

ABSTRACTS OF PRESENTED PAPERS AND POSTERS FOR

Rhode Island's Off-Shore Marine Ecosystem and the Potential Impacts of Alternative Energy Development

Rhode Island Natural History Survey
13th Annual Conference
April 23, 2009

APPLYING EXISTING TECHNOLOGY TO SITE SELECTION, IMPACT ASSESSMENT AND LONG-TERM MONITORING FOR COASTAL WIND FARMS

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Large structures in the marine environment such as oil platforms and wind turbine foundations can serve to enhance habitat for desirable species. Recent work in areas of oil and gas development suggests that structures can create habitat with high diversity and biomass to compliment existing community structure and function. Man-made structures form stable vertical habitat for sessile organisms, providing food sources for predators. Structures may also provide cover against predators and depending on encroachment rules, protection from sport fishing. Recovery of depleted fish stocks has been associated with such conservation communities. At some platform sites, routine maintenance provided a byproduct in the form of shellfish for human consumption. Considerable controversy continues regarding the importance of obsolete oil platforms to the health of fish populations. In the removal and disposal of obsolete platform jackets some see an opportunity to create beneficial reefs while others perceive abdication of responsibility for full restoration of drilling sites. [poster presentation]

THE EFFECT OF OFFSHORE WIND POWER ON COASTAL TOURISM

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To assess the potential effect of visible offshore wind turbines on coastal tourism, we report the results of a survey of 1,076 out-of-state beachgoers, randomly sampled at a variety of Delaware beaches during summer 2007. The survey elicits the opinions and attitudes of tourists toward wind power development, and identifies an effect—that an anticipated offshore wind farm reduces reported beach visitation. Contingent behavior modeling reveals that those who pay more for their trip are significantly more likely to avoid a beach with turbines visible at 6 miles and more likely to shift to a beach out of state. Conversely, respondents less than 30 years old or who were sampled on a boardwalk are significantly more likely to report visiting such a beach. Further, the avoidance effect diminishes when turbines are located further from shore. Interestingly, avoidance of beaches with a visible wind farm is less than avoidance of beaches with a coal power plant located the same distance inland. Potentially mitigating the avoidance effect, we find that a greater percentage is attracted to beaches with wind turbines than the percentage reporting avoidance of them. [oral presentation]

THE CAPE WIND CHALLENGE

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Mass Audubon challenged the developer of Cape Wind and its permitting agencies to accept comprehensive and rigorous monitoring and mitigation conditions that would reduce risks to birds and other wildlife. If these conditions were to be adopted, and remaining data gaps addressed, Mass Audubon would support Cape Wind, the largest clean, renewable energy project in the Northeast. Cape Wind, which would include 130 wind turbines arrayed over 25 square miles of Horseshoe Shoal in Nantucket Sound, is expected to provide the equivalent of 75 percent of the electricity consumed on the Cape.

Mass Audubon proposed this Challenge after five years of project review, including three years of ornithological fieldwork; our assessment of three environmental impact statements and literature review; talks with ornithologists, scientists, and engineers; and a visit to Denmark's offshore wind farms during the 2005 spring bird migration. Mass Audubon's technical review and assessment of three EISs focused primarily on the project's impacts on birds and their habitat in order to determine if the project posed no ecologically significant threat to living resources. This does not mean zero impact on those resources, because the production of energy always entails some level of environmental impact.

Mass Audubon identified data gaps in the EIS' including: nighttime distribution and behavior of long-tailed ducks; migration of endangered terns and threatened plovers; and abundance and distribution of migrating songbirds. Mass Audubon's support for Cape Wind is contingent upon these gaps being addressed with a finding of no ecologically significant threat. We also propose adoption of an Adaptive Management Plan. [oral presentation]

PERSPECTIVES AND CHALLENGES IN EVALUATING CAPE WIND

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Cape Wind Associates, LLC (Cape Wind), proposes to construct and operate a commercial-scale wind energy facility offshore Massachusetts, on federal submerged lands in Nantucket Sound. Pursuant to Section 388 of the 2005 Energy Policy Act, Cape Wind must obtain a lease from the Minerals Management Service (MMS) prior to commencing construction and operation of the project. MMS published the Cape Wind draft Environmental Impact Statement (EIS) in January 2008 and the final EIS on January 16, 2009. MMS expects to issue a decision on the project in 2009; if there is a favorable decision on the project, MMS will issue a lease agreement. [oral presentation]

THE USE OF GEOSPATIAL TECHNOLOGIES IN SUPPORT OF THE RI OCEAN SAMP PROJECT

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The Rhode Island State Office of Energy Resources (OER) has set a goal of obtaining 15% of state's annual energy needs from renewable resources including offshore wind farms located in state and/or adjacent federal coastal waters. In response, the Rhode Island Coastal Resources Management Council (CRMC), with technical support from the University of Rhode Island (URI), has proposed to develop within the Ocean/Offshore Renewable Energy Special Area Management Plan (Ocean SAMP).

The Ocean SAMP process will proceed simultaneously on several fronts, with the research team undertaking studies on the following themes: wind, waves, and storm surge; marine transportation; wind farm technology; noise and electromagnetics; commercial and recreational fisheries; marine mammals and turtles; meteorology and air quality; geology and ocean floor mapping; cultural resources; and flying vertebrates.

Work for this project will generate large amounts of geospatial data. The URI Environmental Data Center (EDC) has been tasked with developing the data storage/retrieval system, assisting with spatial modeling, and providing mapping/visualization support for the research teams and stakeholders. The technical challenges in creating an integrated geospatial database from all the baseline and preexisting studies include converting data to a common format and geographic specifications, compiling accurate metadata, and making data and derivative analytical products available to scientists and decision-makers. This poster provides an overview of the data handling procedures that have been implemented to streamline data consolidation and visualization procedures and protocols. Ultimately, map and data products used to describe the OceanSAMP area will be web accessible via the NARRBAY.org website (<http://www.narrbay.org>). [poster presentation]

THE DANISH EXPERIENCE WITH BIRDS AND OFF-SHORE WIND POWER GENERATION

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Long-distance migratory birds are an internationally shared natural resource, protected under various international legislation and agreements. The current upsurge in proposals to construct large numbers of turbines in extensive wind farms in marine offshore areas throughout the world, with their potential adverse effects on birds, has drawn attention to the need to better understand avian interactions with such structures cited out to sea. We here attempt to define the hazards presented by offshore turbines and discuss the methods used to measure their ecological costs, especially to migrating and locally feeding birds. We base the review on the combined experience from two very detailed pre- and post- construction studies carried out at two Danish offshore wind farms, supplemented by experiences from other projects around Europe. The talk will briefly review the methods developed and used to date, especially the types of data required to measure (i) flight avoidance responses, (ii) feeding distribution avoidance/attraction responses and (iii) to estimate and subsequently measure likely collision rates under operating conditions. The discussion will also define some of the key problems still to be addressed and speculate on how to develop the necessary future survey and remote techniques to gather the required data. We shall emphasize the need to assess the energetic costs of avoidance responses and the fitness consequences of these and those of collision mortality through modeling. Such approaches are essential in order to offer mechanisms for assessing the cumulative effect of many wind farms and the combined effects of other anthropogenic factors, which affect population processes in migratory birds.

ECOLOGICAL SERVICE VALUE INDEX (ESVI) FOR THE RI OCEAN SPECIAL AREA MANAGEMENT PLAN (SAMP): MODEL DEVELOPMENT AND MAPPING

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The goal of the preliminary site screening analysis of the RI OceanSAMP is to establish areas that are suitable for renewable energy development within Rhode Island coastal waters. Tier I of the analysis assessed the physical constraints of various areas including energy resource availability, exclusions, and technology type. The outcome of Tier I is the “Technical Development Index” (TDI) reflecting these issues. Tier II of the analysis assesses use conflicts and collaborations, as well as natural resource uses and values. An “Ecological Services Value Index” (ESVI) analogous to the TDI is to be developed, which will be a composite measure of ecological service values, such that it can be used to compare the impact of potential wind farm

sites on natural resources. The ESVI will be a relative index, based on combinations of individual indices of usage by and of the various natural resources of concern in the area. The ecological analysis will include mapping of habitat values, as well as usage by birds, bats, marine mammals, sea turtles, and fisheries resources. To quantify distributions and relative densities of specific species groups of concern in Rhode Island waters, ASA will develop a wildlife movement (migration and behavior) model (WildMap) based on life history information and available observational data. The model will be supported and ground-truthed by presence/absence, abundance, frequency and spatial observational data, such as that being developed by other researchers involved in the SAMP. For fisheries utilization and other human uses, spatial and statistical data will be incorporated into the overall ESVI. [poster presentation]

BEDROCK STRUCTURE AND FAULTS IN RHODE ISLAND EXTENDING OFFSHORE

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In the event that the stability of offshore wind turbines requires drilling into the bedrock, broken and altered rock along fault zones can be a serious problem. Especially as Rhode Island is demonstrated to be highly faulted and Narragansett Bay is a young structural feature that is still active; activity that is shown by earthquakes to extend offshore. Numerous young faults extend offshore under cover in South County and directly offshore across the mouth of the bay. These onshore faults normally are found to have gravity, magnetic and topographic lineament signatures that allow them to be traced under cover and underwater. Marine geophysical surveys can show characteristic elongate negative magnetic anomalies and disruptions in the anomaly pattern along faults, as well as the bedrock lows resulting from erosion along the weak zones. An early survey off southwest Rhode Island discovered the north to northwest-trending New Shoreham Fault, which is very young and matches the trends of the post- Early Jurassic faults onshore. Additional surveys, conducted for the U.S. Nuclear Regulatory Commission, found others near Block Island and extending from Narragansett Bay. Completion of this work can define the structural framework and principal faults offshore. [poster presentation]

MARINE BENTHIC COMMUNITIES OF BLOCK ISLAND AND RHODE ISLAND SOUNDS

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The benthic invertebrates of Block Island and Rhode Island Sounds include those adapted to near-shore habitats with variable temperature and salinity, mid-shelf species with narrower requirements, and boreal species that avoid elevated temperatures. Studies of benthic fauna in the Sounds began with Verrill and others in 1871 and continued with studies of invertebrate species collected for food or of value as food for fish species. Recent studies related to effects of fishing gear, disposal of dredge spoil and bridge debris, and siting of power generators and lines have provided new information on the distribution of benthos and the hydrography, sediment parameters, and near-bottom dynamics of near-shore shelf environments. In addition to productive commercial and recreational fisheries, the rich benthic communities of these Sounds provide other benefits to human welfare. Some of the benefits that have been measured elsewhere include water filtration, nutrient recycling, carbon sequestration, human waste processing, bottom stabilization, shoreline protection, and fish nursery habitat. We plan to map the major habitats and benthic assemblages of the Sounds using historical data and material collected as part of the RISAMP plan. [oral presentation]

THE LEGAL AND POLICY ISSUES REGARDING PERMITTING OFFSHORE RENEWABLE ENERGY PROJECTS

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As a co-PI on the Ocean Special Area Management Plan, the Legal Program will present analysis of the state and federal permitting process for marine renewable energy projects and how that analysis lends itself to the development of state policies and regulations for the SAMP. Along with legal research and analysis, findings from the 7th Marine Law Symposium, *A Viable Marine Renewable Energy Industry: Solutions to Legal, Economic, and Policy Challenges*, will provide an understanding of achieving a viable marine renewable energy industry for the United States with a focus on offshore wind. The challenges facing the offshore renewable energy industry in the United States include jurisdictional issues, various permitting and licensing schemes, limited financial incentives, the pace and availability of funding for research and development, and concerns regarding environmental and human community impacts. This presentation will review the current challenges for the siting, regulation, and implementation of wind energy in the United States, with a focus on Rhode Island. [oral presentation]

POND-BREEDING AMPHIBIAN HABITAT SUITABILITY NEAR MUNICIPAL WELL FIELDS IN SOUTHERN RHODE ISLAND

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Groundwater withdrawal by large-volume wells has the potential to shorten the duration of inundation, or hydroperiod, in seasonal ponds and adversely affect breeding success of certain amphibians. In 2007 we initiated a study on this topic in southern Rhode Island. We selected for study 24 seasonal ponds from two municipal well fields and 14 control ponds located far from large-volume wells in the Pawcatuck River watershed. One well field pumped 1,035 million gallons (MG) in 2006; the other pumped 148 MG. In 2008 average hydroperiods were 20 weeks for well-field ponds and 30 weeks for control ponds. Twenty-nine percent of the well-field ponds held water long enough for 95% emigration of wood frog metamorphs and 25% held water long enough for 95% emigration of spotted salamander metamorphs. At the control sites, pond percentages were 50 and 43, respectively. In coming weeks, we plan to compare actual hydroperiods observed at well-field ponds with those predicted for those ponds based on models developed over 4 years at the control sites. [poster presentation]

AVIAN USE OF NEARSHORE AND OFFSHORE WATERS WITHIN THE RHODE ISLAND OCEAN SAMP STUDY BOUNDARIES

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The Rhode Island Ocean Special Area Management Plan (SAMP) will define use zones for Rhode Island's ocean waters through a research and planning process that integrates science with public input. As part of this process, we have summarized surveys that have assessed the distribution, abundance, and movement ecology of birds using ocean waters out to 20 miles offshore. More is known about avian use of nearshore habitats, while less is known about offshore ecology. Surveys conducted by C. Raithel at Napatree Spit since 1982 quantify the movement phenology of landbirds and water birds in the region. Systematic aerial surveys conducted by J. Osenkowski and others since 1979 provide useful information on the abundance and interannual variation of waterfowl using nearshore areas. Surveys by USFWS biologists at Sachuest Point and Trustom Pond NWR offer detailed information on fluctuations in waterbird abundance at critical wintering sites. The EPA has coordinated another mid-winter waterfowl survey since 2004. URI biologists studied avian movement ecology of birds at Point Judith in the late 1990s, including data on flight elevations of birds. Finally, some offshore surveys have been conducted in offshore waters by various researchers. These data will be summarized and presented. [poster presentation]

RHODE ISLAND MAPCOAST: PARTNERING ACROSS THE LAND-WATER DIVIDE TO MAP OUR COASTAL RESOURCES

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Current and accurate maps are an important tool for making use and management decisions regarding land and water resources. For over 100 years, the National Cooperative Soil Survey (NCSS; Natural Resource Conservation Service and Land Grant Universities) has been conducting detailed inventories of the nation's soil resources for use in making land use and management interpretations. Recently, these approaches have been used to effectively map subtidal benthic habitats for several coastal lagoons and embayments along the U.S. Atlantic coast from Florida to Maine. In Rhode Island, NCSS scientists have teamed up with geologists, marine scientists, and GIS specialists to create the Mapping Partnership for Coastal Soils and Sediments (MapCoast). Using a variety of soil mapping tools in addition to technologies such as sidescan sonar, sediment profile imaging, underwater video, grab samples, and vibracores, MapCoast has completed maps of a majority of the Rhode Island coastal lagoons. These data are made available to the public at www.mapcoast.org for application in use in management decisions including dredge related activities, mooring field construction, coastal hazards, shellfish production, and eelgrass replanting sites. [poster presentation]

WIND-DRIVEN CIRCULATION IN RHODE ISLAND SOUND: IMPLICATIONS FOR ESTUARINE-SHELF EXCHANGE

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Exchanges between the estuary and shelf affect many ecosystem processes, including larval transport and hypoxia. Fish species that utilize estuaries as juvenile nursery grounds rely on currents to deliver their larvae into an estuary. Hypoxic events in estuaries such as Narragansett Bay (NB) are linked to physical circulation patterns that control rates of flushing and water mass exchange. A key aspect of flushing is the intrusion of less anthropogenically-impacted waters from the continental shelf into the estuary. Understanding the drivers of exchange at the estuarine-shelf interface will help us better understand the dynamics of these two ecological processes. The goal of this study was to identify the environmental conditions that promote the intrusion of shelf water into the estuary. In July-October 2008, we collected time series of velocity and thermal structure with moored Acoustic Doppler Current Profilers and thermistor chains in Rhode Island Sound (RIS), the inner shelf region adjacent to NB. Our observations suggest that eastward wind events drive deep water intrusions from the shelf to the estuary. These data are valuable for calibrating a numerical circulation model of NB-RIS, which will be used to investigate the effects of circulation patterns on larval transport and hypoxia in this ecosystem. [poster presentation]

RECOLONIZATION AND ECOLOGICAL SUCCESSION OF BENTHIC COMMUNITIES AT RHODE ISLAND SOUND ARTIFICIAL REEFS

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Artificial reefs have been shown to increase biomass and species diversity, enhance fish and epifauna production, and provide protective habitat. Two artificial reefs located within Rhode Island Sound (Gooseberry Island and Sheep Point) were created from the demolition of the Jamestown Bridge. Bathymetry and side-scan sonar surveys evaluated seafloor morphology and indicated the formation of concentrated deposits. In 2008, benthic community recolonization was investigated with three survey techniques: underwater photo collection, fish census, and experimental reef habitat comparisons. Images were collected along fixed transect lines with an underwater digital camera system in order to make quantitative assessments of the benthic community. Percent cover of colonial epifauna was estimated with a random-dot method. Visual fish census was performed with a slate recording method to determine fish abundance and diversity. Preliminary observations indicated that the reefs have experienced a moderate degree of colonization, including encrusting organisms (e.g., hydroids, bryozoans, and mussels), lobsters, and various fish species (e.g., cunner and sea bass). Moreover, invasive species, including the tunicates *Didemnum* sp., *Botrylloides violaceus*, and *Ciona intestinalis*, were observed on the bridge debris. Further analysis will determine successional patterns, as well as spatial and temporal trends in the benthic communities inhabiting the reefs. [poster presentation]

OFFSHORE WIND AND BIRDS—AVIAN DATA COLLECTION FOR THE CAPE WIND ENERGY PROJECT

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While electricity demand continues to increase, and with it the realization that air emissions from fossil fuel fired power plants continue to be major producers of green house gasses affecting global climate change, the need for sources of clean renewable power has become apparent. With ocean-based wind farms being proposed as a partial solution, one of the greatest concerns most often voiced by the public and regulators is “what will be the impacts to birds from these large off-shore turbines”? To address this issue, the developer of the Cape Wind Energy Project, a 130-wind turbine project proposed for Nantucket Sound off the coast of Cape Cod Massachusetts, has conducted an extensive, multi-year, multi-dimensional evaluation of the existing avian community and the potential impacts that may be anticipated from the Project. Aerial, boat, and land-based field studies, as well as site-specific radar monitoring have been integral components of this effort. This session will present the issues, data collection methodologies, past and future studies, and results surrounding this important resource question, which is at the heart of one of today’s most controversial renewable energy projects. [oral presentation]

MAPPING MARINE HABITATS FOR RI AND THE NORTHWEST ATLANTIC: A FIRST STEP IN MARINE SPATIAL PLANNING

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Researchers, federal and state government agencies, and conservation organizations have been studying the physical characteristics, habitats, species and human impacts of the Northwest Atlantic for decades. For over a year, the Nature Conservancy has worked with numerous partners to synthesize these datasets for a Northwest Atlantic Marine Ecoregional Assessment (NAM ERA). Our goals are two-fold: establish a publicly-available baseline of information (physical, biological and human use) about the marine environment, and provide information that can aid marine decision makers and managers with a wide range of interests, from energy siting to ecosystem-based management. The maps are being provided to the RI Ocean SAMP to aid in the state's marine spatial planning. In May, 2009, in cooperation with the Northeast Regional Ocean Council (NROC) and NOAA, we will hold workshops for diverse stakeholders. The workshops will review the NAM ERA report, assess the utility of integrated data for regional and state marine spatial planning; educate stakeholders about marine spatial planning, and inform the principles necessary for ecosystem protection that could be included in national legislation. In this presentation, we will review the NAM ERA. [oral presentation]

DOES OFFSHORE WIND FARM NOISE AFFECT MARINE LIFE AND IF SO, WHAT ARE WE GOING TO DO ABOUT IT?

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In Europe, plans to install offshore wind farms have been developed in many countries and first facilities are in use in Denmark, the United Kingdom and the Netherlands. However, if this technology is to be implemented at the broad scale necessary to generate energy for future needs, the costs to the environment must also be considered. One important environmental issue is the noise generated during construction and operation of offshore wind turbines and its potential effects on marine life. For many marine organisms, including marine mammals, marine fish and invertebrates, sound is important to communicate, to locate mates, to search for prey, to avoid predators and hazards, and for short- and long-range navigation. Sound can affect marine organisms in various ways. It can mask biologically relevant signals; it can lead to a variety of behavioral reactions; hearing organs can be affected resulting in hearing loss and at very high received levels, sound can injure or even kill marine life.

In the case of offshore wind farms, the noise generated during pile-driving operations involves sound pressure levels that are high enough to impair the hearing system of marine mammals near the source and disrupt their behavior at a considerable distance from the construction site. Previous investigations also show that the construction phase can have considerable effects on fish species common in northern European waters. In both groups behavioral responses can potentially occur at relatively low levels of noise exposure and therefore impact zones can be quite large. These responses may prevent marine mammals and fish from reaching breeding or spawning sites, finding food, and acoustically locating mates, leading to potential long-term effects on reproduction and population parameters. In the case of fish, avoidance reactions can result in displacement away from potential fishing grounds as well and might result in reduced catches, as has been shown to be the case in herring due to seismic survey activity.

This review will outline the key issues with regards to effects of offshore wind farm related noise on marine life. Source sound pressure levels and propagation of construction and operational noise will be presented. Based on modeling exercises and documented responses, zones of audibility, masking, behavioral response and injury will be outlined for selected marine mammal and fish species. Mitigation measures will be presented and discussed as well. Based on the results, a preliminary concept for the environmental management of offshore wind farms will be presented. [oral presentation]

ASSESSING RHODE ISLAND SOUND'S NEARSHORE AND OFFSHORE AVIAN RESOURCE FOR THE RHODE ISLAND OCEAN SPECIAL AREA MANAGEMENT PLAN

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Research scientists from the University of Rhode Island are completing a coastal resource assessment of Rhode Island Sound for the Coastal Resources Management Council. The Rhode Island Ocean Special Area Management Plan (SAMP) will use recommendations from this assessment, along with public input, to define future usage zones. One such resource that needs to be assessed prior to defining these zones is the avian resource. A high diversity of avian species use or migrate through Rhode Island Sound annually. Our objectives are to better understand avian use of ocean waters by collecting data on phenology, abundance, spatial distribution and movement ecology. A recent review of relevant historical avian data sets found that nearshore phenology and abundance are well documented, but that there is much less known about the spatial distribution and movement ecology for those species found offshore. At the present time, we are conducting land-based point counts, boat-based surveys and using a mobile radar system on Block Island to meet our research objectives. We will also study the movement ecology of a federally-endangered species, the roseate tern (*Sterna dougallii*). A summary of survey protocols and preliminary results will be presented. [oral presentation]