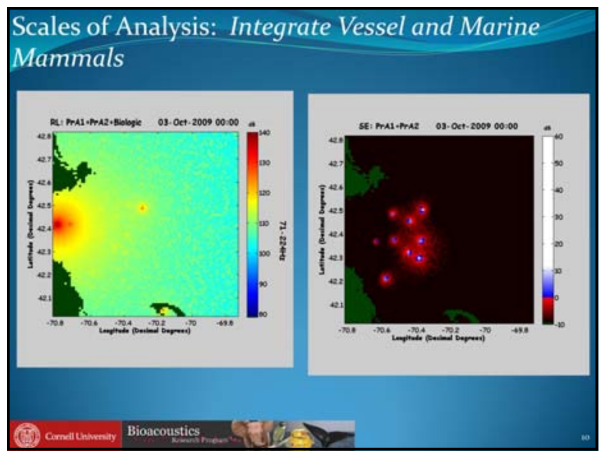
Scales of Analysis: *Integrate Vessel and Marine Mammals*
RL: PrA1+PrA2+Biologic 03-Oct-2009 00:00
SE: PrA1+PrA2 03-Oct-2009 00:00
Latitude (Decimal Degrees)
Longitude (Decimal Degrees)
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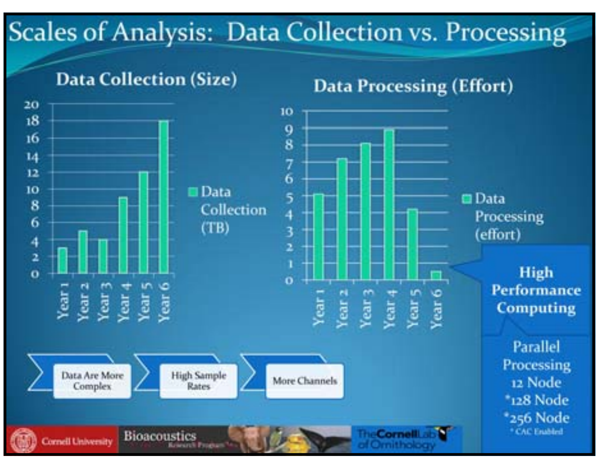
Scales of Analysis: Data Collection vs. Processing
Data Collection (Size)
Data Processing (Effort)
Data Collection (TB)
Data Processing (effort)
Year 1
Year 2
Year 3
Year 4
Year 5
Year 6
High Performance Computing
Parallel Processing
12 Node
*128 Node
*256 Node
* CAC Enabled
Data Are More Complex
High Sample Rates
More Channels
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Forward
Data management, HPC
• Variety of data formats,
• Complicated relationships, and
• Large amounts to manage and re-process
Modeling (noise impacts)
• Impulse -> Models
• Tools -> "Applied Community"
• Create tools that resource managers can use.
New Grants and Basic Research
• Auto Buoy – leveraging arctic, real time data acquisation.
• NSF Glider
(SAIC)
• ONR DCL – Advanced methods for DCL
(NYU, PNNL and Lockheed Martin)
HLS
bp
excelerate
SAIC
NYU
Cornell University
Bioacoustics
Research Program
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Effects of EMFs from Transmission Cables on Marine Organisms

Ann Pembroke
Normandeau Associates, Inc.
Presented at
Atlantic Wind Energy Workshop
July 13, 2011

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Basis of Concern

- Electrosensitivity

- Magnetosensitivity

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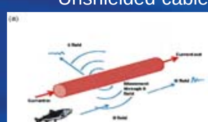
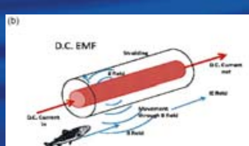
Source of Concern

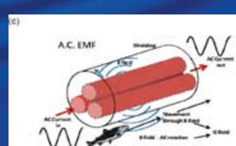
Unshielded cable



courtesy: Scottish Natural Heritage (Gill and Bartlett 2010)

Shielded cables





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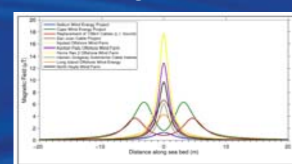
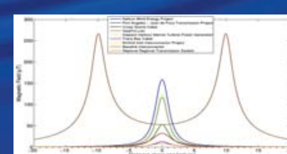
Source of Concern – Magnetic Fields

AC Cables
- 33 – 138 kV
- oscillates



DC Cables
- 75 – 500 kV
- directional



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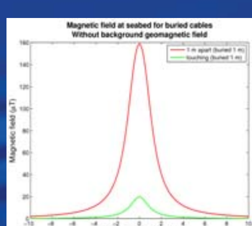
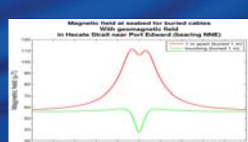
Geomagnetic Field Influence – NaiKun DC export cable

Without geomagnetic field **With geomagnetic field**





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Elasmobranchs Case Study Sandbar Shark

- Demersal, schooling, migratory
- HAPC (juveniles) in Mid-Atlantic
- Sensitive to bioelectric field
- Sensitive to DC magnetic field > geomagnetic field

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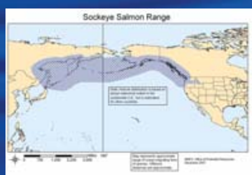
Other Fishes Case Study
Sockeye Salmon



- Anadromous
- Dependence on natal rivers
- Geomagnetic cues
- Pelagic behavior
- Potential impact by DC cables near estuary mouth, but other senses come into play

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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

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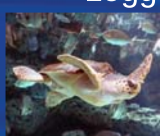
Sea Turtles Case Study
Loggerhead Turtle



- 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

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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

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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 lifestages generally not studied

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Acknowledgements

BOEMRE Pacific Region Contract M09PC00014
http://www.boemre.gov/omm/pacific/enviro/Enviro-Studies/completed-environmental-studies.htm

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William Bailey, Exponent
Timothy Tricas, University of Hawaii
Andrew Gill, Cranfield University
contact: apembroke@normandeau.com

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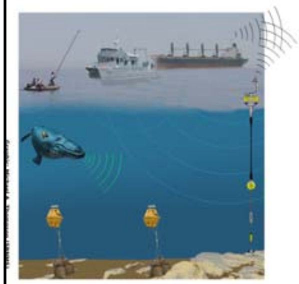
Passive Acoustic (PA) Research at NOAA/ NMFS



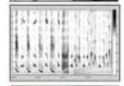
Dr. Sofie Van Parijs

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)

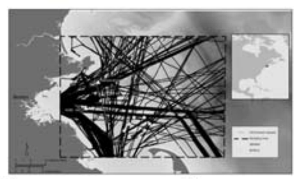
Autonomous acoustic technology (gliders) (2010 – ongoing)

Ocean Noise Project (2007 - ongoing)

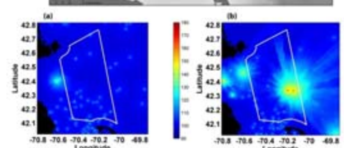
OBJECTIVES

- 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

SBNMS Ocean Noise Project: previous analyses



- Analyses modeled communication range for 89 right whales over the course of one month (April 2008)
- Summary: Calling right whales have lost 72 -84% 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 $\geq$ 120 dB by ships for 20% of the month

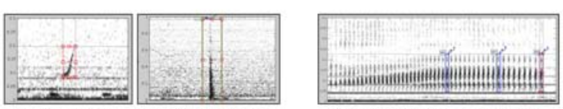


SBNMS Ocean Noise Project: current analyses

Expanding previous project to assess communication masking for multiple species and call types

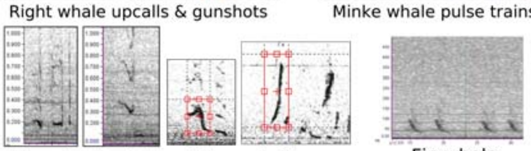
Right whale upcalls & gunshots

Minke whale pulse trains



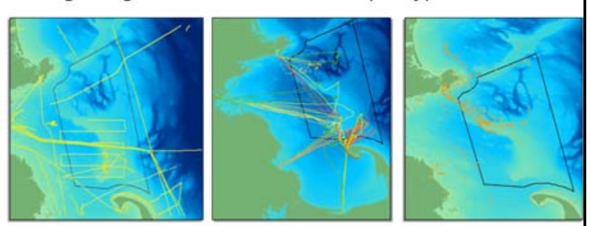
Humpback whale social sounds & song

Fin whale song



SBNMS Ocean Noise Project: current analyses

Integrating sound fields from multiple types of vessels



Large vessels (carrying AIS)

Whale watching vessels

Fishing vessels

Day 2 - 13 July 2011
Presentations/Environmental/
Acoustic Monitoring Technology and Impacts

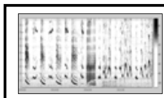
Long term monitoring of Marine Mammals and Fish (2007 - ongoing)

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

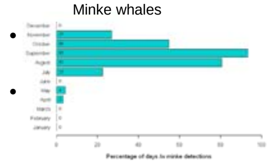
Detectability of Right whale mom-calf pairs

- Objective: Assess calling activity of right whale mothers with their calves across different habitats

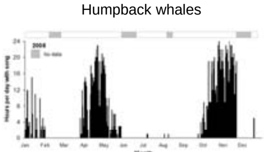


Documenting long term occurrence of whale species

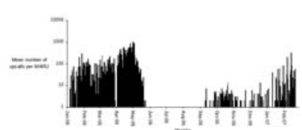
Minke whales



Humpback whales

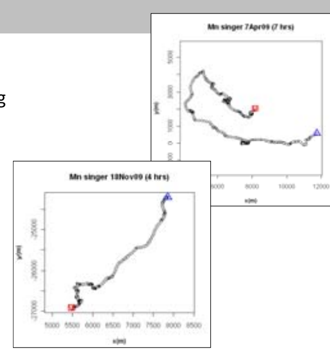


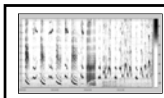
Right whales



Movements of singing humpback whales on foraging grounds

- Developing new tracking metrics to assess changes in behavior

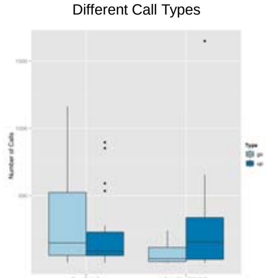


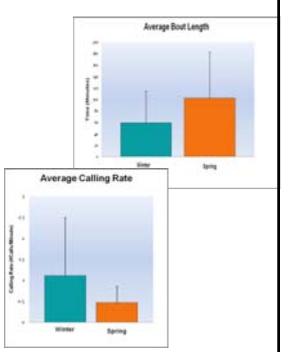


Right whale acoustic behavior

Seasonal variation in calling

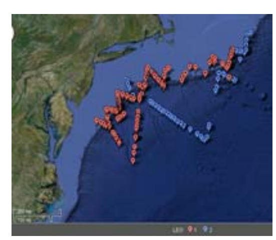
Different Call Types





Acoustic Abundance Estimation of Marine Mammals (2007 – ongoing)

AMAPPS Summer 2011



When bad weather = acoustic detection still possible

AMAPPS Summer 2011

Common Name	Species Code	LEG 1	LEG 2	TOTAL
Bottlenose dolphin	Tt	14	6	20
Common Dolphin	Dd	11	7	18
Striped dolphin	Sc	5	9	14
Atlantic spotted dolphin	Sf	3	10	13
Risso's Dolphin	Gg	2	2	4
Rough-toothed dolphin	Sb	1	1	2
Pilot whale	Gm	1	1	2
Clymene's dolphin	Sclym	1		1
Mixed species	MIX		7	7
Sperm whale	Pm	7	17	24
Humpback whale	Mn		1	1
Beaked whale	BW		1	1
Unknown		93	26	119
		138	88	226
Recording Time (hh:mm)		136:45:00	64:19:00	201:04:00
Days w/ acoustic effort		17	8	25

Integration of acoustic information with visual data

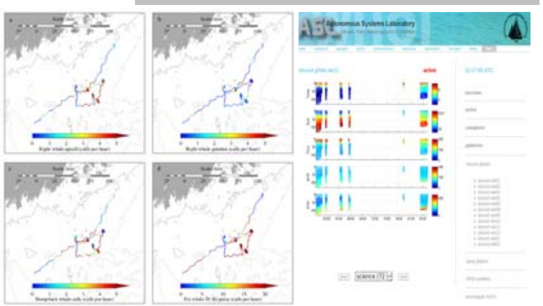
Autonomous Acoustic Technology (2007 – ongoing)

Collaborative project with WHOI (M. Baumgartner & D. Fratantoni)

OBJECTIVES

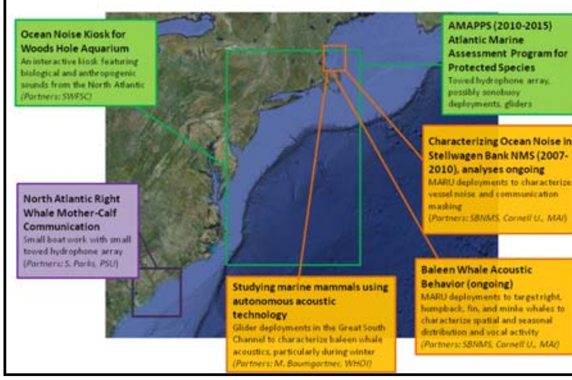
- Record low and mid-frequency marine mammal vocalizations
- Detect, classify, and report vocalizations of interest in REAL TIME
- Collect oceanographic data

Autonomous Acoustic Technology (2010 – ongoing)



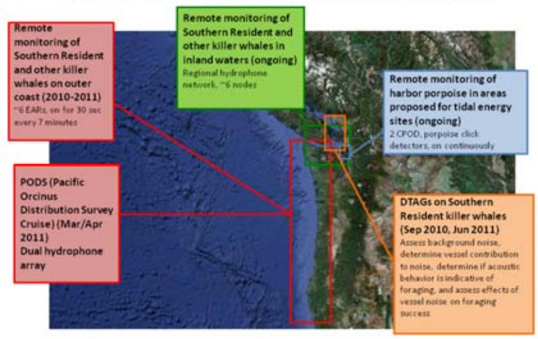
Real time relay of detections underway

NEFSC: Current PAM Field Projects



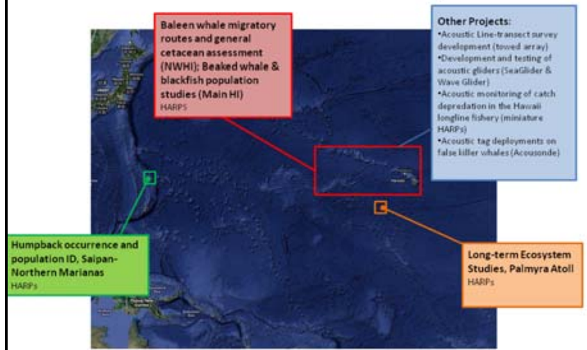
SEFSC: Current PAM Field Projects

NWFSC: Current PAM Field Projects

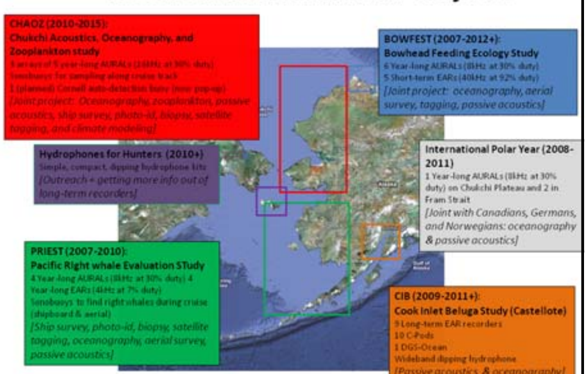


SWFSC: Current PAM Field Projects

PIFSC: Current PAM Field Projects

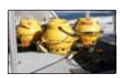


AFSC: Current PAM Field Projects

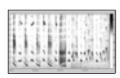


Alaska Fisheries Science Center

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 PA spatial models & others.

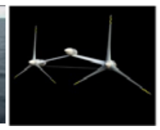
4. NOAA PA archive – working with NGDC for archiving and NOPP project for establishing the data portal.

Day Two

- Open Microphone

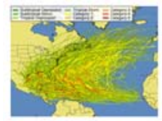
  An opportunity for participants to present any other relevant efforts that have been recently completed, or that are on-going that may have an impact on TA&R research efforts.





"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?

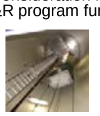
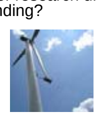




Marine Hydrokinetic (MHK) Devices (with special emphasis on current devices in the Gulf Stream)

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.



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.

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?

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

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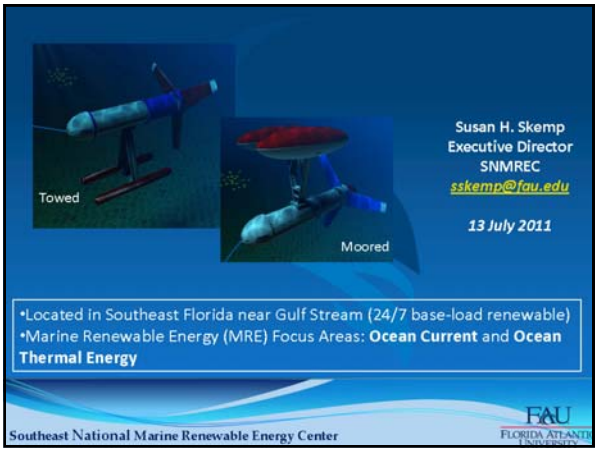
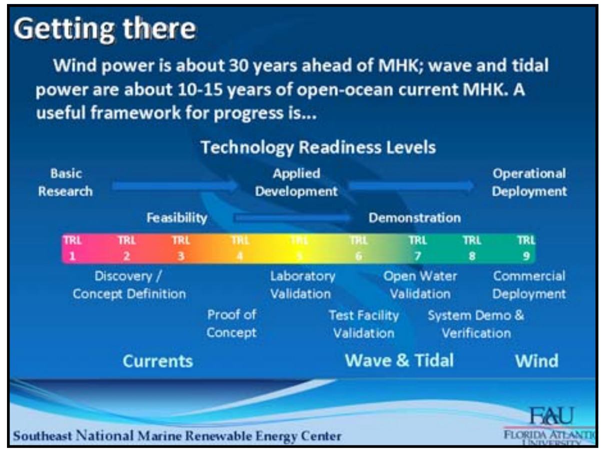
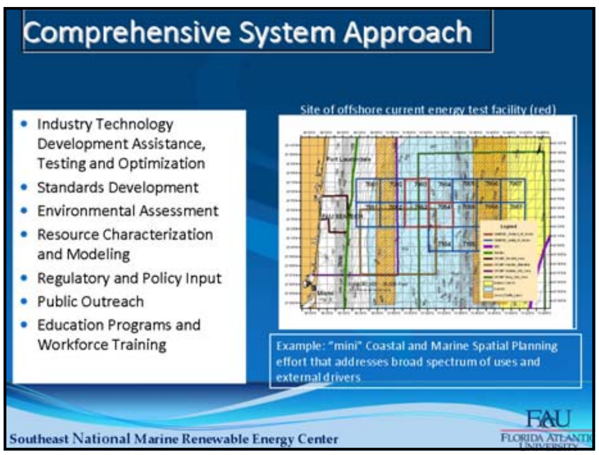
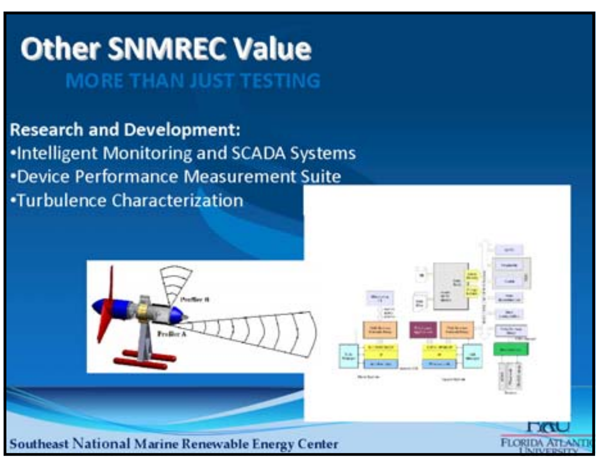
- **Lori Medley**: Engineering & Research Branch, 703-787-1915, Lori.Medley@boemre.gov

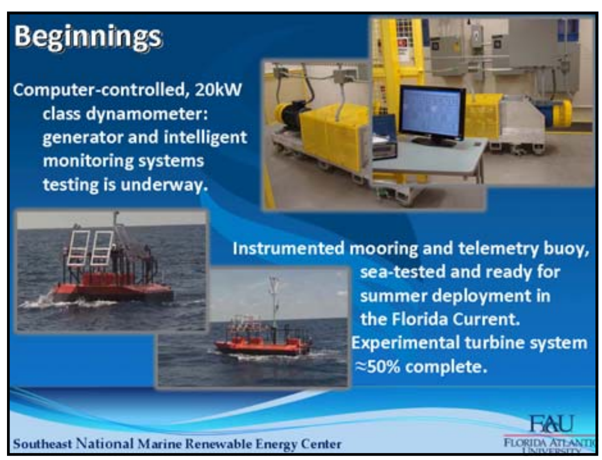
Day 2 - 13 July 2011
Presentations/Technology Assessment and Resource Program











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.

Southeast National Marine Renewable Energy Center — FAU Florida Atlantic University

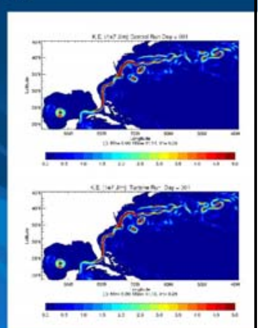
Aerial Surveys

- 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

Southeast National Marine Renewable Energy Center — FAU Florida Atlantic University

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.



Southeast National Marine Renewable Energy Center — FAU Florida Atlantic University

Day 2 - 13 July 2011
Presentations/Birds and Bats

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

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)
    - Summary of historic seabird database and modeling efforts
  - Dr. Richard Veit (CSI/SUNY)
    - Results from ships of opportunity cruises and examples of persistent aggregations or 'hotspots'
  - 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?

Day 2 - 13 July 2011
Presentations/Birds and Bats

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**

Atlantic Wind Energy Workshop July 12-14, 2011

Bureau of Ocean Energy Management, Regulation and Enforcement

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

Atlantic Wind Energy Workshop July 12-14, 2011

Bureau of Ocean Energy Management, Regulation and Enforcement

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.)

Atlantic Wind Energy Workshop July 12-14, 2011

Bureau of Ocean Energy Management, Regulation and Enforcement

Birds – Data Needs for Best Bird Map

- Sensitivity Analysis
  - Identify species vulnerabilities to offshore wind development
    - behavior
    - environmental
    - conservation status
  - Prioritize species based on vulnerability

Atlantic Wind Energy Workshop July 12-14, 2011

Bureau of Ocean Energy Management, Regulation and Enforcement

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)

Atlantic Wind Energy Workshop July 12-14, 2011

Bureau of Ocean Energy Management, Regulation and Enforcement

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

Atlantic Wind Energy Workshop July 12-14, 2011

Bureau of Ocean Energy Management, Regulation and Enforcement

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

2

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

3

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

4

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)

5

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)

6

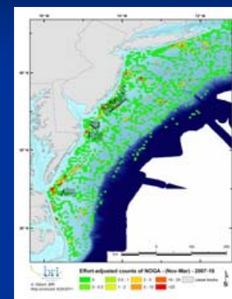
Lease Construction and Operations Stage

- 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

7

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?



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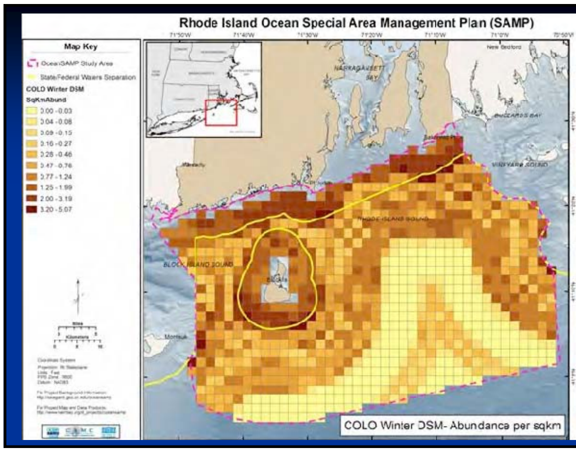
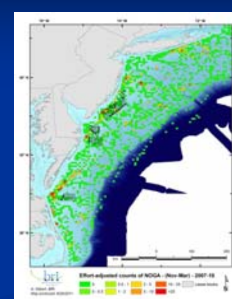


Information needs

- Guideline development for avian surveys
  - How many surveys are needed to detect a "hot spot" or persistent aggregation?



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Information needs

- Identify priority species.
  - What species are we most concerned about?
  - T & E
  - Guilds
  - Umbrella species
  - Others?
- Species risk – How are they vulnerable?
  - Life history
  - Behavior
  - Migration
  - Etc…

11

Immediate Information Needs

Key stage	Information need
Planning and Analysis	• Maps of species distribution & abundance • Identification of priority species
Lease or Grant	-
Site Assessment	• Estimated number of surveys
Commercial Development	• Maps of species distribution & abundance (updated) • Risk assessment for priority species

12

Summary: Workshop on Marine Bird Science and Offshore Wind

Melanie Steinkamp
US Fish and Wildlife Service

Workshop Goals and Objectives

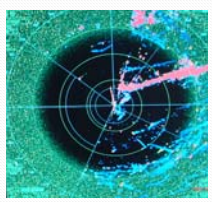
Goals:

1) Present current knowledge of the distribution and abundance of marine birds and
2) 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.

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

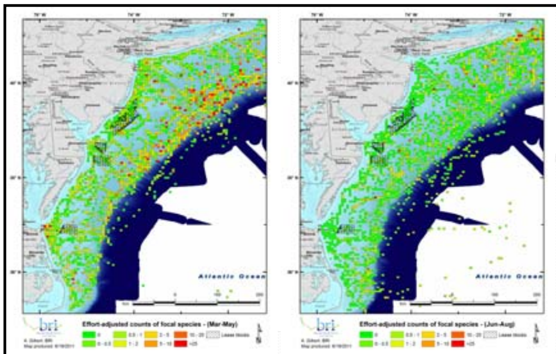


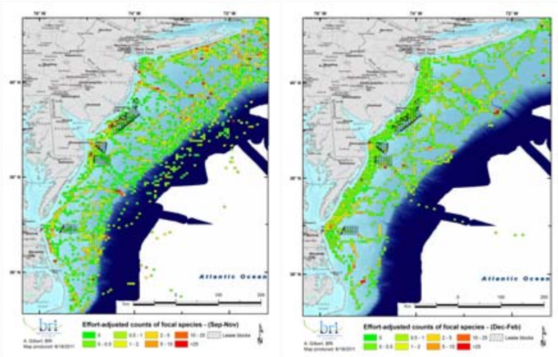
Participation

- Sixty-five participants; 15 via web-ex
- Diversity of interests – federal, state, industry, advocacy groups and NGOs , consultants, and academia.
- Seventeen presentations: results-focused
  - Information from Surveys
  - Information from Tracking Studies
  - Predictive Modeling Studies
  - Emerging Technologies, Information Syntheses, and Tools

Workshop Materials

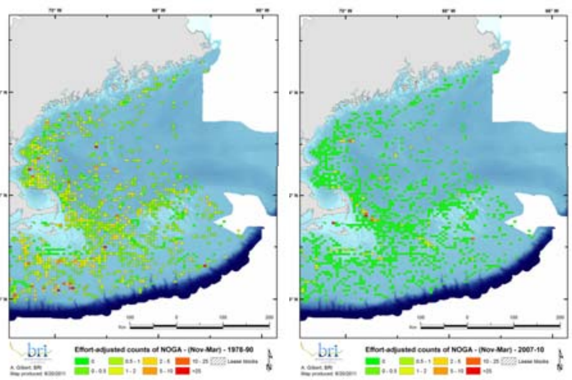
- Much prep work ahead of time
- Used seabird database of historic (and most recent) seabird data compiled by USGS.
- Created seabird distribution and abundance maps to stimulate discussions
- Asked all PI's doing work in the Atlantic on seabirds to provide data.
  - Dist and Abund from historic database
  - NJ and RI study results
  - Results of listed spp study (piping plover, least tern, red knot)
  - Cape Wind Studies
  - Tracking Studies

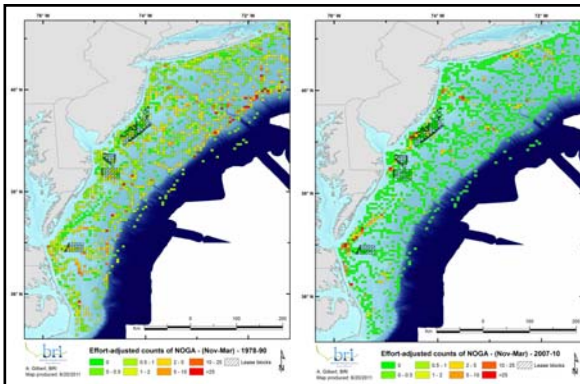




Focal Species

- Audubon's Shearwater
- Cory's Shearwater
- Greater Shearwater
- Northern Fulmar
- Northern Gannet
- Common Murre
- Dovekie
- 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

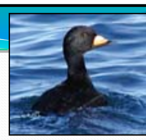
Breakout Sessions

- "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

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

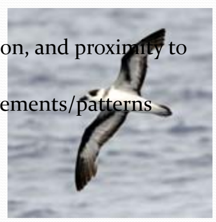
Anthropogenic
- Commercial and recreational fisheries

Factors

Species groups – Which species to focus on for potential impacts – includes collision, displacement and avoidance. Weather is major potential factor
- Gannets and fish easting 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

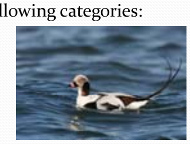
Breakout

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

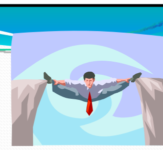
- Available data was reviewed within the following categories:
  - Distance from shore (nm)
    - Within 3 miles of coastline
    - Between 3 and 25 miles offshore
    - 25 miles to 200 miles
    - Greater than 200 miles
  - Seasonal (summer, winter and migration)
  - Region
    - Gulf of Maine, Hudson Canyon to Cape Cod, Mid-Atlantic and South Atlantic
- Data quality – from 1 (poor, low confidence) to 5 (excellent, high confidence)



PROCESS FOR IDENTIFYING PERSISTENT AGGREGATIONS and INTERPRETING THEM

1. Define P.A. - define parameters for P.A., by species? Include temporal/seasonal factors.
2. Map P.A.s
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 E species needs, other species such as white-winged scoter, other sea ducks, geese, 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



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.

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 factors)
- 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, avoidance, 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

BOEMRE Research on Birds on the Atlantic OCS

2) Potential for Interactions Between Endangered and Candidate Bird Species and Wind Facility Operations on the Atlantic Outer Continental Shelf (Pandion Systems, Inc. – now Normandeau Associates)

- light-sensitive data loggers on red knots to determine their migratory flight paths
- observations on bird behavior and avoidance actions when encountering an operating coastal wind turbine

BOEMRE Research on Birds on the Atlantic OCS

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
- uses the Avian Knowledge Network data to predict whether piping plovers are "coast huggers" or "shortcutters" 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.

BOEMRE Research on Birds on the Atlantic OCS

3) Automated Analysis of Bird Vocalization Recordings (Cornell University)

- software developed to automate the analysis of bird vocalizations digitally recorded offshore

BOEMRE Research on Birds on the Atlantic OCS

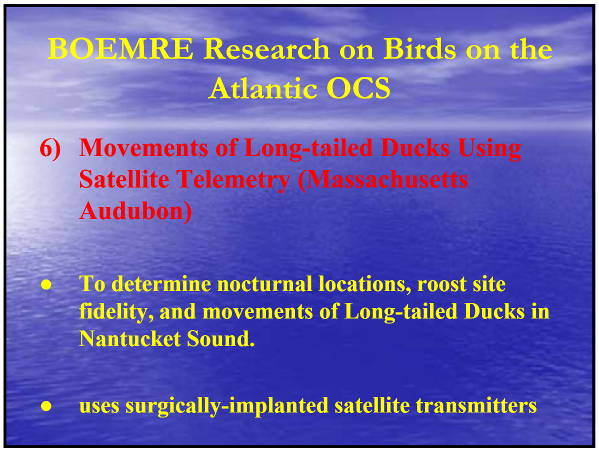
4) Pilot Study of Aerial High-Definition Imagery Surveys for Seabirds, Marine Mammals, and Sea Turtles on the Atlantic OCS (Pandion Systems, Inc. – now Normandeau Associates)

- 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
- will include testing the effect of flight altitudes and camera combinations on transect widths and image resolution
- will recommend a sampling design and provide a cost estimate

BOEMRE Research on Birds on the Atlantic OCS

5) Acoustic/Thermographic Monitoring of Temporal and Spatial Abundance of Birds Near Structures on the Atlantic OCS (Pandion Systems, Inc. – now Normandeau Associates)

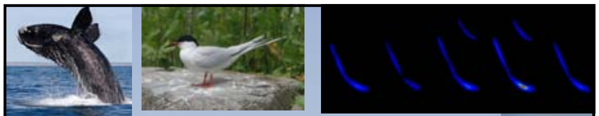
- A combination acoustic/thermographic detection device that can verify recorded vocalizations to species via thermal imagery simultaneous with the recordings
- will provide information on circadian, seasonal, annual, and weather-related variation in bird species presence near OCS structures in daylight and darkness and all weather conditions
- 2011 deployment will be at Frying Pan Shoals Lighthouse and University of Delaware – Lewes wind turbine


BOEMRE Research on Birds on the Atlantic OCS
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


BOEMRE Research on Birds on the Atlantic OCS
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


Potential Future BOEMRE Bird Studies on the Atlantic OCS
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


Potential Future BOEMRE Bird Studies on the Atlantic OCS
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.
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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"
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3. Aerial High-definition Imaging Pilot Study
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Project Team

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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."

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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

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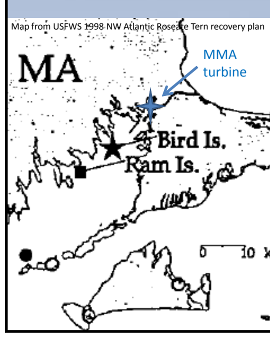
Results Summary 1: Bird mortality-behavior studies at a coastal wind turbine in Buzzards Bay,



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Day 2 - 13 July 2011
Presentations/Birds and Bats

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):

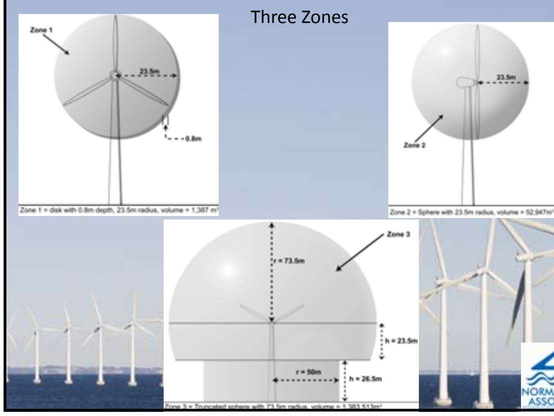
- collision mortality = 0-5 birds/MW/yr
  (3 years of carcass searches with bias-correction expts)
- No Roseate or Common Tern mortality
  (high COTE activity, low ROST activity at site)
- Some evidence of behavioral avoidance of rotor by terns
  - higher passage rate when rotor stopped
  - density decrease near rotor

Results Summary 1: Bird mortality-behavior studies at a coastal wind turbine in Buzzards Bay, MA

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

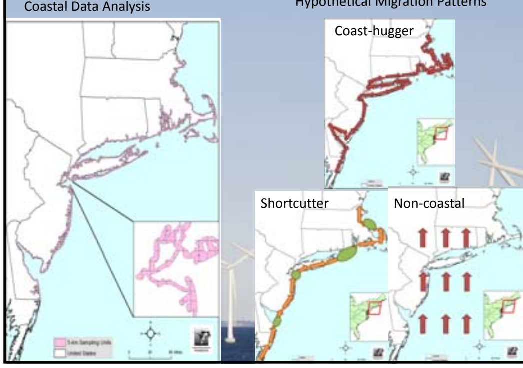
Tern Avoidance Observations
Three Zones



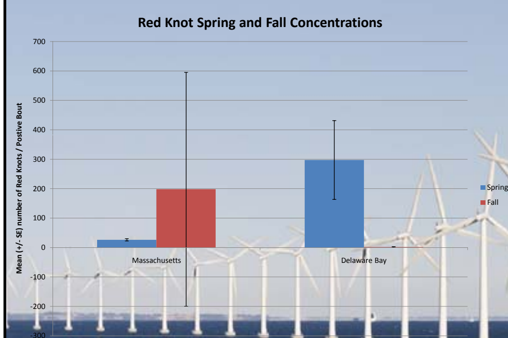
Results Summary 2: Tracking Intercontinental Migration Paths of Red Knots using light-sensitive Geolocators

- 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



Results Summary 3: Comprehensive Geospatial Analysis Using Avian Knowledge Network Data

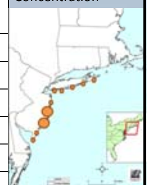


Results Summary 3: Comprehensive Geospatial Analysis Using Avian Knowledge Network Data

Piping Plover Data for coastal New Jersey (AKN)

	Total Number of Valid Observation Bouts	Total Bouts with Piping Plover (% of Total)	Total Piping Plover (PIPL) Observations	Mean PIPL/Bout of Positive Observations (+/- SE)	Mean PIPL/Bout of Positive and Negative Observations (+/- SE)	Maximum PIPL Observed in a Single Bout
March	641	19 (2.9%)	34	1.78 (0.21)	0.053 (0.01)	4
April	527	36 (6.8%)	120	3.33 (0.45)	0.23 (0.04)	11
May	831	60 (7.2%)	292	4.86 (0.88)	0.35 (0.07)	35
June	346	21 (6.0%)	136	6.48 (1.58)	0.39 (0.12)	32
July	341	27 (7.9%)	171	6.33 (1.24)	0.50 (0.13)	27
August	310	14 (4.5%)	134	9.57 (2.78)	0.43 (0.16)	29
September	397	16 (4.0%)	134	8.38 (1.30)	0.33 (0.09)	22
October	545	10 (1.8%)	103	10.3 (2.43)	0.18 (0.07)	22

Hypothetical Coastal Migratory Concentration



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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

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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. Desholm

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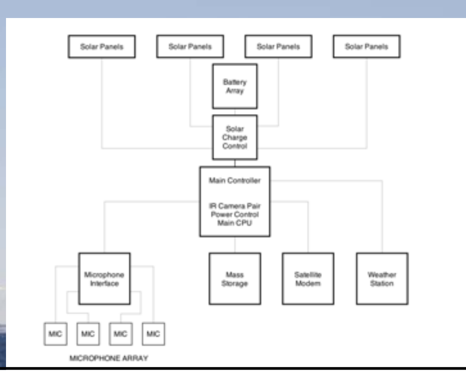
Acoustic/Thermographic Offshore Monitoring System (ATOM)



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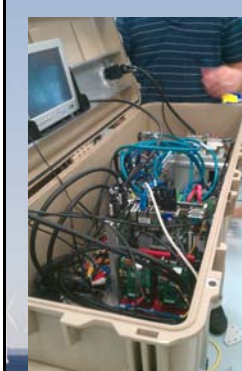

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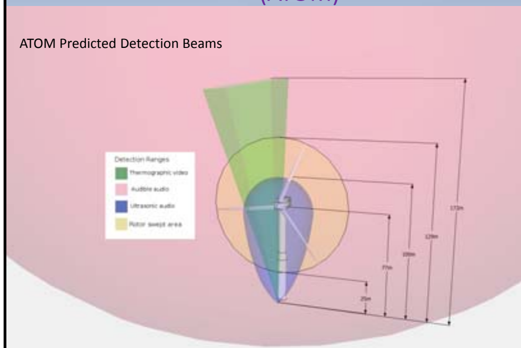
Acoustic/Thermographic Offshore Monitoring System (ATOM)

ATOM Predicted Detection Beams



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Aerial High-definition Imaging Pilot Study

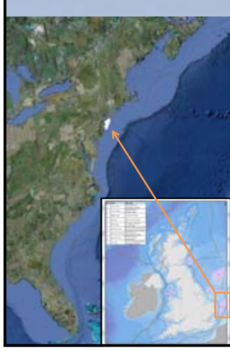
- Objective
  Determine optimal technology and methodology for conducting high-definition aerial ocean wildlife surveys in the U.S.
  - Birds, marine mammals, and sea turtles
  - Cover a very large area in a very short time
  - Cost-effective and safe
- Scope
  Conduct pilot studies, evaluate image-gathering 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

Aerial High-definition Imaging Pilot Study

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

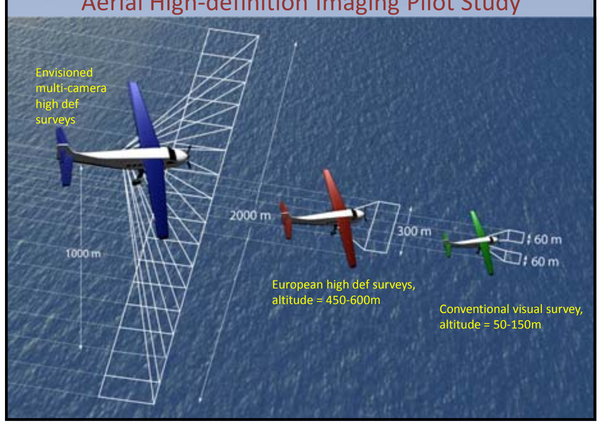
Aerial High-definition Imaging Pilot Study

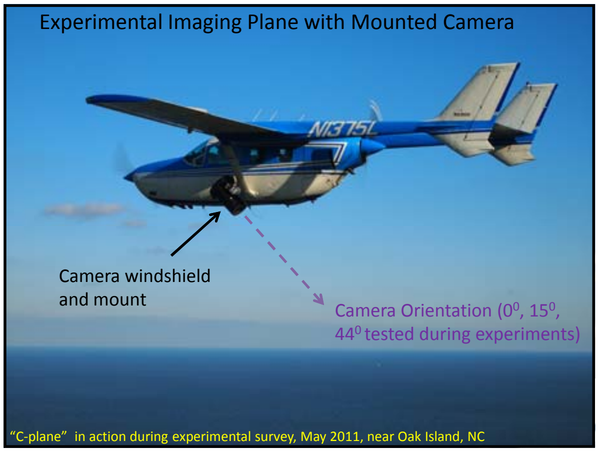


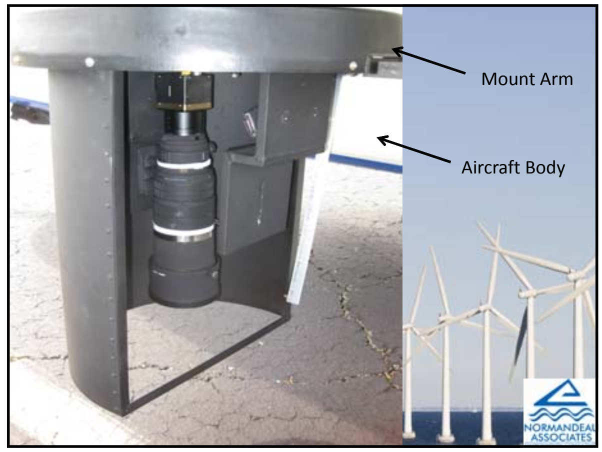
←Crown Estate Round 3 Zones

- 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 mi^2 survey area
- 610 meter flight altitude
- 174 mph airspeed
- Survey time: 3 days

Aerial High-definition Imaging Pilot Study

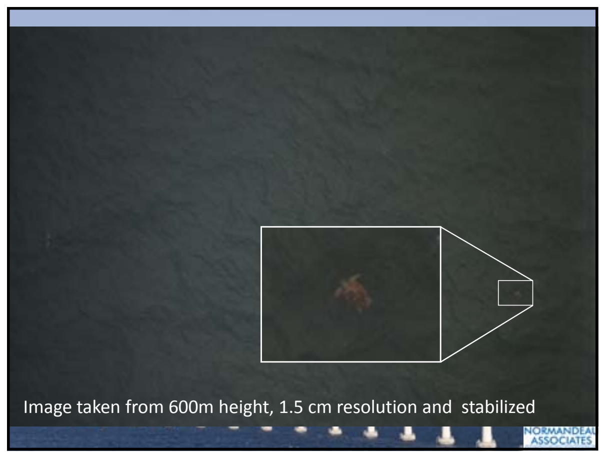


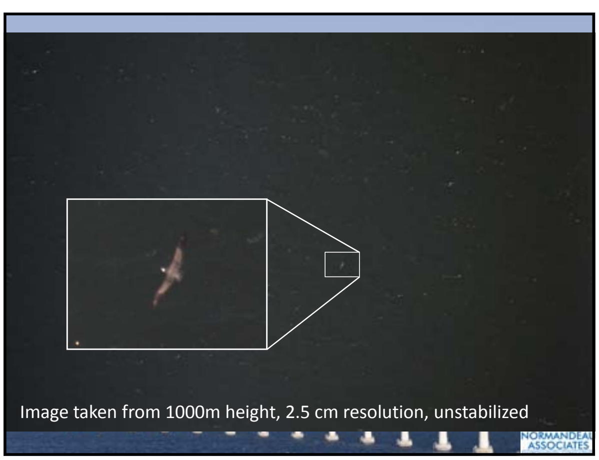




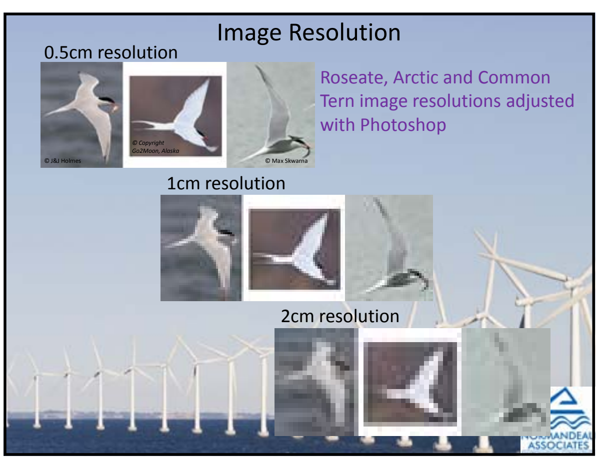
Experimental Design

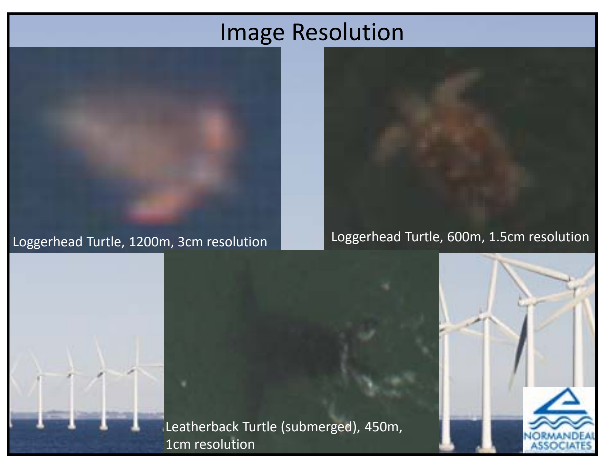
Treatment Factor	Treatments				
Aircraft	Twin-engine manned fixed wing	Unmanned Aerial Vehicle			
Resolution	1 cm	1.5 cm	2 cm	2.5 cm	3 cm
Camera Type	Area Scan	Line Scan			
Light Polarization	With	Without			
Angle	0^0	15^0	44^0		
Altitude	1200m	1000m	850m	600m	450m
Gyroscopic Stabilization	With	Without			





Glare (importance of camera angle)





Importance of Flight Altitude % individuals within RSZ

Bird species or group	NJDEP 2010 (New Jersey)	Paton et al. 2010 (Rhode Island)
Large gull spp.	6.8%	Herring Gull: 12.8% Great Black-backed Gull: 8%
Bonaparte's Gull	0	0
Laughing Gull		2.9%
Ring-billed Gull		18.8%
Black-legged Kittiwake		10.9%
Long-tailed Duck	0	0
Loon spp.	Red-throated Loon: 2% Common Loon: 9.3%	Red-throated Loon: 21.7% Common Loon: 5.1%
Northern Gannet	5.3%	6.7%
Common Eider	0	0
Scoter spp.	< 2%	0
Scaup spp.	29%	54.5%
Common Tern	0.5%	11.5%
Forster's Tern	1%	
Roseate Tern		12.5%
Guillemot, Razorbill	Razorbill: 0	0
Cormorant spp.	7.3%	0
Geese spp.	14.3%	0
Procellariform seabirds	0	0
Dabbling duck spp.	5.8%	0
Heron spp.	49.3%	
Osprey	0.1%	
Phalarope spp.	0	0

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Aerial High-definition Imaging Pilot Study

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

Allan F. O'Connell[1], Beth Gardner[1,2], Andrew T. Gilbert[1,3]

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

Dataset	Years of surveys	Region of survey
Manomet Center for Conservation Sciences	1978-1980	Gulf of Maine, Mid-Atlantic Bight
Cetacean and Seabird Assessment Program	1980-1988	Gulf of Maine, Mid-Atlantic Bight
Georgia pelagic surveys	1982-1985	South Atlantic Bight
Southeast Fisheries Science Center surveys	1992,1998,1999	South Atlantic Bight
Winter Survey of the Mid-Atlantic	2001-2003	Mid-Atlantic Bight
Cape Wind, Mass Audubon	2002-2006	Nantucket Sound
North Carolina shelf—trophic predators	2004-2005	Offshore North Carolina
Bar Harbor whale watch	2005-2006	Offshore Mount Desert Island, ME
NOAA Ecosystem Monitoring Survey	2007-2010	Gulf of Maine, Mid-Atlantic Bight
NOAA Herring Acoustic Survey	2006-2010	Gulf of Maine, Mid-Atlantic Bight

Data standardization

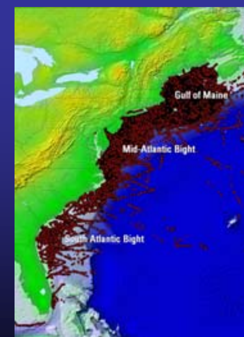
- Create master observation dataset
  - **Create standard species lists**
  - **Create common data fields (date, time, observation ID, effort ID, etc.)**
- Create effort dataset when possible and link to species observations
  - **presence AND absence data**
  - **facilitates error detection**

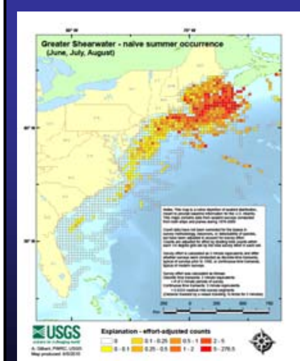
Survey effort

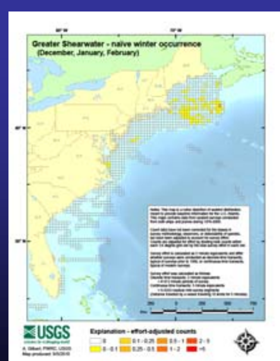
- Standardized survey effort to account for both discrete-time and continuous-strip surveys.
- Color schemes represent a standardized range of the number of surveys conducted in each grid cell in 5 minute equivalents.
  - Discrete time transects: 5 minute equivalents = # of 5 minute periods of survey
  - 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)

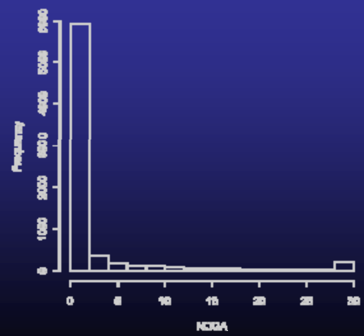
Modeling

- ~ 70 sea bird species in the data base 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

Truncated Count Frequency



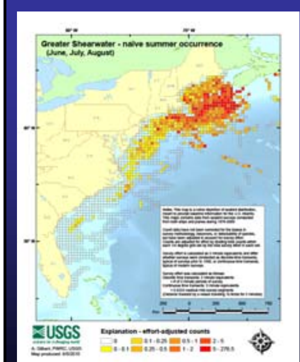
Poisson Model

$$y_{ijt} \sim Poisson(\lambda_{ijt})$$

where y_{ij} is the observation at grid cell i during survey j in year t

The log-linear full model is:

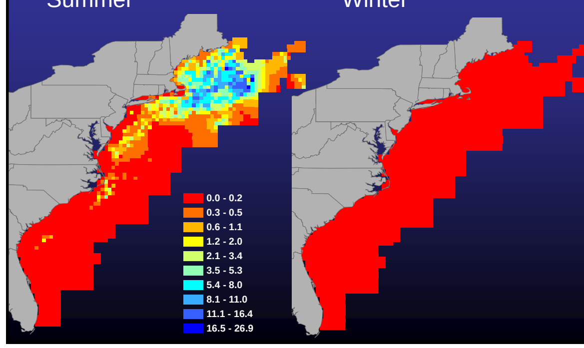
$$\log(\lambda_{ijt}) = \log(effort_{ij}) + a + \alpha_2[Month_{ij}] + \beta_1 * SST_{ij} + \beta_2 * Chlor_{ij} + \beta_3 * NAO_t + Z_i$$



Results – GRSH

Summer

Winter



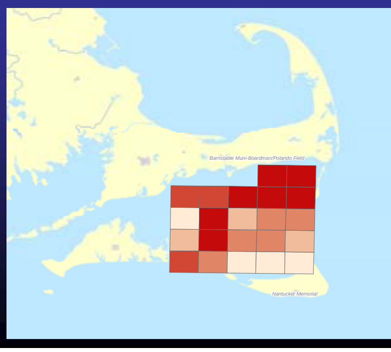
Shortcomings

- 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

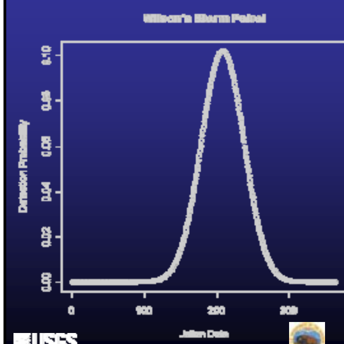
Occupancy Models

- 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



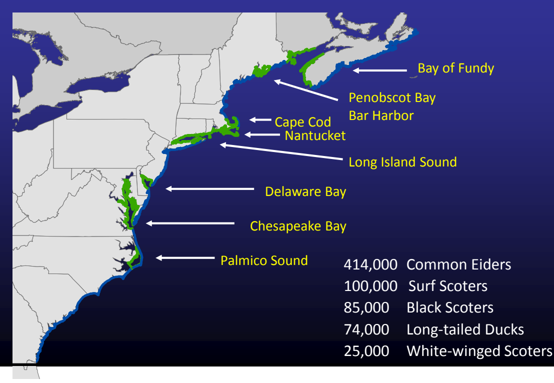
Detectability



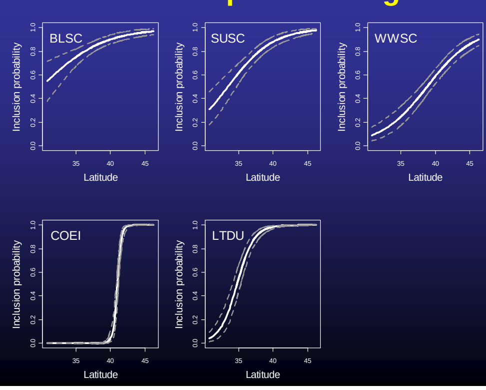
Summary

- 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



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

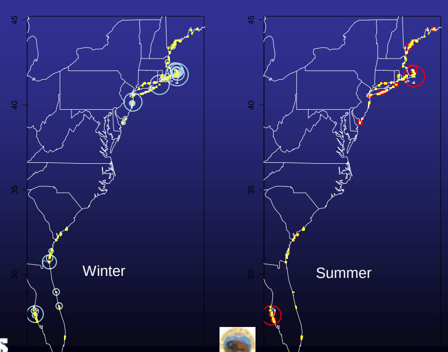
Implications for climate change

- 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
- 2003-2009
- 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

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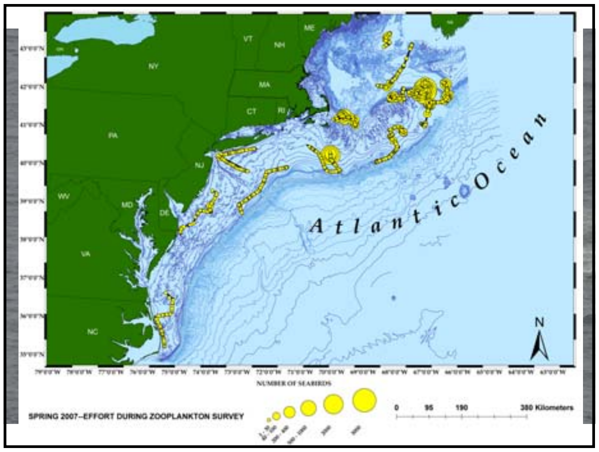
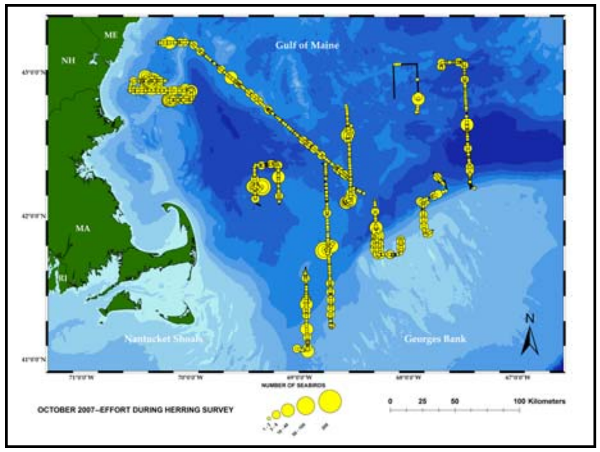
USFWS
Melanie_Steinkamp@fws.gov



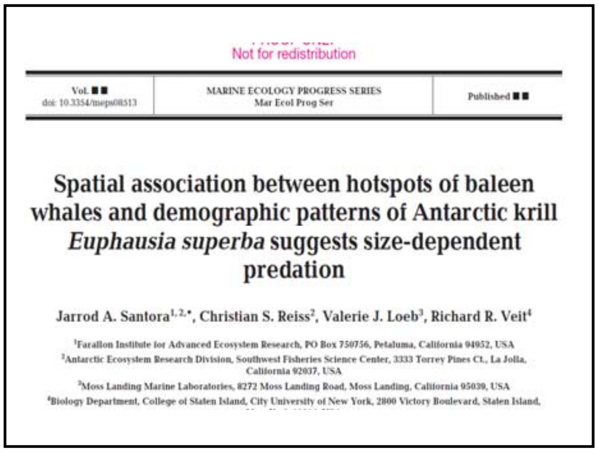


So 19 cruises so far
Summer 2007-February 2011

4 Ecomon per year
1-2 Herring per year
3 whoi cruises

Hotspots

Combining shipboard data with large spatio-temporal databases



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Vol. ■■ doi: 10.3354/meps08513	MARINE ECOLOGY PROGRESS SERIES Mar Ecol Prog Ser	Published ■■

Spatial association between hotspots of baleen whales and demographic patterns of Antarctic krill *Euphausia superba* suggests size-dependent predation

Jarrod A. Santora[1,2,*], Christian S. Reiss[2], Valerie J. Loeb[3], Richard R. Veit[4]

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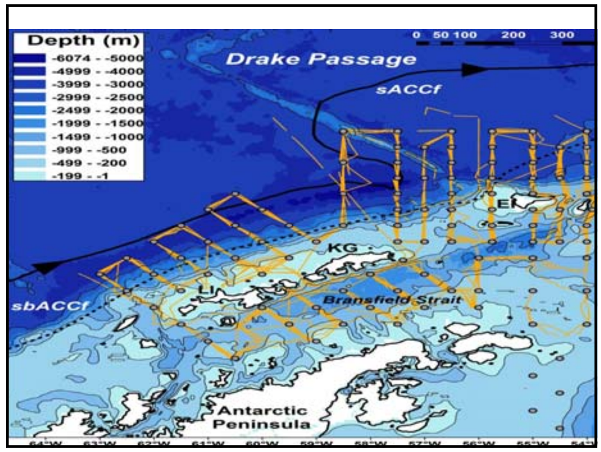
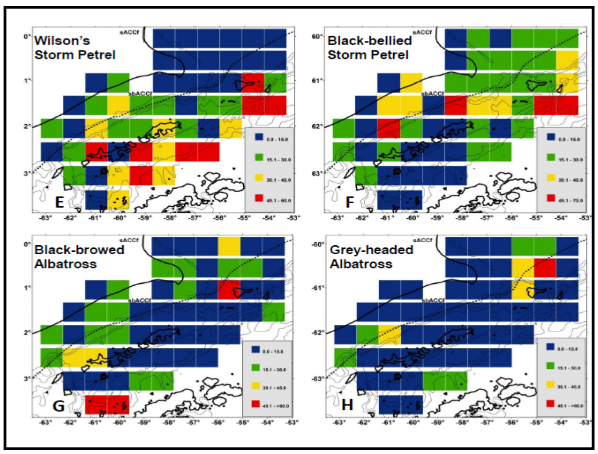
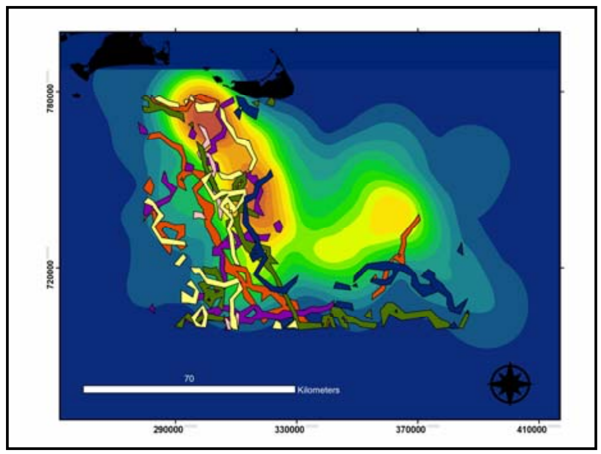
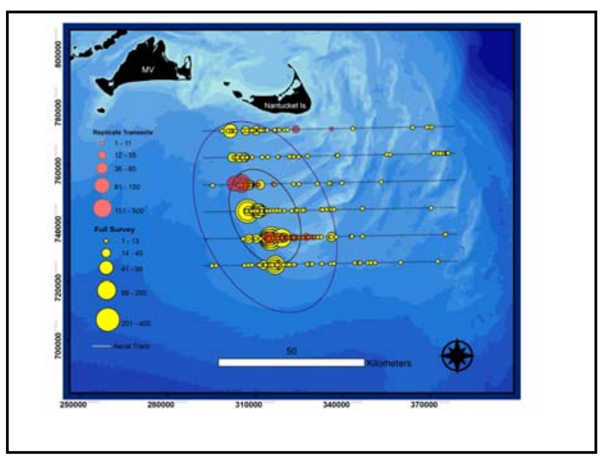
[2]Antarctic Ecosystem Research Division, Southwest Fisheries Science Center, 3333 Torrey Pines Ct., La Jolla, California 92037, USA
[3]Moss Landing Marine Laboratories, 8272 Moss Landing Road, Moss Landing, California 95039, USA
[4]Biology Department, College of Staten Island, City University of New York, 2800 Victory Boulevard, Staten Island,









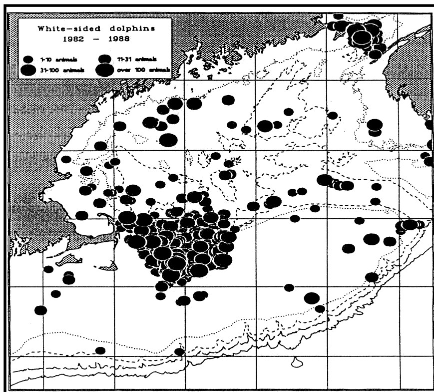
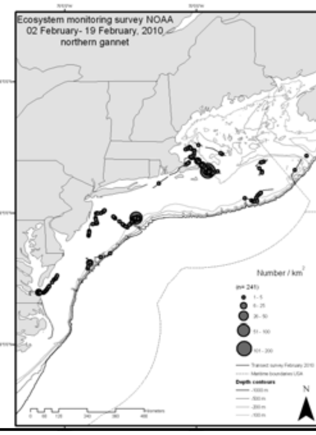


Figure 10-3. The distribution of white-sided dolphin (Lagenorhynchus acutus) sightings throughout the study area, 1982–1988.

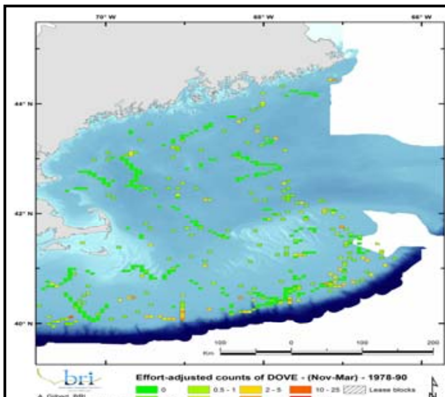


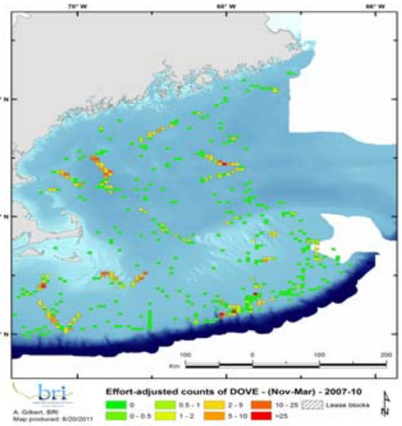
Historical Comparisons

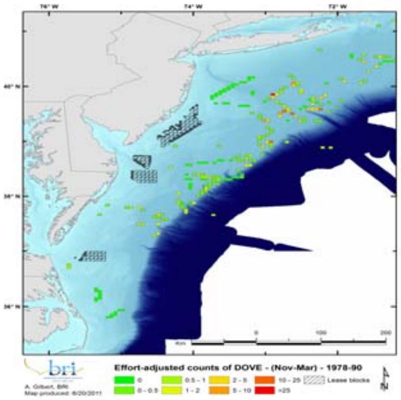
Manomet Bird Observatory Data
1970s-1980s

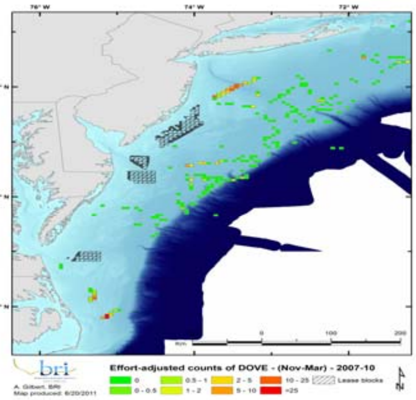
Table 2. Densities of dominant species recorded in 2010 (birds/km²). Density estimates for 1970s-1980s (from Powers 1983) given *in italics* bel

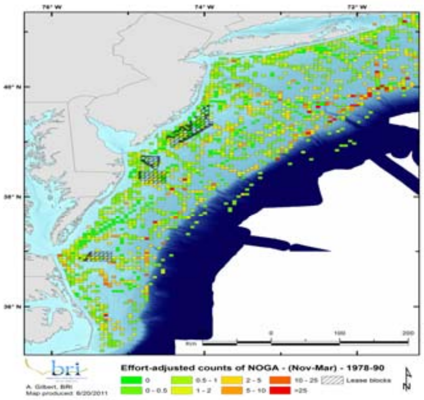
	February 2010	May 2010	August 2010	November 2010
Northern Fulmar	2.4 *(7.5)*	1.6 *(3.8)*	0 *(0)*	**8.5** ***(1.5)***
Greater Shearwater	0 (0)	6.8 *(1.5)*	7.3 *(2.75)*	5.7 *(7.5)*
Wilson's Storm-petrel	0 *(0)*	4.4 *(6.0)*	3.9 *(8.0)*	1.59 *(0.5)*
Northern Gannet	1.4 *(1.0)*	0.28 *(1.75)*	0.29 *(0.25)*	**6.3** ***(1.25)***
Herring Gull	2.6 *(3.75)*	0.50 *(1.5)*	1.7 *(0.75)*	2.3 *(8.5)*
Dovekie	0.36 *(1.0)*	0.09 *(1.0)*	0 *(0)*	**8.1** ***(0)***

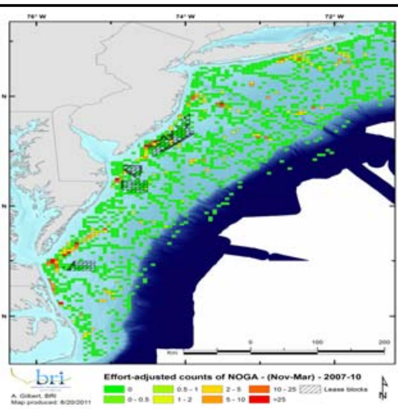






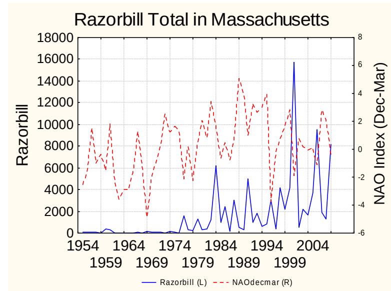


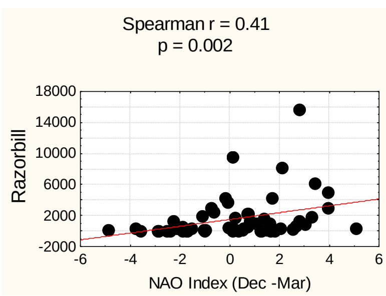


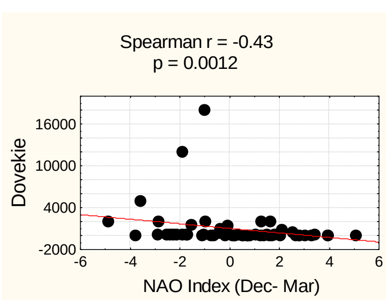


Climate Change

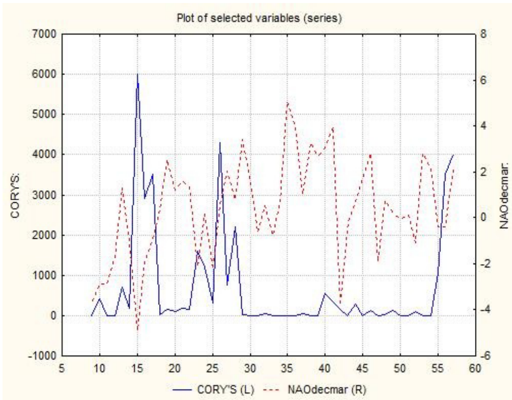
Need to know this for interpretation of current data

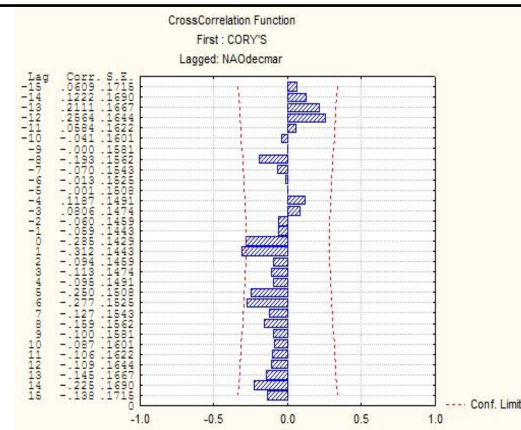

Razorbill Total in Massachusetts
Razorbill
NAO Index (Dec-Mar)
18000
16000
14000
12000
10000
8000
6000
4000
2000
0
8
6
4
2
0
-2
-4
-6
1954 1964 1974 1984 1994 2004
1959 1969 1979 1989 1999
Razorbill (L)
NAOdecmar (R)


Spearman r = 0.41
p = 0.002
Razorbill
18000
14000
10000
6000
2000
-2000
-6 -4 -2 0 2 4 6
NAO Index (Dec -Mar)


Spearman r = -0.43
p = 0.0012
Dovekie
16000
10000
4000
-2000
-6 -4 -2 0 2 4 6
NAO Index (Dec- Mar)


© Aviad Scheinin





Summary

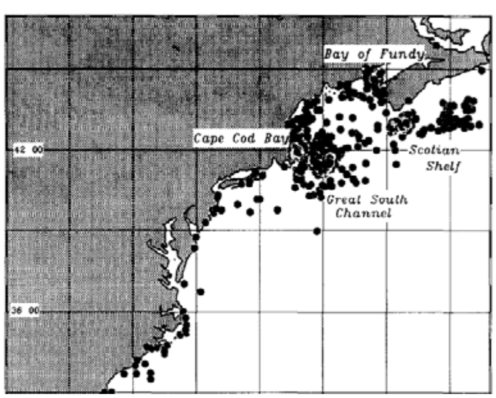
1.) Hotspots are evident and persistent

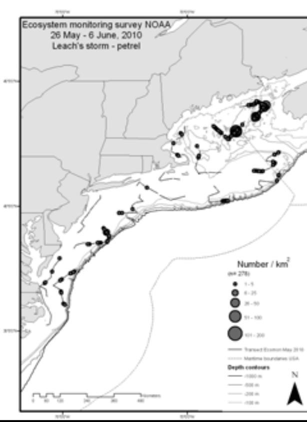
2.) Changes evident 1970s-present

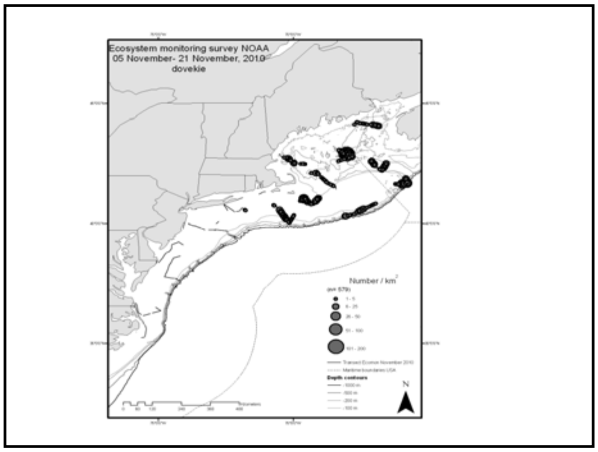
3.) Changing climate has impacted birds

Table 3. Greater Shearwater abundance within four strata sampled both in the 1970s (Powers 1983) , 2008-2009 and 2010 (this study).

		1970s (Powers 1983) Birds/km²	2008-2009 Birds/km²	2010 Birds/km²
May		2.0	**3.7**	**19.8**
		2.0	**4.3**	**7.3**
		2.0	0.1	0.2
	Mid	0	**4.1**	0.05
August		**8.0**	3.0	12.9
		3.0	0.3	8.1
		3.0	0.3	1.0
	Mid	0	0.1	0
October		**30.0**	4.4	(Nov) 6.2
		12.0	5.7	(Nov) 5.9
		15.0	0.7	(Nov) 2.8
	Mid	**2.0**	0	(Nov) 8.0






Ecosystem monitoring survey NOAA
05 November- 21 November, 2010
dovekie
Number / km²
1 - 5
101 - 200
N

Ongoing Offshore Bat Studies in the Gulf of Maine

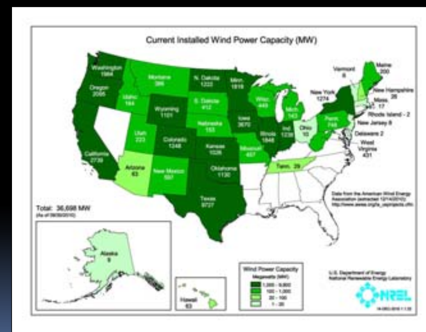
Atlantic Wind Energy Workshop
Herndon, Virginia

July 13, 2011

Steve Pelletier, CWB, Principal Scientist
Trevor Peterson, Project Scientist
Sarah Boyden, Project Scientist
Noel Dodge, Project Scientist

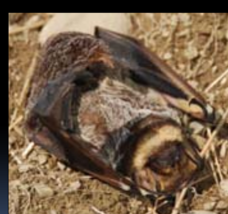
Stantec

2010 US Wind Energy Picture

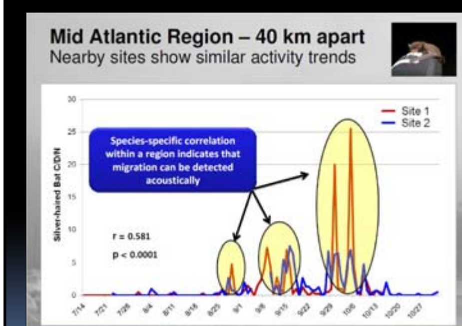


Terrestrial Studies

Onshore post-construction studies indicate turbines pose direct and indirect mortality risks to bats.



Terrestrial Trends - *example*



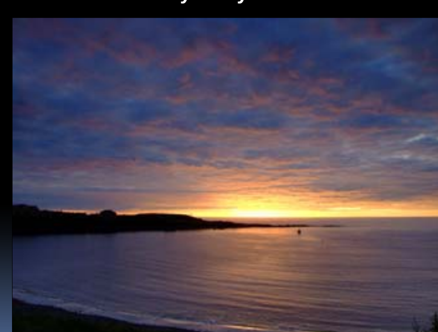
These studies help us better understand species:

- 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

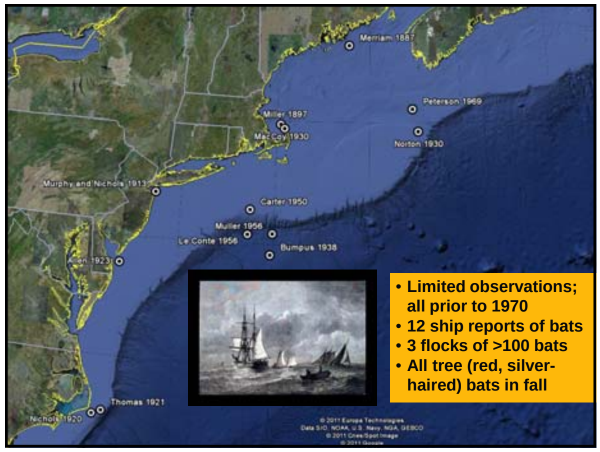
Griffin 1940 summarizes multiple observations aboard ships at sea.

"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

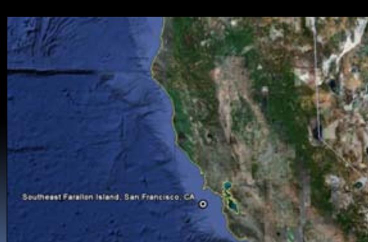


- **Limited observations; all prior to 1970**
- **12 ship reports of bats**
- **3 flocks of >100 bats**
- **All tree (red, silver-haired) bats in fall**

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

Offshore Studies in Europe

- **Hutterer *et al*. 2005 –** Bat migrations in Europe: a review of banding data and literature.
- **Ahlén 2005 -** Summary: Bat casualty risks at offshore wind power turbines. Report from introductory studies.
- **Ahlén 2007 -** Risk Assessment for Bats at Offshore Windpower Turbines.
- **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

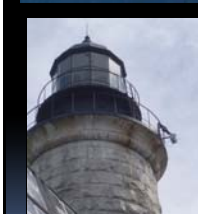
Offshore Platforms

- **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

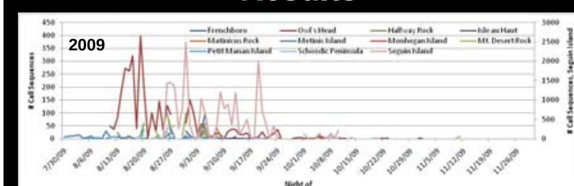
Results

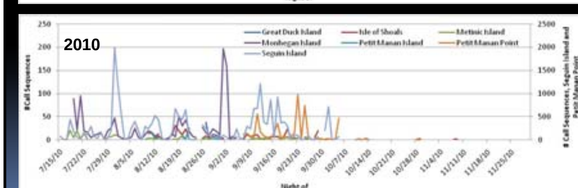
- Remote acoustic detectors effective for long-term detection and monitoring of northeast bat species
- Bats detected at all 2009 and 2010 survey sites
- Peak movement periods detected
- Bats detected until mid-November
- Resident and migratory species documented at most sites

Results

	2009	2010
Geographic Area	~125 miles	~170 miles
# Survey Sites*	12	7
Survey Period	7/28 – 11/30	7/13 – 11/30
Survey Effort	948 nights	526 nights
# Recorded Call Sequences	26187	26768
*Detectors still deployed at 3 offshore sites (~300 potential survey nights of data)		

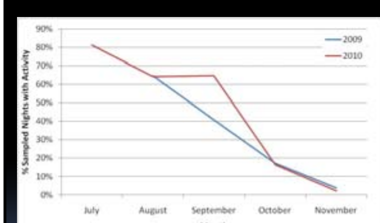
Results



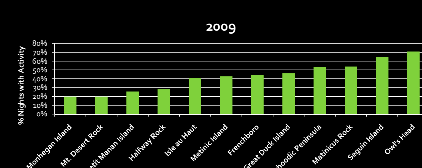


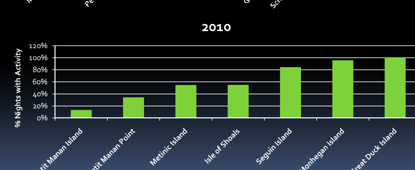
Results

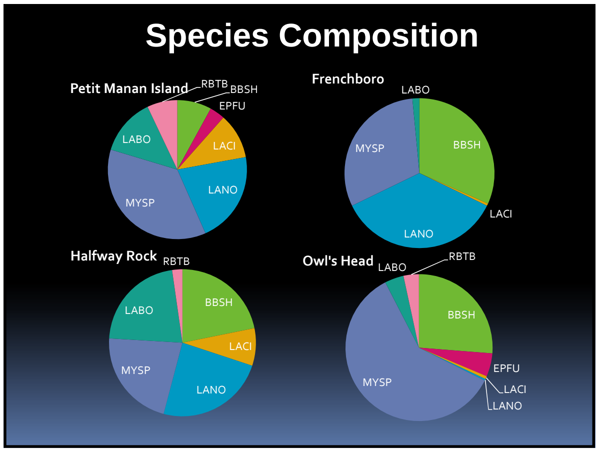
- Overall decline in monthly activity between July and November



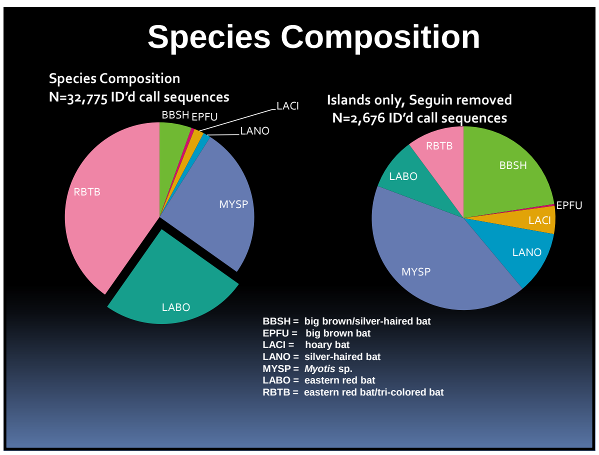
Overall Bat Presence

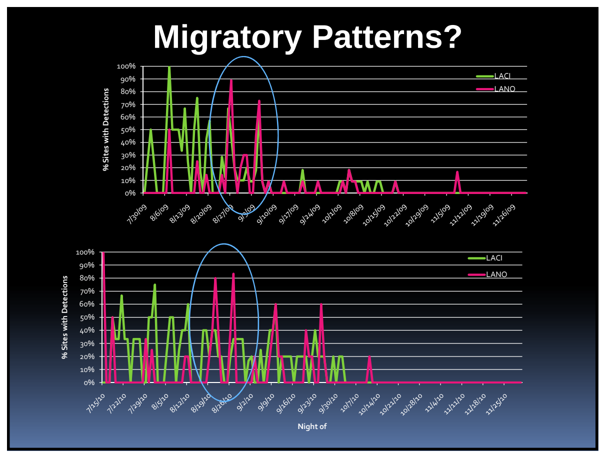




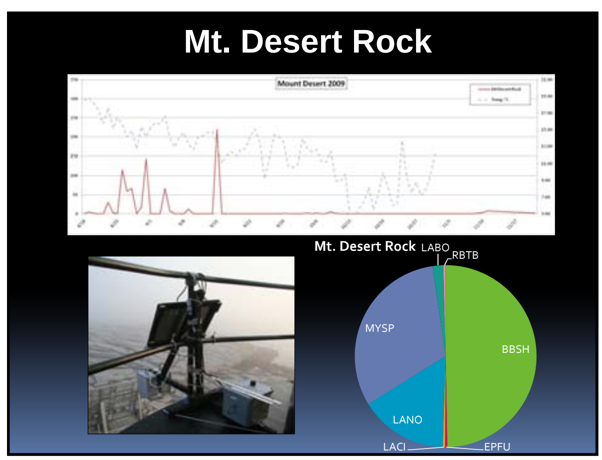

Species Composition
Petit Manan Island
RBTB
BBSH
EPFU
LACI
LANO
MYSP
LABO
Frenchboro
LABO
BBSH
LACI
LANO
MYSP
Halfway Rock
RBTB
BBSH
LACI
LANO
MYSP
LABO
Owl's Head
LABO
RBTB
BBSH
EPFU
LACI
LANO
MYSP


Seguin Island?
• 40,049 call sequences
• 76% of all recorded call sequences
• High Risk Location?
Offshore habitats inevitably altered


Species Composition
Species Composition
N=32,775 ID'd call sequences
BBSH
EPFU
LACI
LANO
MYSP
LABO
RBTB
Islands only, Seguin removed
N=2,676 ID'd call sequences
RBTB
BBSH
EPFU
LACI
LANO
MYSP
LABO
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


Migratory Patterns?
% Sites with Detections
LACI
LANO
% Sites with Detections
LACI
LANO
Night of


Mt. Desert Rock


Mt. Desert Rock
Mount Desert 2009
Mt. Desert Rock
LABO
RBTB
BBSH
MYSP
LANO
LACI
EPFU

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?

- Bats susceptible to barotrauma and collisions with terrestrial wind turbines (Arnett *et al* 2008, Rydell *et al* 2010, Young *et al* 2009, Horn *et al* 2008, Baerwald *et al* 2009);
- Greater understanding of seasonal landscape movements, conditions of movements (Merriam 1887, Miller 1897, Norton 1930, Griffin 1940, Carter 1950, Mackiewicz & Backus 1956, Cryan & Brown 2007, Reynolds 2006, Baerwald & Barclay 2009, Cryan, pers. comm.);
- Potential Operational Controls (Arnett *et al*. 2010, Baerwald *et al*. 2009).

Can Pre-Construction Data Predict Risk?

To a bat, is this…

…the same as this?

Summary Observations to Date

- Variety of species extend offshore but more frequently silver-haired, hoary, eastern red bats, and *Myotis* spp.
- Bats migrate and forage in near- and offshore areas predominantly during spring and fall migration periods (Merriam 1887, Miller 1897, Norton 1930, Griffin 1940, Mackiewicz & Backus 1956, Ahlén 1997, Cryan & Brown 2007).
- Bats may be vulnerable to offshore wind activities
- Planned regional, multi-seasonal surveys will serve to define issues and develop potential resolutions.

Thank You

Day 3 - 14 July 2011
Presentations/Summaries

Environmental: Monitoring and Baseline Studies

Overview, Summary, and Needs

Atlantic Wind Energy Workshop July 12-14, 2011 | Bureau of Ocean Energy Management, Regulation and Enforcement

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

Atlantic Wind Energy Workshop July 12-14, 2011 | Bureau of Ocean Energy Management, Regulation and Enforcement

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

Atlantic Wind Energy Workshop July 12-14, 2011 | Bureau of Ocean Energy Management, Regulation and Enforcement

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

Atlantic Wind Energy Workshop July 12-14, 2011 | Bureau of Ocean Energy Management, Regulation and Enforcement

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

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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

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Day 3 - 14 July 2011
Presentations/Summaries

Information Management and Data Sharing Products Panel

Needs:

- 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
- Data quality and comparability (apples to apples)

Developers Panel

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"

Day 3 - 14 July 2011
Presentations/Summaries

Broad Scale Habitat, Abundance, and Distribution-Consultation Process

Needs:

- Characterization data necessary 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 for data collection between BOEMRE, NMFS, USFWS
- Establish timelines for consultation

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Broad Scale Habitat, Abundance, and Distribution-Baseline Data

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 – SASI (swept area seabed impact approach)
- NMFS – overview of ongoing marine mammal survey efforts (ship, aerial, PAM); search for the best density and distribution indicators
- NMFS data variability (CetMap) – prioritization: habitat based density, stratified density, habitat affinity, presence only
- BOEMRE – discussed AMAPPS, collecting broad scale, multiyear data using various technologies, to be combined into a common database
- US Navy – conducting numerous data collection projects in their OPAREAs; broad geographic coverage; coordinating with NOC to make historic and ongoing data available

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Broad Scale Habitat, Abundance, and Distribution-Baseline Data

Needs:

- 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

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Acoustic Monitoring Technology and Impacts

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.

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Acoustic Monitoring Technology and Impacts

Needs:

- 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?

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Summary of Common Issues

- 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 motile resources, what is an acceptable scale for surveys? Regional vs. site-specific
- Database management, maintenance, storage & archival, as well as data cataloguing

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July 14, 2011

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

Priority Research Needs

- **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

Priority Research Needs

- **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)

Priority Research Needs

- **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**

Day 3 - 14 July 2011
Presentations/Summaries

Birds and Bats Breakout Session

Wednesday July 13, 2011

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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

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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

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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

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Presentation Summary

- Current Research Efforts (cont'd)
  - Dr. Allan O'Connell (USGS)
    - Summary of historic seabird database and modeling efforts
  - Dr. Richard Veit (CSI/SUNY)
    - Results from ships of opportunity cruises and examples of persistent aggregations or 'hotspots'
  - 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

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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?

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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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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

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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.)

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Birds – Data Needs for Best Bird Map

- 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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Presentations/Summaries

Technology Assessment and Resource (TA&R) Program

Renewable Energy Studies

Moderator: Lori Medley (BOEMRE)

Facilitator: Dan White (CSA)

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TA&R Program
Meeting Objectives

- Provide an Update on TA&R Projects
- Identify Key Data Needs and Research Gaps
- Develop Potential Research Topics

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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/Survivability of Offshore Wind Farms on the OCS**"

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TA&R Program
Review of Renewable Energy Studies Cont.

- 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"**
- TA&R 656 **"Seabed Scour Considerations"**
- TA&R 627 **"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"**

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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/Templates/Go-Bys**
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**

KDN – Key Data Need
RG – Research Gap

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Potential Research Topics
Key Data Needs

Wind Turbine Condition Monitoring for Safety and Inspection.
Structure 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?
- Require industry/manufactures to supply some set of specifications that could be monitored and action levels for monitoring data.
- Determine how the data should be collected: real time; some regular interval; after extreme event; or black box?

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Potential Research Topics
Key Data Needs Cont.

Example Formats/Templates/Go-Bys
- 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

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

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.

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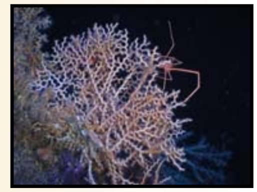
Presentations/Summaries

The National Oceanographic Partnership Program (NOPP)

Atlantic Wind Energy Workshop, 14 July 2011

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

Day 3 - 14 July 2011
Presentations/Summaries

NOPP Funding Process

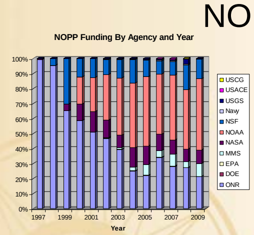
Research topics developed by agencies.
↓
Announcement for funding.
↓
Submission deadline.
↓
Proposal processing by lead agency and NOPP Office.
↓
Peer reviewers (panel) solicited.
→
Written reviews submitted for each proposal by panelists.
↓
In-person panelists meeting led by program managers.
↓
Proposal discussion and scoring made by panel
↓
Review of panel scores by agency program managers.
↓
Funding agreements, selection and announcement of funded projects.

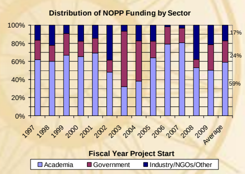
Proposal Review Criteria

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.

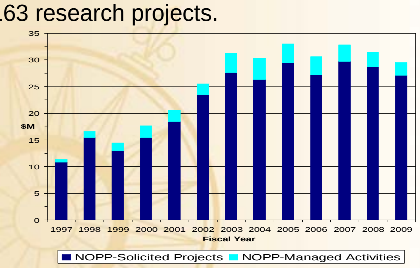
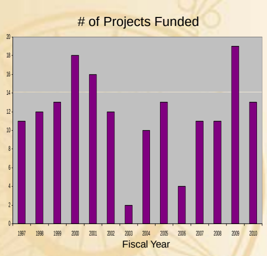


Figure: FY 1997-2009 investment in NOPP-Funded Activities, including both NOPP-Solicited Projects and NOPP-Managed Activities. Note that the dollar amounts shown are those spent each year; out-year commitments are not shown.

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
- 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.

APPENDIX B:
SPEAKER/PRESENTER BIOSKETCHES

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.

Joel Whitman

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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.

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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.

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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.

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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

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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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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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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 application of appropriate statistical techniques to remotely sensed data, and currently focus on the application of statistical models to the problem of hydrographic data processing; ocean mapping; and associated technologies.

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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.

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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.

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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.

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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.

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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.

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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.

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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 and maintenance, spatial analysis, and water quality analysis. Mr. Nixon has a Master's degree in Coastal and Marine Policy and Law from the University of Rhode Island.

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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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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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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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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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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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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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TECHNOLOGY ASSESSMENT AND RESOURCE PROGRAM: RENEWABLE ENERGY STUDIES

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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. 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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BIRD, BATS AND OFFSHORE WIND DEVELOPMENT: REMAINING INFORMATION GAPS

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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.

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