Mitigation and Monitoring Practices Tool for Offshore Wind Energy Development

User Manual

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List of Abbreviations and Acronyms

E-TWG	Environmental Technical Working Group
EMF	electromagnetic field
F-TWG	Fisheries Technical Working Group
Hz	hertz
kHz	kilohertz
MMP	mitigation and monitoring practice
NOAA	National Oceanic and Atmospheric Administration
NYSERDA	New York State Energy Research and Development Authority
OPR	NOAA Office of Protected Resources

1 Introduction

The New York State Energy Research and Development Authority (NYSERDA) has developed this Mitigation and Monitoring Practices Tool (Tool) as a resource to be used by the Environmental Technical Working Group (E-TWG) and the Fisheries Technical Working Group (F-TWG) in their roles to advise New York State in the responsible development of offshore wind energy. Representatives of offshore wind energy developers, New York State, and other stakeholders may also be end users of the Tool, for example during refinement of environmental mitigation plans for individual development projects.

NYSERDA published the New York State Offshore Wind Master Plan (Master Plan) in December, 2017[1]. The Master Plan outlines the state's ongoing activities to advance the development of offshore wind energy in the New York Bight, including convening Technical Working Groups focused on fishing, maritime commerce, the environment, jobs, and the supply chain. Members of the Technical Working Groups offer technical knowledge, practical experience, and personal interest that can inform the state's decision-making process.

As part of the implementation phase of the Master Plan, the state encourages the E-TWG and F-TWG to pursue several activities, including the development of fisheries and environmental best management practices (BMPs) to effectively reduce or eliminate impacts that could result from offshore wind energy development. For purposes of the Tool and User Manual, BMPs are practices that have been determined to be the best approaches to minimizing and avoiding impacts on wildlife and fisheries resources. Because the "best" practices have not yet been determined as part of New York's Master Plan, the Tool focuses on collecting a wide range of mitigation and monitoring practices (MMPs) that can help the User evaluate and consider what would constitute BMPs, at both broad and project-specific scales. The term MMP will be used throughout this manual to refer to the contents of the Tool.

The Tool houses a collection of MMPs, extracted from a range of sources (including agency reports, environmental assessments, scientific literature, technical guidance documents, and others), and is intended to serve as a resource

[1] New York State Energy Research and Development Authority (NYSERDA). 2017. New York State Offshore Wind Master Plan Charting a Course to 2,400 Megawatts of Offshore Wind Energy. NYSERDA Report 17-25. https://www.nyserda.ny.gov/All-Programs/Programs/Offshore-Wind/Offshore-Wind-in-New-York-State-Overview/NYS-Offshore-Wind-Master-Plan .

to the E-TWG and F-TWG, as well as other stakeholders. The Tool is searchable by various categories, including, but not limited to:

- Resource Groups - birds/bats, marine mammals/sea turtles, fish, benthos, and fisheries;
- Stressors;
- Potential effects; and
- Development phases of offshore wind.

As part of the effort to support development and evaluation of MMPs, the Tool provides details about these MMPs that could support further evaluation of how best to incorporate MMPs into the state's plans for offshore wind energy development. This Tool does not prioritize or judge the value of individual or combined MMPs, and it does not consider site- and project-specific conditions that might affect how and whether certain MMPs may be practicably implemented. It does, however, provide several sorting criteria that may be useful to the E-TWG and F-TWG and other users when assessing potential MMPs.

The geographic scope of the review includes MMPs that have been applied around the world, but the geographic scope of resources is limited to resources that occur in the New York Bight. For example, bottlenose dolphins occur outside the New York Bight, but they also occur within it and so are part of the resources considered. Dugongs do not occur in the New York Bight, so MMPs specifically aimed at reducing dugong impacts (to the exclusion of any species that may occur in the New York Bight), would not be included in the Tool.

Section 1 describes the objectives of the Tool. Section 2 describes the methodology for developing the Tool and defines the terms used throughout the Tool. Section 2 also provides a brief overview of the types of MMPs identified for each resource group, and provides some sorting criteria that may be useful for assessing MMPs. Section 3 provides instructions for using the Tool, and Section 4 lists references cited for MMPs for each resource.

2 MMP Tool Development

The Tool is a Windows application that allows the User to sort and organize MMPs. Specific worksheets for collecting MMPs were developed for five resource groups including birds/bats, marine mammals/sea turtles, fish, benthos, and fisheries. These worksheets were then combined into a master worksheet and linked to the Tool such that MMPs could be sorted by the User's specific interest.

The Tool houses categories that are used to sort the specific type(s) of MMPs, including: resource groups; subgroups; stressors; potential effects; development phases; type of industry; implementation status; whether the MMP includes mitigation or monitoring; generalized MMP category; and source citations. The Tool allows the User to sort by type of MMP, resource, or phase of development to determine the unique and shared MMPs across all resources. For example, if the User decides to focus on the construction period of development, MMPs specific to construction activities can be extracted from the tool across all five resources; however, if birds are the topic, MMPs can be extracted from the tool across all phases of development for that resource.

Section 2.1 provides information on the sources used for the MMPs, and Section 2.2 provides the definitions for the terms used in the above list of categories to sort the MMPs. Section 2.3 describes the specific resources and subgroups for which the MMPs would apply, and provides a brief overview of the MMPs that have been applied to these resources. In addition, Section 2.4 provides some sorting criteria that may be useful for assessing MMPs.

2.1 Sources of MMPs

MMPs were collected from a number of different sources, including agency reports; environmental assessments; stakeholder workshop proceedings; scientific literature; permits for offshore construction, cable laying, and surveys; technical guidance documents; and other sources of mitigation and monitoring activities. In addition to sources relating to offshore wind energy development in the U.S., sources were drawn from Europe, the onshore wind industry, and other maritime industries and activities that are relevant to offshore wind energy development. Section 4 lists all the references cited for MMPs for each resource. In general, the language in a source was maintained for the description of the MMP in order to make it easy to locate where it occurred in the cited literature.

2.2 Definitions of Terms in the Tool

Specific definitions were developed for each category in the worksheets to ensure consistency in meaning across worksheets and resource types. Most definitions within categories were developed to be mutually exclusive, though MMPs could apply to multiple options within each category (with the exception of "Generalized MMPs," below).

2.2.1 Stressors

Stressors are external stimuli that can cause changes to the behavioral, physical, chemical, and/or biological characteristics of an organism, species, or the ecosystem inhabited by the organism/species. In the case of fisheries, stressors are unintended consequences of offshore wind energy development activities that potentially affect fishing and fisheries. While stressors can occur in the natural environment or from human activities, in this case NYSERDA is focusing on anthropogenic stressors associated with offshore wind energy development on the Outer Continental Shelf (not in state waters or the cable interconnect to land). NYSERDA has endeavored to include all stressors that could occur within federal offshore wind lease areas. Section 2.2.1.1 defines stressors that affect birds and bats, marine mammals and sea turtles, fish, fisheries and/or benthos while Section 2.2.1.2 includes stressors specific to fisheries.

2.2.1.1 Stressors Associated with all Resource Groups

Bottom Disturbance. Bottom disturbance is physical change to the substrate as a result of wind farm activities, such as packing down sediment with piles or digging up sediment with anchors or jet plows. Changes in turbidity (i.e., amount of suspended particles in water) are considered water quality changes and are not included in bottom disturbance. Displacement of sediment around a structure is considered scouring, and is not included in bottom disturbance.

Changes in Vessel Traffic. Changes in vessel traffic include changes in vessel abundance, densities, types, and routes compared to what currently exist, due to activities relating to the offshore wind facility or to displacement of other vessel operations as a result of offshore wind facility activities. This includes, but is not limited to, vessels operating in pre-construction site assessment surveys, construction activities, and maintenance activities. This also includes changes in fishing or shipping patterns in response to wind farm activities.

EMF, Vibration, and Heat. EMF can be generated by the cables that carry electricity from and between energy sources to power stations and may produce local distortions in Earth's main electric and magnetic fields. Vibration is an oscillation of parts of a fluid. Vibration can result in particle motion, which is detectable by some marine organisms. Although sound usually has a vibratory component, it differs from vibration in general in that sound also contains a waveform and is perceived by hearing organs; sound is not included in this category. Heat is an increase in water or air temperature above typical levels.

Light. Light is artificial light produced by, or in relation to, the offshore wind energy development at a project site. Artificial light produces a luminescence that is brighter or different in color than natural light occurring at the site during the period in question. Examples include lights on vessels, construction equipment, turbines, and other infrastructure to aid in navigation and construction, among other purposes.

Long-term Structures. Long-term structures are objects added to the environment that occupy physical space and are present for longer than the construction period. Examples of long-term structures include offshore wind turbines, foundations, scour protection, substations, and other infrastructure associated with the operational wind facility. This term may also apply to the pre-construction phase in the case of meteorological towers, and to the decommissioning phase in the case of any below-water (e.g., foundations) or subsurface (e.g., cables) infrastructure that may be left in place after the towers have been removed. Displacement of sediment around a structure is considered scouring, and is not included in long-term structures.

Scouring. Scouring is a physical process related to the movement of seabed sediment around a structure due to its presence, which causes changes in wave or current flows, and results in a reduction in seabed levels around the structure.

Sound. Sound is created by a vibrating object and travels as a pressure wave through a medium, and these pressure waves can be sensed by organisms using hearing organs. Activities that produce sound include, but are not limited to, exploratory surveys, pile driving, dredging, and vessel operation. Vibrations that are not related to sound are considered in the Electromagnetic Fields (EMF), Vibration, and Heat stressor category.

Water Quality Changes. Water quality is a description of the chemical, physical, and biological characteristics of water as it relates to the health of an organism or ecosystem within the marine environment. Examples of changes in water quality include, but are not limited to, changes in turbidity (amount of suspended particles in water), addition of chemicals (e.g., antifouling paint or oil), and changes in dissolved oxygen (e.g., reductions in oxygen due to warming of the water).

2.2.1.2 Fisheries-specific Stressors

Effects on Fishery Target Species. Effects on fishery target species are changes in target fish abundance, distribution, and or/behavior as a direct or indirect result of offshore wind energy development. Such changes are considered effects on fish and other organisms, but are a stressor to fisheries, potentially causing changes in fishery effort or loss of revenue.

Impaired Safe Fishery Access. Impaired safe fishery access is an inability to safely access and operate within fishing grounds (e.g., impairment of navigational

equipment, potential to catch buried cables in fishing gear and/or anchors, increased risk of collision with structures).

Inadequate Infrastructure: Inadequate infrastructure includes situations in which offshore wind energy development may increase the strain on shoreside infrastructure such as ports and docks, fueling stations, fish processing facilities, and other related systems. Inadequate infrastructure also includes situations in which vessel infrastructure and equipment such as engines, global positioning systems, radar, fishing gear, and safety equipment may be insufficient to account for changes in fishing vessel behavior caused by the need to navigate around or through offshore wind energy facilities.

Insufficient Communication. Insufficient communication includes situations in which there is inadequate dialog, information sharing, workshops, and/or development of novel communication strategies between stakeholders, offshore wind energy developers, regulatory agencies, and/or advisory groups related to offshore wind energy projects.

Loss of Fishing Grounds. Loss of fishing grounds is loss or inaccessibility of usual fishing areas resulting from short- and long-term aspects of offshore wind energy development. Loss or inaccessibility could be due to factors such as physical barriers, difficulty in maneuvering or setting gear, and risk of gear damage or loss. Safety issues are considered impaired safe access and not included in loss of fishing grounds. Reduction in desirability of fishing grounds in association with changes in fish abundance, distribution, and/or behavior is considered an effect on fishery target species, defined above, and is not included in loss of fishing grounds.

2.2.2 Potential Effects

Potential effects are the changes to the behavioral, physical, chemical, and/or biological characteristics of an organism, species, or the ecosystem inhabited by the organism/species due to stressors related to offshore wind energy development. In the context of fisheries, potential effects are impacts on fishing activities and revenue as a result of stressors related to offshore wind energy development. Additionally, changes in fishing effort, grounds, and revenue can result from changing markets, ocean conditions, permit and licensing requirements, protected species interactions, natural fish abundance and distribution patterns, and other factors unrelated to offshore wind energy development. For purposes of describing potential MMPs to address effects of stressors on fisheries, effects are considered outcomes that are a result of offshore wind energy development and not other biological, physical, and economic factors that affect fisheries.

Behavioral Disturbance. Behavioral disturbance is a change in individual or group short-term natural behavior (e.g., localized movement patterns, alertness) or behavior patterns (e.g., change from spawning, feeding behavior, or social behavior to another behavior pattern) as a result of a stressor(s), not including

changes that would constitute displacement/barrier effects and attraction (listed separately below).

Displacement. Displacement is avoidance of an area associated with offshore wind energy development by individuals or groups as a result of a stressor(s). This can include short- or long-term effective loss of offshore habitat (such as foraging or roosting grounds, calving/spawning grounds, and above- or below-water movement areas). This also includes barrier effects, in which individuals may alter local or long-distance movements to avoid aspects of offshore wind energy development (including offshore infrastructure and vessel traffic).

Attraction. The movement of individuals or groups toward areas associated with offshore wind energy development in response to a stressor (e.g., attraction to a light source on a wind turbine). This can be caused by sensory attractants or other attractants such as increased prey availability, ways to avoid predators, or changes in other resources.

Habitat Fragmentation/Modification. Habitat fragmentation is the loss of habitat that results in division of large, contiguous habitats into smaller disconnected habitat patches. Habitat modification is the change in size, composition, structure, or function of an existing habitat (e.g., wind turbines provide new substrate that can support encrusting organisms that would not otherwise be present in the same numbers or species composition).

Injury/Mortality. Injury includes physical damage to the body, internal or external, permanent or temporary, as well as physiological changes (e.g., stress) that may or may not be expected to lead to death. Mortality is death of an organism.

Community Alteration/Invasive Species. Community alteration is a permanent) change to the composition, structure, or function of an ecological community (a group of populations of multiple species occupying the same geographic area at the same time). Invasive species are non-native species that are introduced into a new environment as a result of offshore wind energy development and cause ecological and/or economic harm.

Change in Fishing Effort: Change in fishing effort is short- or long-term change in common fishing patterns in time and space, including fishing outside typical fishing grounds, increased effort and/or competition among fishing vessels at available fishing areas, and changes in the numbers of fishing vessels or fisheries in a given area as result of offshore wind energy development.

Loss of Fishing Revenue: Loss of revenue is reduced fisheries revenue from typical baseline or expected ranges due to offshore wind energy development. Loss of revenue can result from loss of gear, damaged gear, reduced catch, additional fuel and other operations costs, etc. Changes in fishing effort due to offshore wind energy development may be accompanied by loss of revenue, but

in some cases, revenue may not be affected within normal and/or expected ranges despite changes in fisheries.

2.2.3 Development Phases

Development phases are the stages of offshore wind facility development/operation, each of which encompass a number of activities and, as a result, may have different types of stressors. MMPs are likely to be implemented by development phase.

Pre-construction. This phase includes site assessment work such as geotechnical and geophysical surveys, installation of meteorological towers or buoys, and environmental or other surveys.

Construction. This phase, which can last for several years, includes various activities associated with building the turbines and connecting them to the electrical grid, including jack-up barges and other vessel activity. Construction also includes installation of undersea cables among turbines and sub-stations.

Operations & Maintenance. This phase, which can last 25 years or more, is the period in which turbines are generating electricity and includes activities relating to turbine monitoring and maintenance.

Decommissioning. This phase includes decommissioning activities chosen for a given project site, which may include full removal of structures, removal of above-water structures (to a certain water depth to avoid navigational hazards), or repowering.

2.2.4 Industry

Industry terms define the type of industry for which MMPs have been suggested or implemented in the U.S. or other countries.

Offshore Wind. Offshore wind refers to any offshore wind energy development in marine or freshwater (e.g., Great Lakes) locations.

Onshore Wind. Onshore wind refers to wind energy development in terrestrial locations.

Oil and Gas. Oil and gas includes both onshore and offshore oil and gas development.

Maritime. Maritime refers to any marine or freshwater activity other than offshore wind and oil & gas. This includes shipping, fisheries, transmission, and other industries that operate in the marine environment.

Generic/General. Generic/general includes any industry that is not included in the above options, or situations where an industry was not specified.

2.2.5 Implementation Status

The implementation status defines the degree to which the use or efficacy of an MMP has been tested.

Not Implemented. Not implemented means that the MMP was not implemented in the source literature.

Field Tested. Field tested refers to a situation in which an MMP has not been implemented in a real-world development situation but has been tested in another way, such as academic research or prototypes.

Implemented. Implemented means that the MMP was implemented in the source literature, but there was no testing or assessment indicated as to whether it was effective at reducing impacts on the resource of interest.

Implemented and Evidence of Effectiveness. Implemented and evidence of effectiveness means that the MMP was (1) implemented in the source literature, and (2) found to be effective when tested or assessed for effectiveness at reducing impacts on the resource of interest.

Unknown. Unknown means that, based on source literature, it is unclear whether or not the MMP was implemented.

2.2.6 Implementation Details

The implementation details provide one or two examples from scientific literature or technical documents of how the MMP has been implemented and/or tested in cases for which testing or implementation has occurred.

2.2.7 Mitigation/Monitoring

Mitigation. Mitigation is an action taken to minimize, avoid, or offset impacts (e.g., using a sound reduction technology).

Monitoring. Monitoring is an action taken to evaluate impacts, progress, or quality of something (e.g., monitoring for bird collision to determine impacts, or evaluate a mitigation strategy for effectiveness).

For example, a camera system on a turbine that can record bird behavior and collisions, but has no method to reduce collisions, is a “monitoring” method. The data from the camera system will be used to determine impacts at the project site, and could be used to inform adaptive management at that site or to inform decision making for future studies, but there is no direct effort to minimize impacts at the test site. Alternatively, if the camera is linked to an acoustic deterrent or turbine shutdown approach, it would be considered a “mitigation” method. And in the case in which data from the camera system are being used for both purposes – that is, if the camera system is part of a mitigation approach, but

also saves data to be used in future impact assessments—then both "mitigation" and "monitoring" apply.

2.2.8. Mitigation Hierarchy

The most applicable level(s) of the mitigation hierarchy was(were) chosen for each MMP. For MMPs that were solely monitoring recommendations, no mitigation hierarchy levels were chosen.

Avoidance. Avoidance will eliminate impacts entirely. For example, siting a project outside the range of an animal completely avoids impacts on that animal. As another example, operating equipment outside the hearing range of an animal avoids sound impacts on that animal.

Minimization. Minimization will reduce the impacts. For example, sound dampening technology may reduce the amount of sound, thus reducing the impact of sound on organisms.

Restoration. Restoration refers to measures taken to improve or rehabilitate ecosystem components that are impacted by the project. For example, if a met tower were placed in a mesophotic coral area and after removal of the tower, coral was transplanted back to the area.

Offset. Offset is compensation for impacts. For example, monetary compensation could be provided for loss of fishery access. As another example, improvement of off-site habitat or establishment of a marine protected area in another place could offset degradation of habitat in the project area. (Restoration defined above requires restoration of areas directly impacted by the project; other rehabilitation or preservation efforts are offsets typically described as compensatory mitigation.)

2.2.9 Generalized MMPs

Generalized MMPs are categories or types of specific MMPs gathered in the spreadsheets. Generalized MMPs needed to be general enough that multiple specific MMPs would aggregate into a generalized MMP category. Generalized MMPs have also been designed to be mutually exclusive.

Barriers. Barriers include MMPs that include physical creation of an obstacle to prevent a stressor (e.g., sound, EMF) from propagating (e.g., bubble curtains to block sound, cable burial to block EMF, scour protection to block sediment movement).

Siting/Seasonality. Siting and seasonality include MMPs that consider geographic location choices for long-term wind farm structures (e.g., macro-siting) and/or time of year in activities, including vessel activities. Micro-siting of turbines is considered a structure configuration MMP rather than siting/seasonality.

Shutdown/Low Power. Shutdown and low power include MMPs that require stopping or reducing the power of an activity (e.g., shutdown of geophysical surveys when marine mammals are present, soft-start pile driving). This also includes curtailment of turbine operations but not feathering or increasing cut-in speed, which are included in turbine operation parameters.

Vessel Operation Parameters. Vessel operation parameters include MMPs that involve choices in vessel number, behavior, location, direction, equipment, and actions of vessel crew (e.g., positioning vessels with thrusters, educating crew to avoid whale collisions). Vessel location choices are different than siting choices for structures or seasonal activities (see Siting/Seasonality). This is also different from shutdown/low power. If equipment on a vessel is being shut down or run at low power (e.g., shutdown of an echosounder), it is considered a shutdown/low power MMP rather than a vessel operation parameter.

Limit an Activity. Limit an activity includes MMPs that do not fall into other categories and include a restriction in activity (e.g., avoiding pile driving at night, not using explosives).

Structure Configuration. Structure configuration includes MMPs that involve choices in turbine numbers and sizes, foundation types, and how turbines are arranged in space (e.g., micro-siting).

Water Quality Management. Water quality management includes MMPs that are designed to avoid water quality impacts, such as following dumping and bilge water regulations.

Compensation. Compensation includes MMPs that involve offsetting an impact through financial means or by restoration, enhancement, or other conservation measures.

Turbine Operation Parameters. Turbine operation parameters include MMPs that focus on movement of turbines (e.g., increased cut-in speed to avoid bats). Curtailment is not included in this category as it is considered a shutdown/low power MMP.

Deterrence/Attraction Reduction. Deterrence/attraction reduction MMPs include efforts to actively discourage animals from approaching activities and/or structures (e.g., use of pingers) or reduce the attractiveness of activities or structures (e.g., avoid including nesting habitat on turbines, use colors not attractive to birds). This does not include choices in lighting meant to reduce attraction, which is considered a lighting alternative MMP.

Lighting Alternatives. Lighting alternatives MMPs include choices in lighting that can minimize attraction or deter animals, including considerations like number and intensity of lights, lighting color, and periodicity.

Engagement/Communication. Engagement/communication MMPs include outreach efforts, information sharing, research facilitation, and other efforts to inform and learn from stakeholders in ways that will minimize and avoid impacts of offshore wind energy development.

Monitoring. Monitoring includes MMPs that observe and evaluate potential impacts to inform decisions and adapt management practices (e.g., measuring the numbers of marine mammals or birds traveling through an area to inform siting or mitigation actions). MMPs categorized as monitoring do not include any specific mitigation actions. Rather, specific actions are included in other generalized MMPs. For example, clearance for marine mammals prior to starting pile driving is a shutdown/low-power action, or turning on a deterrence device when birds are detected by a monitoring device is a deterrence/attraction reduction action.

Fisheries Safety. Fisheries safety MMPs are direct actions to reduce hazards of offshore wind energy development to increase safety of people and vessels (e.g., safety protocols for designating vessel right-of-way, marking designated transit zones, and infrastructure modifications to improve offshore communication and reduce interference with navigational equipment). This does not include outreach, research, and information sharing efforts, which are considered engagement/communication MMPs.

2.3 Resource Groups

MMPs are focused on minimizing and avoiding potential impacts of offshore wind energy development on the following resources:

- Birds and Bats,
- Marine Mammals and Sea Turtles,
- Fish,
- Benthos, and
- Fisheries.

2.3.1 Birds and Bats

2.3.1.1 Bird and Bat MMP Overview

Flying wildlife that interact with offshore wind energy facilities fall into two general types. First, marine birds (e.g., waterbirds such as sea ducks, gulls, terns, and alcids) use the ocean environment for many purposes, including foraging, roosting, travel to and from breeding colonies, and migration. Second, bats and more land-based bird taxa such as passerines, raptors, and shorebirds, are most likely to encounter offshore wind energy development during migration, though some species are also known to forage and roost offshore (e.g., peregrine falcons). When an MMP was general enough to pertain to all birds or all bats, “all birds” or “all bats” was chosen as the subgroup within the resource.

MMPs for migrants and more land-based taxa most often address potential impacts from collisions (e.g., mortality or injury) and, to a lesser degree, displacement from typical migratory routes. Potential effects on marine birds are more varied. While mortality and displacement from typical habitat use areas are still the most common concerns, MMPs also focus on habitat modification, behavioral disturbance, and attraction to structures. Long-term structures and artificial light are prominent stressors. Other stressors, such as changes in vessel traffic, primarily affect marine birds that use the aquatic environment. Overall, most mitigation practices for birds and bats focus on the following:

- Siting and configuration of turbines and wind farms,
- Lighting alternatives,
- Deterrence/attraction reduction, and
- Turbine operation parameters.

These management practices are primarily aimed at reducing collision risk, as well as disorientation from lighting, and draw a great deal from other marine industries (e.g., offshore oil and gas) and the onshore wind energy industry. Displacement and barrier effects for birds are commonly monitored at offshore wind energy facilities, but there are few accepted mitigation strategies for these types of impacts.

2.3.1.2 Bird and Bat Subgroup Definitions

Birds are animals in the class Aves, and bats are animals in the order Chiroptera. The Tool focuses on MMPs that would apply to birds and bats that rely on or travel through the ocean and marine ecosystems. MMPs that have been applied to onshore wind projects are included in the Tool in cases in which they could be applicable to offshore wind energy development.

Marine Birds. Marine birds are defined for this purpose as waterbirds that are expected to interact with marine environments on the Outer Continental Shelf on a regular basis. This includes auks, gannets, cormorants, gulls, skuas, jaegers, loons, grebes, sea ducks, shearwaters, petrels, storm-petrels, terns, and phalaropes (which are shorebirds but occur pelagically).

Nocturnal Aerial Migrants. Bats and many species of birds migrate at night, including over the water. This group can include passerines, shorebirds, some waterfowl, some raptors, and other bird species, as well as bats.

2.3.2 Marine Mammals and Sea Turtles

2.3.2.1 Marine Mammal and Sea Turtle MMP Overview

Marine mammals and sea turtles often are subject to similar or the same MMPs to protect these resources from sound, vessel strike, and other disturbance. MMPs for offshore wind energy development for these resources generally address potential impacts from behavioral disturbance, displacement, habitat modification, and injury/mortality. The major stressors associated with these potential impacts

are sound, long-term presence of structures, and changes in vessel traffic. Because marine mammals are specialists in different hearing frequencies, they are split into hearing groups for purposes of evaluating impacts from sound under the U.S. regulatory framework[2]. Thus, MMPs were considered for low-frequency, mid-frequency, and high-frequency cetaceans and pinnipeds (seals) separately. Furthermore, because North Atlantic right whales are subject to laws that do not apply to other marine mammals, North Atlantic right whales were considered as a separate subgroup within the resource. When an MMP was general enough to pertain to all marine mammals, "all marine mammals" was chosen as the subgroup within the resource. MMPs directed at sea turtles were not species-specific, so sea turtle MMPs were considered to apply to "all sea turtles." Overall, most MMPs to protect marine mammals and sea turtles focus on the following:

- Seasonal activity periods,
- Siting that considers important habitats,
- Minimizing received sound levels, and
- Avoiding vessel strike.

2.3.2.2 Marine Mammal and Sea Turtle Subgroup Definitions

Marine mammals are mammals that rely on the ocean and marine ecosystems and include the cetaceans (baleen and toothed whales), pinnipeds (seals, sea lions, and walruses), sirenians (manatees and dugongs), and polar bears. Of these, only cetaceans and seals occur within New York State's geographic scope . Sea turtles are turtles that rely on the ocean and marine ecosystems and include seven species, of which loggerhead, leatherback, Kemp's ridley, and green sea turtles seasonally live in the New York Bight.

Low-Frequency Cetaceans. Low-frequency cetaceans are more sensitive to lower frequency sound. Their generalized hearing range is from 7 hertz (Hz) to 35 kilohertz (kHz). Low-frequency cetaceans include all mysticetes (baleen whales) (NOAA OPR 2018).

Mid-Frequency Cetaceans. Mid-frequency cetaceans are more sensitive to mid-frequency sound. Their generalized hearing range is from 150 Hz to 160 kHz. Mid-frequency cetaceans include most delphinid species (dolphins), beaked whales, and sperm whales (but not pygmy and dwarf sperm whales) (NOAA OPR 2018).

High-Frequency Cetaceans. High-frequency cetaceans are more sensitive to high-frequency sound. Their generalized hearing range is from 275 Hz to 160 kHz. High-frequency cetaceans include porpoises, river dolphins, pygmy/dwarf

[2] National Oceanic and Atmospheric Administration (NOAA) Office of Protected Resources (OPR). 2018. 2018 Revision to: Technical Guidance for Assessing the Effects of Anthropogenic Sound on Marine Mammal Hearing (Version 2.0). Underwater Thresholds for Onset of Permanent and Temporary Threshold Shifts. NOAA Technical Memorandum NMFS-OPR-59.

sperm whales, *Cephalorhynchus* species, and some *Lagenorhynchus* species (NOAA OPR 2018).

Pinnipeds. *Phocid* pinnipeds include all earless seals or "true seals," such as harbor or common seals and gray seals. *Otariid* pinnipeds include all eared seals (fur seals and sea lions) and walruses.

North Atlantic Right Whale. The North Atlantic right whale (*Eubalaena glacialis*) is listed as endangered under the Endangered Species Act. This sub-taxon was applied in the case that an MMP applied only to North Atlantic right whales and not to other marine mammals (i.e., regulations and guidelines specifically for North Atlantic right whales).

Sea Turtles. Sea turtles includes any of seven species of marine turtles, including both leatherback and hard-shelled turtles. Sea turtles live most of their lives at sea but come onto beaches for nesting.

2.3.3 Fish

2.3.3.1 Fish MMP Overview

Although fish resources can experience impacts from offshore wind energy development, a variety of MMPs to avoid and/or minimize impacts have been developed and/or discussed within a laboratory setting, the literature, and field investigations. Although MMPs for fish cover a range of potential impacts, the majority generally address behavioral disturbances, displacement, habitat fragmentation and/or modification, and injury/mortality. The stressors associated with these impacts are sound, bottom disturbance, the presence of long-term structures, and EMF/vibration/heat. Because fish can spend their lives in different regions within the water column, they can be separated into two groups for the purpose of evaluating these impacts: pelagic fish (those living mainly within the water column) and demersal/groundfish (those living mainly on the seafloor). When an MMP was general enough to pertain to all fish, the "all fish" category was selected as the subgroup within the resource. Fisheries-specific resources were considered separately from fish as a taxonomic group. Overall, most MMPs to protect fish resources focus on the following:

- Siting that considers important habitats, species-specific spawning, and migration patterns,
- Minimizing received sound levels,
- Use of proper shielding and/or burial depths of cables, and
- Engagement/communication with stakeholders.

2.3.3.2 Fish Subgroup Definitions

Fish are organisms in the taxonomic groups of teleosts (bony fish such as sturgeon), elasmobranchs (cartilaginous fish such as sharks), and agnaths (jawless fish such as lamprey).

Pelagic Fish. Pelagic fish are fish that live and feed mainly in the water column.

Demersal/Groundfish. Demersal and groundfish are fish that live and feed mainly on or close to the seafloor.

2.3.4 Benthos

2.3.4.1 Benthos MMP Overview

MMPs for impacts on the benthic environment are similar to those for impacts on fish species and mainly address bottom disturbances, scouring, and the presence of long-term structures. Because benthic resources can be divided into sessile/unable to easily escape (e.g., some invertebrates, seagrass/kelp/algae) and mobile, and because some stressors may have more of an impact on invertebrates or seagrass/kelp/algae, they can be separated into three groups for the purpose of evaluating these impacts: demersal/groundfish (those living mainly on the seafloor), benthic invertebrates (organisms without backbones that live mainly on the seafloor as adults), and seagrass/kelp/algae. When an MMP was general enough to pertain to all benthic resources, the "all benthos" category was selected as the subgroup within the resource. Some MMPs for impacts on demersal/groundfish are also included under fish resources. Overall, most MMPs to protect benthic resources focus on the following:

- Siting that considers important habitats, sensitive seafloor habitats, and current flow,
- Use and routine inspection of scour protection devices,
- Engagement/communication with stakeholders, and
- Construction methods that limit impacts on the benthic environment.

2.3.5.2 Benthos Subgroup Definitions

Benthos are organisms that spend the majority of their lives on the seafloor. These organisms include both flora and fauna.

Demersal/Groundfish. Fish are organisms in the taxonomic groups of teleosts (bony fish such as sturgeon), elasmobranchs (cartilaginous fish such as sharks), and agnaths (jawless fish such as lamprey). Demersal and groundfish are fish that live and feed mainly on or near the seafloor.

Benthic Invertebrates. Benthic invertebrates are organisms without backbones (e.g., crabs, lobsters, and sea slugs) that live mainly on the seafloor as adults.

Seagrass/Kelp/Algae. Seagrass are flowering plants that grow entirely underwater, though they may be exposed to air at different tidal stages. Kelp are large, brown algal underwater seaweeds of the order Laminariales. Algae are non-flowering plants that grow entirely underwater, though they may be exposed to air at different tidal stages.

2.3.5 Fisheries

2.3.5.1 Fisheries MMP Overview

Fisheries resources can experience a series of interrelated impacts from offshore wind energy development, including impacts on target species (discussed in detail in the fish and benthos sections); where the wind farm(s) is sited with respect to ports, transit routes, and prime fishing grounds; and impacts on the livelihood and revenue from operating in a wind farm (e.g., safety, loss of gear). MMPs included in the Tool cover both commercial fisheries (conducted with the goal of selling the catch for profit) and recreational fisheries (conducted for sport or pleasure), but in general, most MMPs address concerns related to commercial fisheries. Overall, most MMPs to protect fisheries resources focus on the following:

- Siting that considers important fishery grounds and transit routes,
- Engagement and communication between the fishing industry and developers during all stages of development,
- Development of compensation fund distribution programs, and
- Safety measures to minimize danger and conflicts between vessels and wind farms.

2.3.5.2 Fisheries Subgroup Definitions

Commercial Fisheries. Commercial fisheries are fisheries conducted with the goal of selling the catch for profit.

Recreational Fisheries. Recreational fisheries are fisheries conducted for sport or pleasure (including charter and for-hire fishing).

2.4 MMP Sorting Criteria

There are myriad MMPs available to address the potential effects of offshore wind energy development on marine wildlife and fisheries. Each proposed offshore wind energy project will have unique factors associated with location, wildlife present, size of the project, and specific activities and equipment that will affect which MMPs will constitute BMPs for each phase of the project. BMPs will be implemented as suites of actions, so the synergism among BMPs is also important for each project. However, BMPs can also be considered generally in the context of broad assessment criteria, without requiring detailed information about proposed projects. The approach described below can provide quantitative and qualitative assessments of MMPs to evaluate which MMPs may be BMPs, address future project needs and BMP gaps, and better understand stakeholders' priorities regarding wildlife and fisheries protection.

The example criteria provided in this User Manual are meant to suggest some criteria that may be useful to the User when referencing or assessing MMPs. These criteria could simply be used to sort MMPs in the Tool, for example by choosing only to view MMPs relevant to specific taxa or development phases. Alternatively, such criteria can be used to develop a rating system by which to

quantitatively evaluate each criterion for a given MMP. An example rating system for quantifying MMPs is provided in Appendix A.

The Tool is not designed to assign value judgements or assess priorities for MMPs using any of the potential sorting criteria. Section 2.4 is meant to describe some ways the User could go about assessing and organizing MMPs. Some examples are provided in Appendix A to make it clear how quantitative parameters can be assigned to sorting criteria, but these examples are not meant to be taken as recommendations. They are simply examples to support understanding of the method by which criteria could be developed and applied.

Example potential MMP assessment criteria are presented below. In Section 2.4.1, the focus is on criteria that could be reasonably evaluated by the E-TWG and F-TWG or other users as part of a generalized process. In Section 2.4.2, other criteria are mentioned that may be important but are unlikely to be evaluated at this stage, mainly because the available data are insufficient to evaluate them or they need to be considered on a more project-specific basis (such as cost of implementing MMPs).

2.4.1 Example Sorting Criteria Currently Applied in the Tool

Implementation Status and Demonstration of Efficacy. Users may choose to focus on MMPs that have been successfully implemented and demonstrated to have effectiveness.

Applicability to Multiple Taxonomic Groups. MMPs may address potential impacts on multiple resource groups and/or subgroups, rather than focusing on a specific group of organisms. The Tool indicates whether MMPs apply to marine mammals, sea turtles, fish, fisheries, birds, bats, and/or benthos, and also provides some sub-groups within these resource categories that would allow for sorting relative to the type of resources addressed by each MMP.

Species of Conservation Concern. Users may want to sort MMPs relative to minimizing and/or avoiding impacts on species with special conservation status. For example, a criterion could be associated with minimizing impacts on species listed under the Endangered Species Act with categories broken down by numbers of ESA-listed species affected or specific ESA species. The Tool specifically indicates when North Atlantic right whales are the target of an MMP. Additionally, other resources or sub-groups can be used to determine ESA status. For example, MMPs aimed at low-frequency cetaceans would affect endangered baleen whales, or those aimed at sea turtles would affect threatened and endangered sea turtles. The species notes section of the Tool also indicates if a particular species is targeted, but in some cases, the sub-group in which an ESA species would fall, would be the indicator as to whether an MMP may affect an ESA-listed species. For example, roseate terns would likely be affected by MMPs that target Marine Birds or All Birds. All marine mammals and all migratory birds

have protected status under U.S. laws, so a criterion for species protected under laws other than ESA could be applied.

Applicability to Multiple Phases of Development. Four phases of development are included in the Tool and can be used to rank the numbers and types of phases of development to which an MMP is applicable.

Application to Industry. Four industries are included in the Tool and can be used to evaluate which industry or number of industries apply to an MMP.

Applicability to Stressors. The number or type of stressors to which MMPs apply are indicated in the Tool and can be used to create criteria for sorting based on type or number of stressors addressed by MMPs.

Applicability to Potential Effects. The number or type of potential effects to which MMPs apply are indicated in the Tool and can be used to create criteria for sorting based on type or number of potential effects addressed by MMPs.

Mitigation Hierarchy. The type of mitigation within the mitigation hierarchy (avoidance, minimization, restoration, offset) can be specified to evaluate the level of mitigation associated with MMPs.

2.4.2 Example Sorting Criteria not Currently Applied in the Tool but can be Implemented with Minor Changes

Additional criteria could be used to sort and organize MMPs. An example of a criterion that is not explicitly addressed in the Tool is indicating whether the MMP has the potential to result in human use conflicts.

2.4.3 Example Sorting Criteria Outside the Current Scope of the Tool

To meet User goals, there may be additional criteria that are difficult to address using the Tool framework. Such criteria may be useful, but may be difficult to adequately assess without site- and project-specific information or additional scientific data. In some cases, proxies might be applied to address such criteria if they are of critical importance to User goals. For example, it may be reasonable to use potential to reduce lethal impacts as a proxy for addressing the potential to reduce population-level consequences. Some examples of criteria of this type are the following:

- Reduction in Population-Level Consequences
- Cost
- Feasibility
- Ease of Implementation
- Relationship to Statutes/Regulations

This is not an exhaustive list of potential criteria of interest to Users but provides examples of criteria that may be of interest based on the literature reviewed in creating the Tool. Further details of these potential criteria are provided in Appendix B.

3 Tool Instructions

Steps 1 through 8 below include instructions on how to use the Tool, which can be accessed on the F-TWG website (http://nyfisheriestwg.ene.com/).

1. The Tool is located under the Resources tab at the top of the homepage (see Figure 1). Upon opening the Resources tab, the User navigates to “MMP Tool” (see Figure 1).

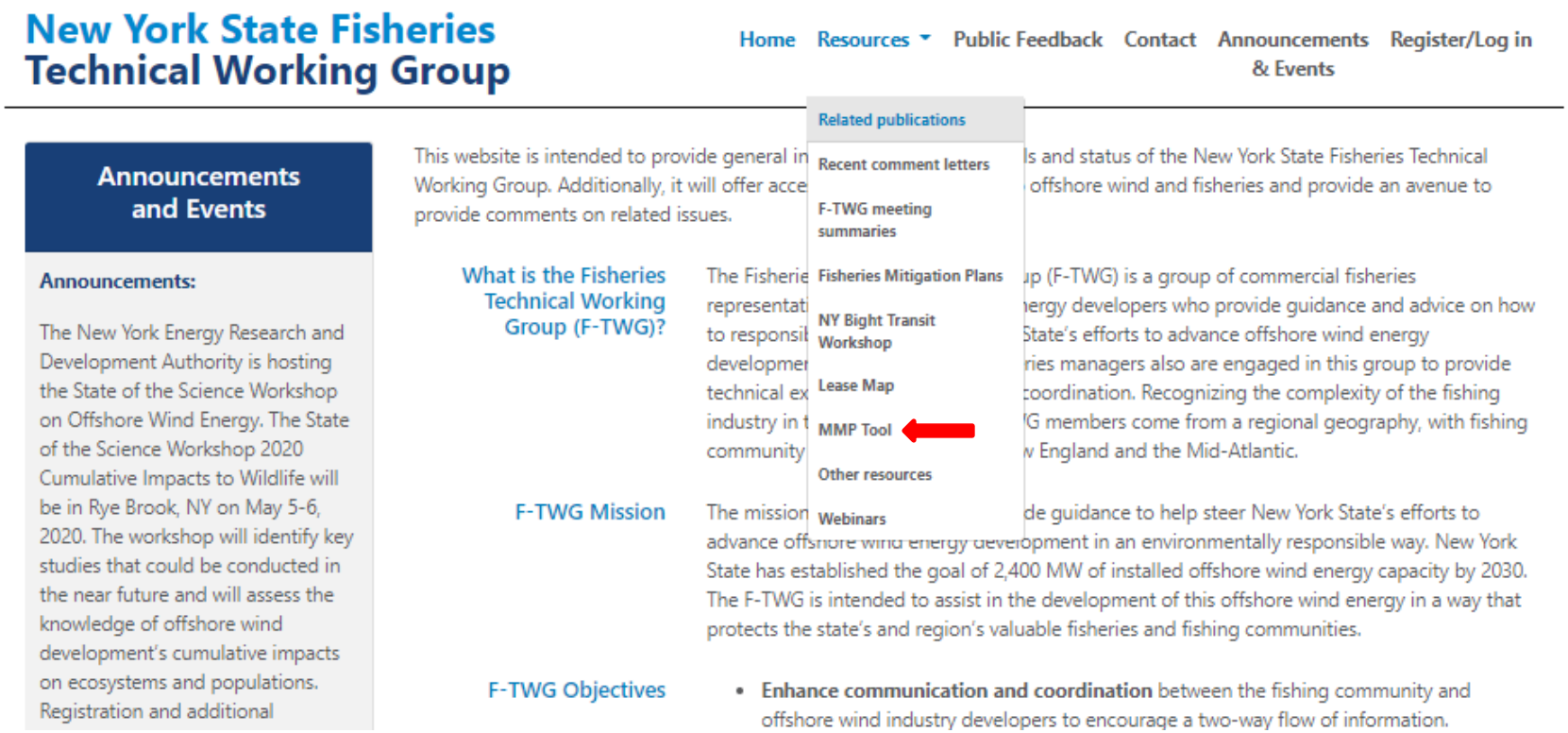

Figure 1 Opening the Tool.

2. The User clicks on “MMP Tool” to navigate to the input screen of the Tool (see Figure 2).

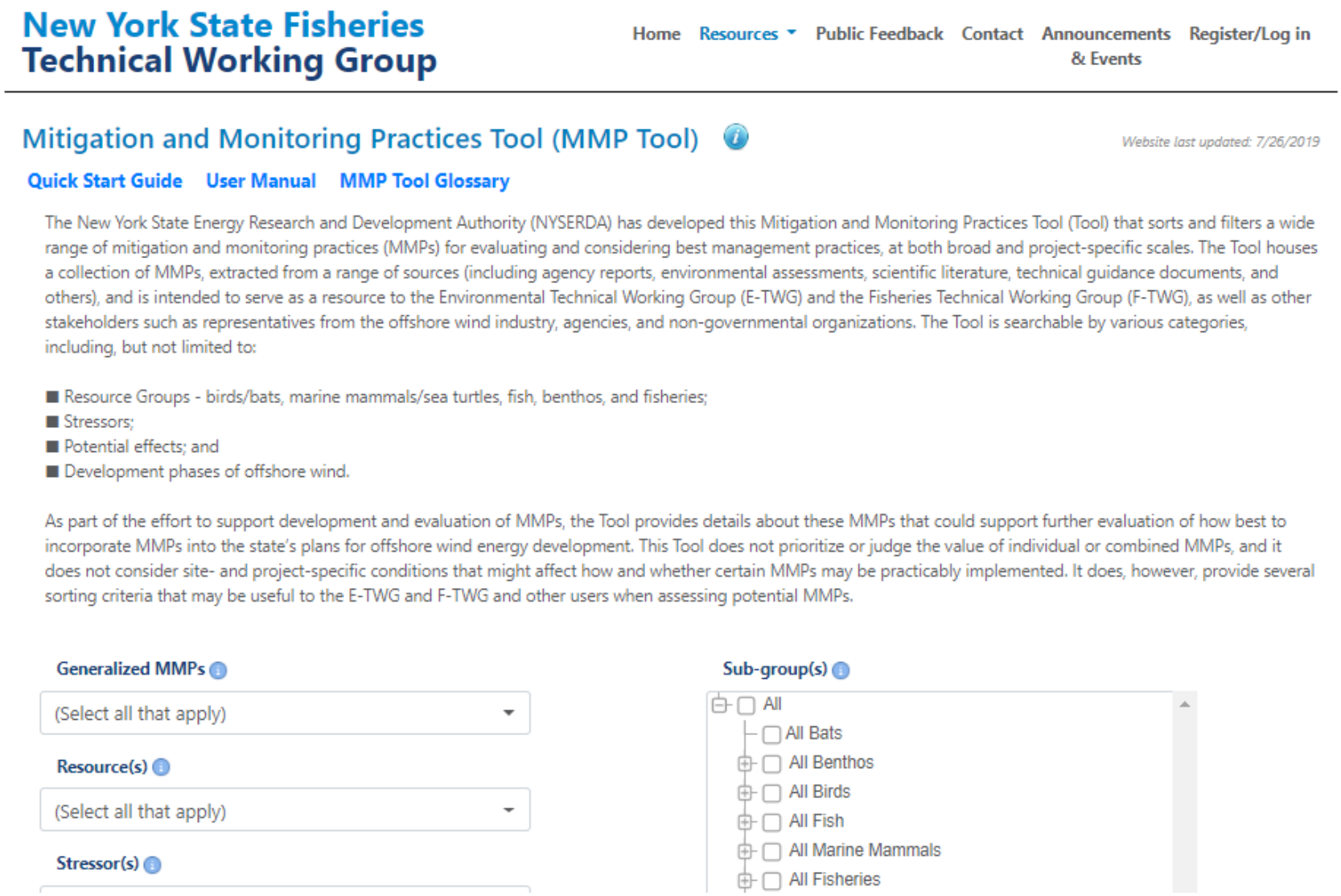

Figure 2 Input screen of the Tool.

3. Dropdown menus appear under each category in the input screen of the Tool. The User may select more than one sub-category by clicking on each item in the category's dropdown menu. For types of resources, the User may select sub-groups of bats, benthos, birds, fish, marine mammals, fisheries, and/or sea turtles in the Sub-group(s) box. An "All" checkbox is also available in the Sub-group(s) box to save time if all sub-groups are desired in the output. If a subgroup has a "+", then the User may select it to expand the list to view more specific sub-group(s). The User clicks the boxes next to the specific sub-group(s) that should be included in the output of the Tool. (See Figure 3 for an example selection.) Adding criteria is an "and" condition. For example, if the user chooses fisheries and marine mammals as resources, MMPs for both resources will be included in results.

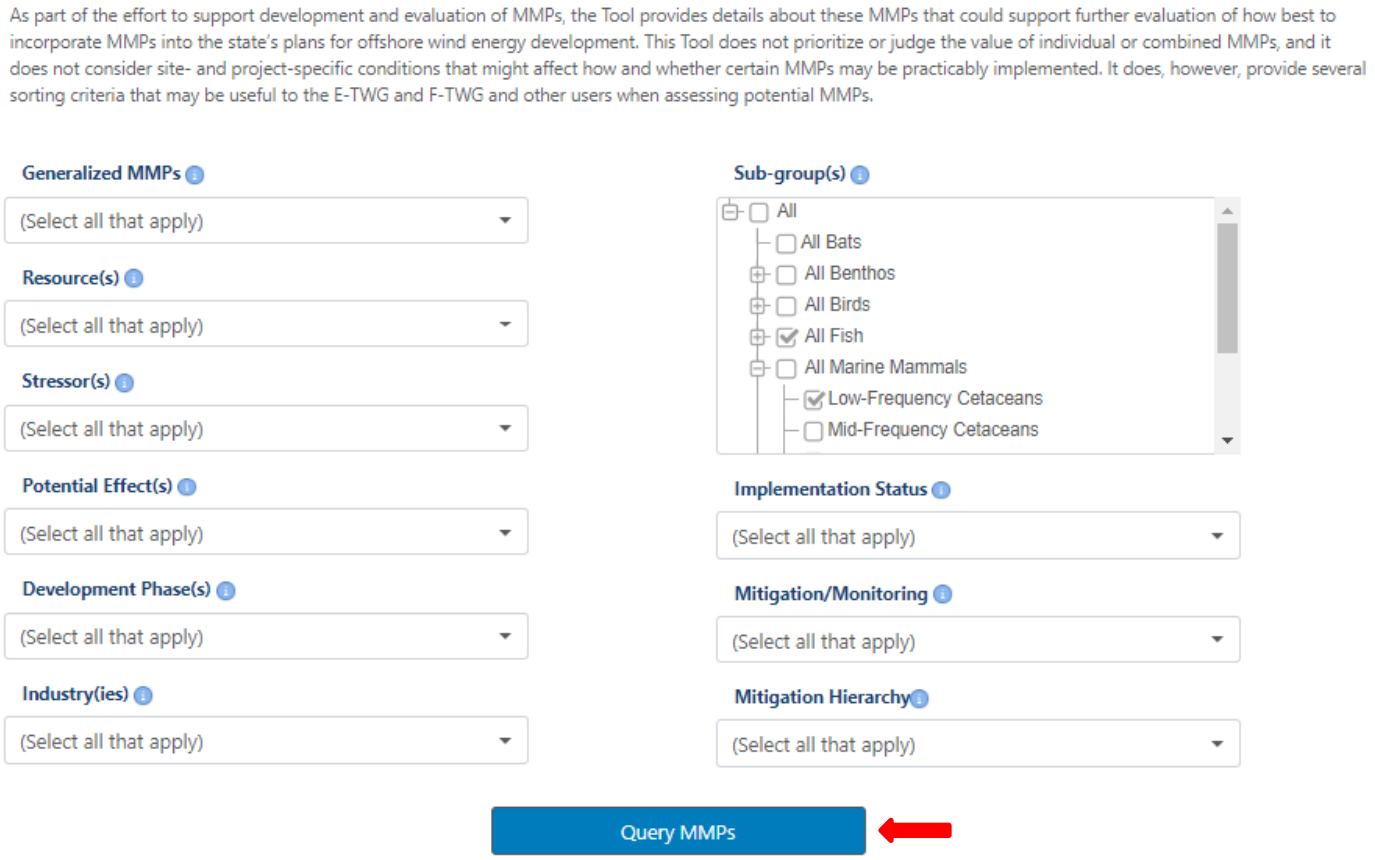

Figure 3 Example of selected categories.

4. After selecting sub-categories and sub-groups, the User clicks the "Query MMPs" radio button (red arrow in Figure 3).
5. Below the category boxes, an output table will appear that shows the results of sorting and filtering the MMP database for the combination of chosen sub-categories and sub-groups (see Figure 4). To access specific examples of generalized MMPs (i.e., non-specific MMPs applicable to multiple sub-groups), the User clicks the "Generalized MMP" dropdown menu and selects one or more generalized MMPs (A in Figure 4). This selection will sort and filter the results box based on the selected generalized MMP(s). Scroll bars (B in Figure 4) allow the User to slide the output box to see information that does not fit on the screen.

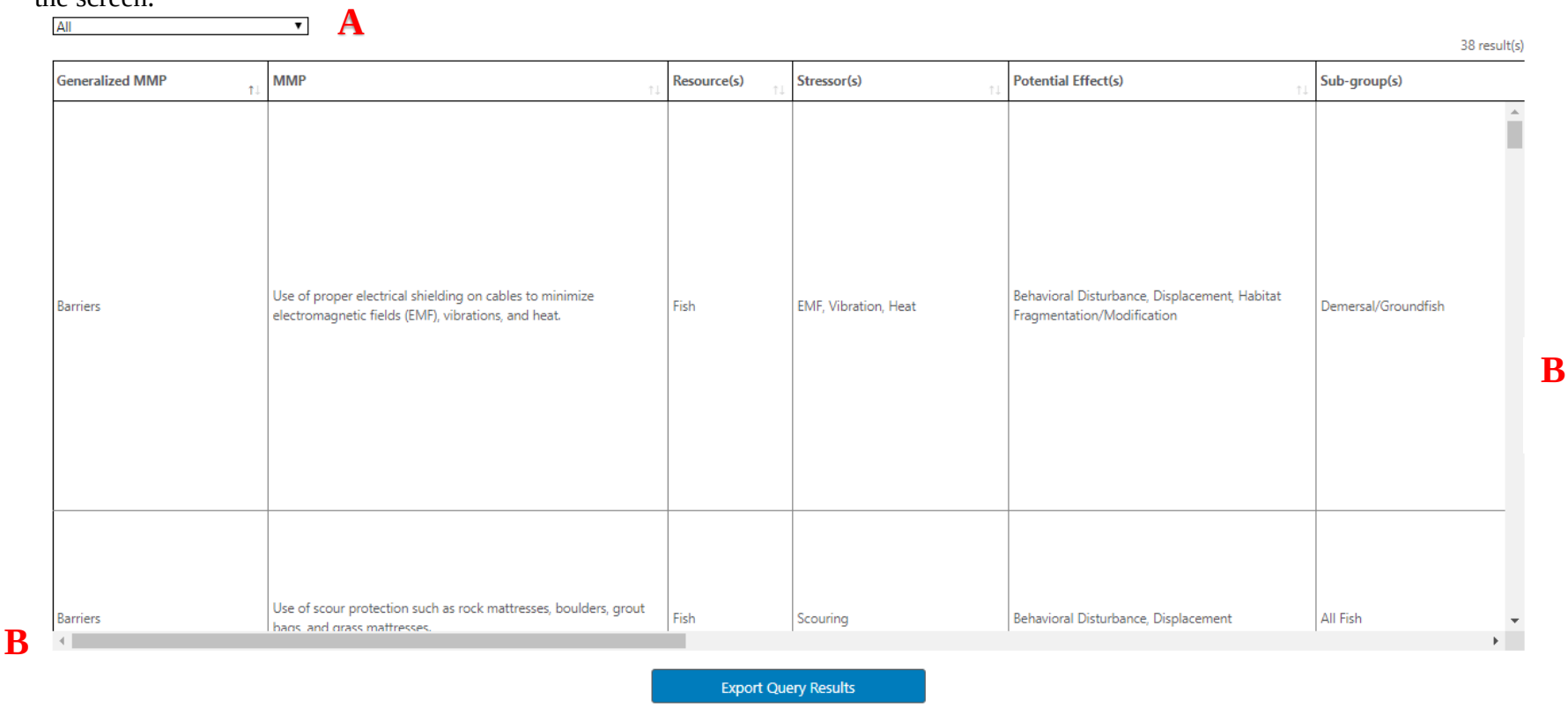

Figure 4 Example output of specific MMPs

6. To the far right of the output box is a column entitled “Citation(s).” The User can hover over the citation to access the full citation (see Figure 5).

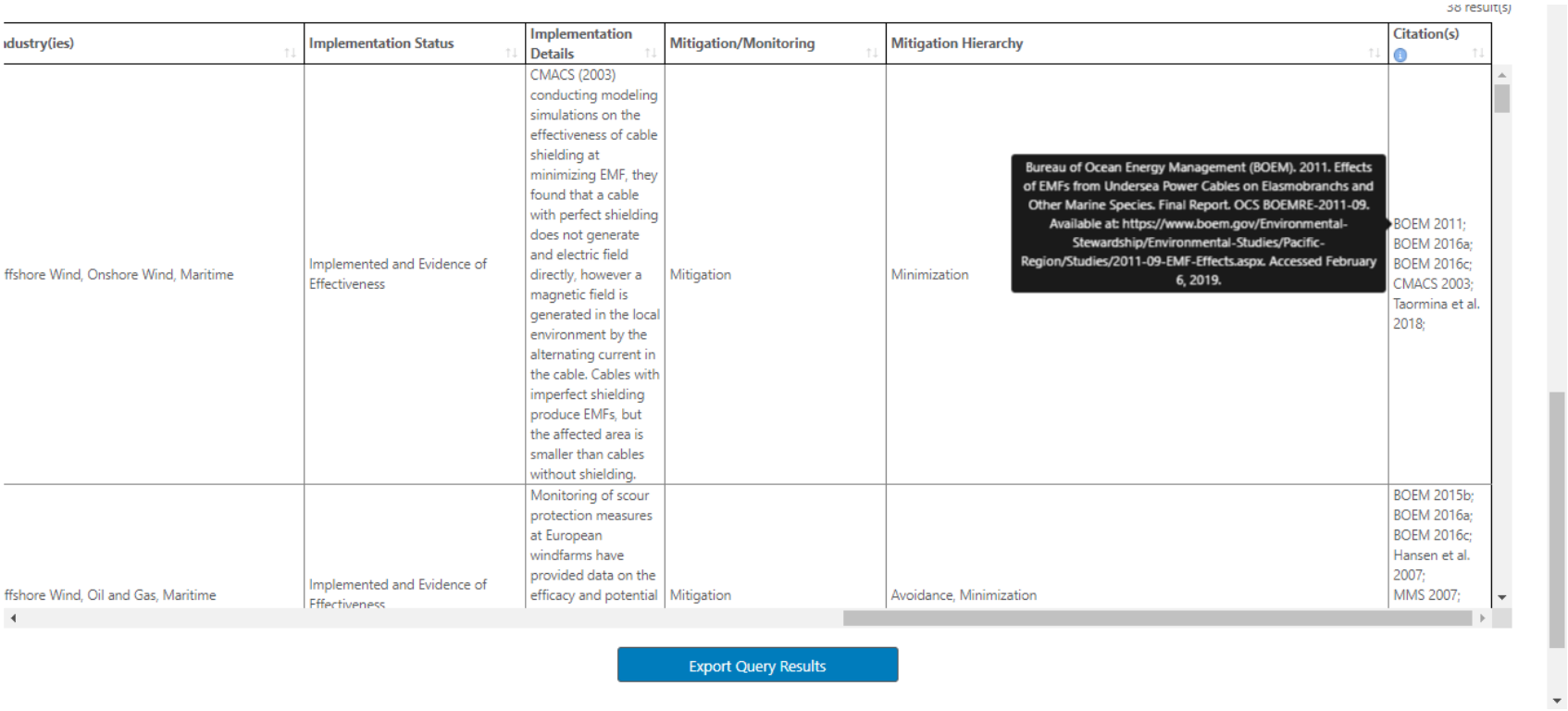

Figure 5 Example output from hovering over a citation in the “Citation(s)” column of the output box.

7. In the columns entitled “MMP” and “Implementation Details,” the total characters are truncated to 500 to maintain a user-friendly screen view. In the case that the information in the cell is more than 500 characters, an ellipsis can be seen at the end of the 500 characters in the cell. The User can their cursor hover over the cell to access the full entry (see Figures 6a and 6b).

Generalized MMP	MMP	Resour
	grounds.	
Compensation	Compensation through out-of-kind solutions to enhance populations by acting on biological parameters that influence population levels including 1) habitat expansion, 2) prey fostering, 3) predator control, 4) exotic/invasive species removal, 5) species reintroductions/resettlement, and 6) supplementary feedings.	Birds ar
Compensation	While renewable energy projects may displace existing uses of the marine environment, they may also open doors to new opportunities for fishermen. Some examples include research, repair, construction, enforcement, monitoring, and guarding. Mitigation funds could be used to help fishermen transition into these new positions through the development of training programs and the provision of gear needed to support their new role(s). Other examples of such new industries might include sight-seein...	Fisherie
Compensation	Compensation Fund: The developer and fishing industry representatives should develop a compensation fund and the processes for managing the fund. A Compensation Fund Plan should establish the sources and amount of funding, the terms of	Fisherie

Figure 6a Example output of a cell with more than 500 characters with ellipsis indicated with red arrow.

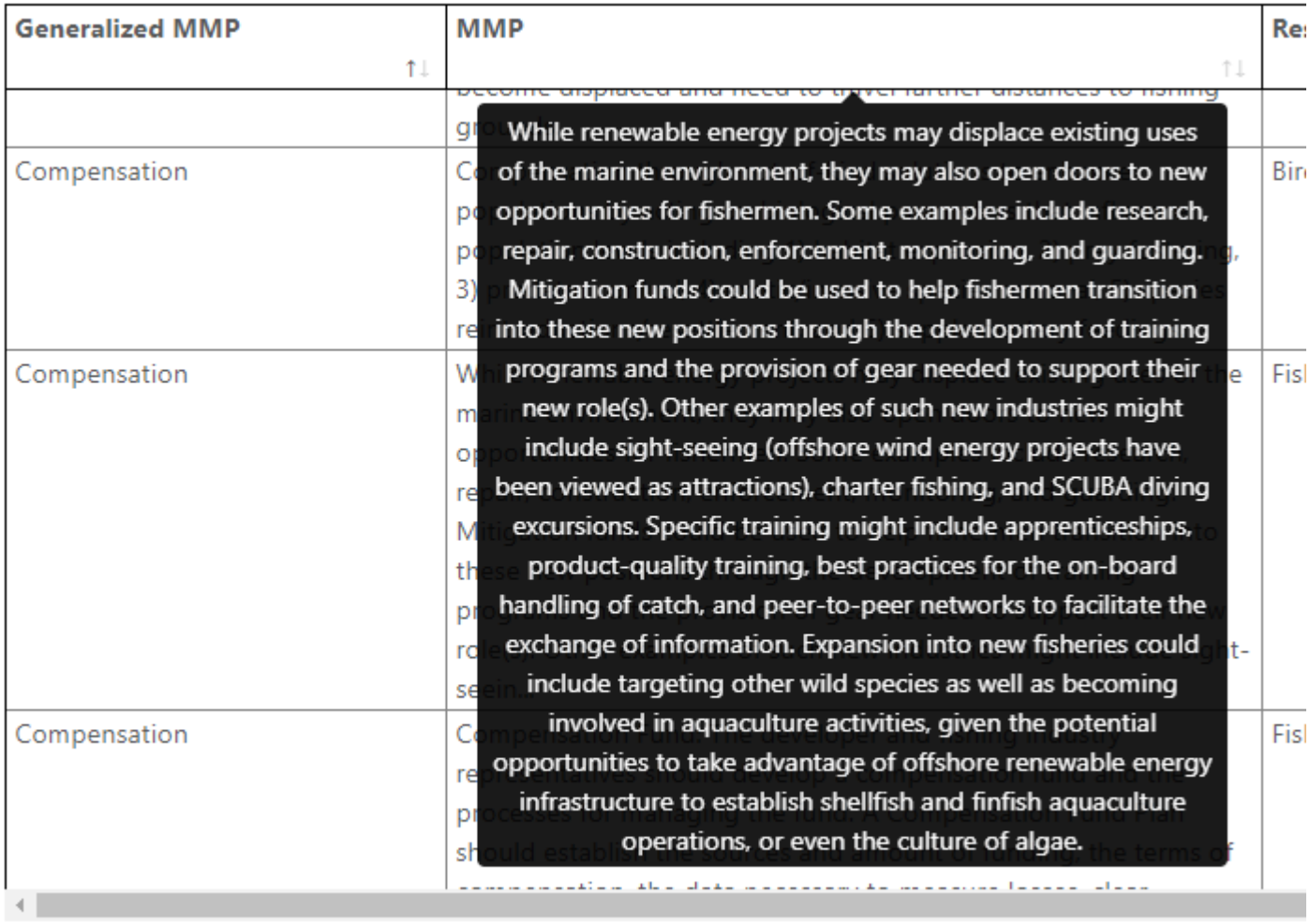

Figure 6b Example output from hovering over a cell with more than 500 characters in the output box.

8. Outputs from the Tool can be downloaded into an excel spreadsheet to preserve the record or further manipulate the information for MMP evaluation. To do this, the User clicks the "Export Query Results" radio button (A in Figure 7) at the bottom of the screen. The User can then save the excel file (B in Figure 7) in a specified folder by the User.

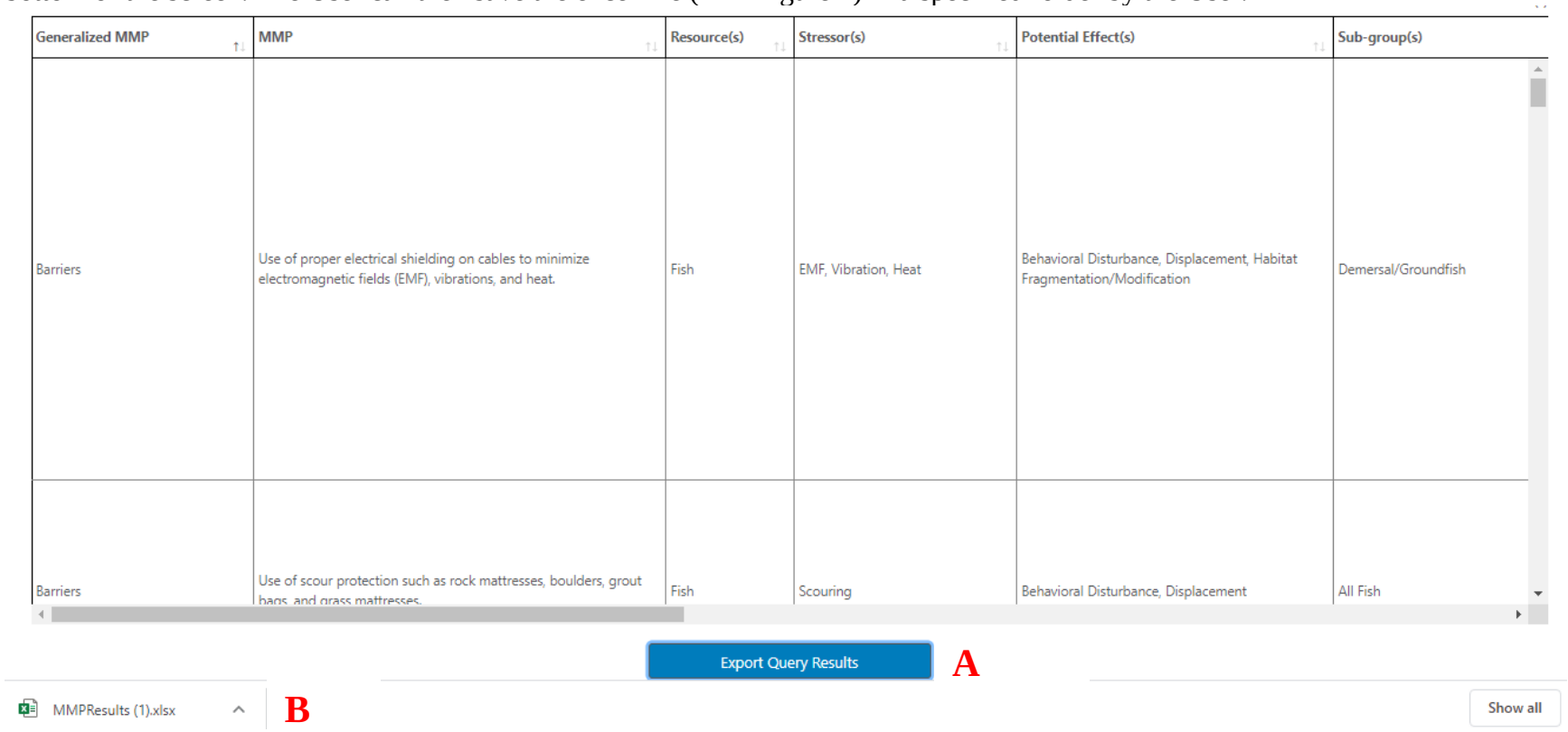

Figure 7 Example of how to export and save Query Results.

4 Literature Cited in Tool

Links are provided for most references. Some journals do not provide links to articles without subscriptions. Links provided below may not be permanent. Also, some links may require a creation of a login to gain access, such as on researchgate.net or Tethys.pnnl.gov.

4.1 Birds and Bats Literature Cited

Aguilera, E., R.L. Knight, and J.L. Cummings. 1991. An Evaluation of Two Hazing Methods for Urban Canada Geese. Wildlife Society Bulletin. 19:32–35.

Ahlen, I., L. Bach, H.J. Baagøe, and J. Pettersson. 2007. Bats and Offshore Wind Turbines Studies in Southern Scandinavia. Report 5571. Prepared for Swedish Environmental Protection Agency. Stockholm, Sweden. pp. 1-36. Available at: https://www.naturvardsverket.se/Documents/publikationer/620-5571-2.pdf. Accessed February 5, 2019.

Arnett, E.B. and E.F. Baerwald. 2013. Impacts of Wind Energy Development on Bats: Implications for Conservation. In R.A. Adams and S.C. Pedersen, (Eds.), Bat Evolution, Ecology, and Conservation. New York, NY: Springer Science+Business Media. pp. 435–456.

Arnett, E.B. and R.F. May. 2016. Mitigating Wind Energy Impacts on Wildlife: Approaches for Multiple Taxa. Human–Wildlife Interactions. 10:28–41. Available at: https://www.researchgate.net/publication/303788469_Mitigating_wind_energy_impacts_on_wildlife_Approaches_for_multiple_taxa. Accessed February 5, 2019.

Arnett, E.B., W.K. Brown, W.P. Erickson, J.K. Fiedler, B.L. Hamilton, T.H. Henry, A. Jain, G. D. Johnson, J. Kerns, R.R. Koford, C.P. Nicholson, T.J. O'Connell, M.D. Piorkowski, and R.D. Tankersley. 2008. Patterns of Bat Fatalities at Wind Energy Facilities in North America. Journal of Wildlife Management. 72:61–78.

Arnett, E.B., M. Schirmacher, M.M.P. Huso, and J.P. Hayes. 2010. Effectiveness of Changing Wind Turbine Cut-in Speed to Reduce Bat Fatalities at Wind Facilities. Prepared for the Bats and Wind Energy Cooperative and the Pennsylvania Game Commission. Austin, TX. pp. 1-73. Available at: https://tethys.pnnl.gov/sites/default/files/publications/Arnett_and_Schirmacher_2010.pdf. Accessed February 5, 2019.

Arnett, E.B., M.M.P. Huso, M.R. Schirmacher, and J.P. Hayes. 2011. Altering Turbine Speed Reduces Bat Mortality at Wind-Energy Facilities. Frontiers in Ecology and the Environment. 9:209–214. Available at: https://www.researchgate.net/publication/261939946_Altering_turbine_speed_reduces_bat_mortality_at_wind-energy_facilities. Accessed February 5, 2019.

Arnett, E.B., C.D. Hein, M.R. Schirmacher, M.M.P. Huso, and J.M. Szewczak. 2013a. Evaluating the Effectiveness of an Ultrasonic Acoustic Deterrent for Reducing Bat Fatalities at Wind Turbines. PLoS ONE 8:e65794. Available at: https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3686786/. Accessed February 5, 2019.

Arnett, E.B., G.D. Johnson, W.P. Erickson, and C.D. Hein. 2013b. A Synthesis of Operational Mitigation Studies to Reduce Bat Fatalities at Wind Energy Facilities in North America. Prepared by Bat Conservation International. Austin, TX. pp. 1-38. Available at: https://www.researchgate.net/publication/298349872_A_Synthesis_of_Operational_Mitigation_Studies_to_Reduce_Bat_Fatalities_at_Wind_Energy_Facilities_in_North_America. Accessed February 5, 2019.

Arnett, E.B., E.F. Baerwald, F. Mathews, L. Rodrigues, A. Rodríguez-Durán, J. Rydell, R. Villegas-Patraca, and C.C. Voigt. 2016. Impacts of Wind Energy Development on Bats: A Global Perspective. In C.C. Voigt and T. Kingston (Eds.), Bats in the Anthropocene: Conservation of Bats in a Changing World. New York, NY: Springer. pp. 295–323.

American Wind Wildlife Institute (AWWI). 2018. Bats and Wind Energy: Impacts, Mitigation, and Tradeoffs. Prepared by T.D. Allison. Washington, DC. pp. 1-42. Available at: https://awwi.org/wp-content/uploads/2018/11/AWWI-Bats-and-Wind-Energy-White-Paper-FINAL.pdf. Accessed February 5, 2019.

Baerwald, E.F., J. Edworthy, M. Holder, and R.M.R. Barclay. 2009. A Large-Scale Mitigation Experiment to Reduce Bat Fatalities at Wind Energy Facilities. Journal of Wildlife Management. 73:1077–1081.

Band, W., M. Madders, and D.P. Whitfield. 2007. Developing Field and Analytical Methods to Assess Avian Collision Risk at Wind Farms. In M. de Lucas, G.F.E. Janss, and M. Ferrer (Eds.), Birds and Wind Power. Mardrid, Spain. pp. 259–275. Available at: https://tethys.pnnl.gov/publications/developing-field-and-analytical-methods-assess-avian-collision-risk-wind-farms. Accessed February 5, 2019.

Barclay, R.M.R., E.F. Baerwald, and J.C. Gruver. 2007. Variation in Bat and Bird Fatalities at Wind Energy Facilities: Assessing the Effects of Rotor Size and Tower Height. Canadian Journal of Zoology. 85:381–387.

Belant, J.L. and S.K. Ickes. 1997. Mylar Flags as Gull Deterrents. In Proceedings of the Thirteenth Great Plains Wildlife Damage Control Workshop. pp. 73–80. Available at: http://digitalcommons.unl.edu/cgi/viewcontent.cgi?article=1358&context=gpwdcwp. Accessed February 5, 2019.

Bellefleur, D., P. Lee, and R.A. Ronconi. 2009. The Impact of Recreational Boat Traffic on Marbled Murrelets (*Brachyramphus marmoratus*). Journal of Environmental Management. 90:531–538.

Bernardino, J., K. Bevanger, R. Barrientos, J.F. Dwyer, A.T. Marques, R.C. Martins, J.M. Shaw, J.P. Silva, and F. Moreira. 2018. Bird Collisions with Power Lines: State of the Art and Priority Areas for Research. Biological Conservation. 222:1–13.

Black, A. 2005. Light Induced Seabird Mortality on Vessels Operating in the Southern Ocean: Incidents and Mitigation Measures. Antarctic Science. 17(1):67–68. Available at: http://www.google.com/url?sa=t&rct=j&q=&esrc=s&source=web&cd=3&cad=rja&uact=8&ved=2ahUKEwiT1KPRuaXgAhWKY98KHR1kB8IQFjACegQIBRAC&url=http%3A%2F%2Fwww.nirb.ca%2Fportal%2Fdms%2Fscript%2Fdms_download.php%3Ffileid%3D319857%26applicationid%3D125087&usg=AOvVaw3YGZeaiZ70eksYxEjOOw7N. Accessed on February 5, 2019.

Blackwell, B.F., G.E. Bernhardt, and R.A. Dolbeer. 2002. Lasers as Nonlethal Avian Repellents: Potential Applications in the Airport Environment. The Journal of Wildlife Management. 66:250–258. Available at: http://digitalcommons.unl.edu/cgi/viewcontent.cgi?article=1141&context=icwdm_usdanwrc. Accessed February 5, 2019.

Bureau of Ocean Energy Management (BOEM). 2012. Developing Environmental Protocols and Modeling Tools to Support Ocean Renewable Energy and Stewardship. OCS 2012-082. Prepared by J. McCann. Herndon, VA. pp. 1-632.

Bureau of Ocean Energy Management (BOEM). 2013. Evaluation of Lighting Schemes for Offshore Wind Facilities and Impacts to Local Environments. OCS 2013-0116. Prepared by T.L. Orr, S.M. Herz, and D.L. Oakley. Herndon, VA. pp. 1-431. Available at: https://www.boem.gov/ESPIS/5/5298.pdf. Accessed February 5, 2019.

Bureau of Ocean Energy Management (BOEM). 2017. Improving Efficiencies of National Environmental Policy Act Documentation for Offshore Wind Facilities Case Studies Report. OCS 2017-026. Prepared by P.A. English, T.I. Mason, J.T. Backstrom, B.J. Tibbles, A.A. Mackay, M.J. Smith, and T. Mitchell. Sterling, VA. pp. 1-217. Available at: https://www.boem.gov/Improving-Efficiencies-of-National-Environmental/. Accessed February 5, 2019.

Bomford, M. and P.H. O'Brien. 1990. Sonic Deterrents in Animal Damage Control: A Review of Device Tests and Effectiveness. Wildlife Society Bulletin. 18:411–422.

Brown, W.M. and R.C. Drewien. 1995. Evaluation of Two Power Line Markers to Reduce Crane and Waterfowl Collision Mortality. Wildlife Society Bulletin. 23:217–227. Available at: https://www.waterboards.ca.gov/waterrights/water_issues/programs/bay_delta/california_waterfix/exhibits/docs/SOSC/sosc_35.pdf. Accessed February 5, 2019.

Bruinzeel, L.W. and J. van Belle. 2010. Additional Research on the Impact of Conventional Illumination of Offshore Platforms in the North Sea on Migratory Bird Populations. A&W-rapport 1439. Prepared for Ministry of Public Works, Rijkswaterstaat, and Water dienst. pp. 1-27. Available at: http://www.altwym.nl/uploads/file/359_1288624898.pdf. Accessed February 5, 2019.

BSH (Federal Maritime and Hydrographic Agency) and BMU (Federal Ministry for the Environment, Nature Conservation and Nuclear Safety). 2014. Effects of the Alpha Ventus Offshore Test Site on Distribution Patterns, Behaviour and Flight Heights of Seabirds. In A. Beiersdorf and K. Wollny-Goerke (Eds.), Ecological Research at the Offshore Windfarm Alpha Ventus: Challenges, Results and Perspectives. Prepared by B. Mendel, J. Kotzerka, J. Sommerfeld, H. Schwemmer, N. Sonntag, and S. Garthe. Springer Spektrum. pp.95-110. DOI 10.1007/978-3-658-02462-8_11. Available at: https://www.researchgate.net/publication/277710440_Effects_of_the_alpha_ventus_offshore_test_site_on_distribution_patterns_behaviour_and_flight_heights_of_seabirds. Accessed February 5, 2019.

Buckland, S.T., M.L. Burt, E.A. Rexstad, M. Mellor, A.E. Williams, and R. Woodward. 2012. Aerial Surveys of Seabirds: The Advent of Digital Methods. Journal of Applied Ecology. 49:960–967. Available at: https://www.researchgate.net/publication/250053265_Aerial_surveys_of_seabirds_The_advent_of_digital_methods. Accessed February 5, 2019.

Burke, C.M., G.K. Davoren, W.A. Montevecchi, and F.K. Wiese. 2005. Seasonal and Spatial Trends of Marine Birds along Support Vessel Transects and at Oil Platforms on the Grand Banks. In S.L. Armsworthy, P.J. Cranford, and K. Lee (Eds.), Offshore Oil and Gas Environmental Effects Monitoring: Approaches and Technologies. pp. 587–614. Available at: https://www.researchgate.net/publication/285777845_Seasonal_and_spatial_trends_of_marine_birds_along_support_vessel_transects_and_at_oil_platforms_on_the_Grand_Banks. Accessed February 5, 2019.

California Energy Commission (CEC). 1992. Wind Turbine Effects on Avian Activity, Habitat Use, and Mortality in Altamont Pass and Solano County Wind Resource Areas 1989-1991. P700-92-001. Prepared by BioSystems Analysis, Inc. Tiburon, CA. pp. 1-199. Available at: https://tethys.pnnl.gov/sites/default/files/publications/Orloff-1992.pdf. Accessed February 5, 2019.

California Energy Commission (CEC). 2002. Golden Eagles in a Perilous Landscape: Predicting the Effects of Mitigation for Wind Turbine Blade-Strike Mortality. P500-02-043F. Prepared by G. Hunt. Santa Cruz, CA. pp. 1-72. Available at: https://tethys.pnnl.gov/sites/default/files/publications/Hunt-2002.pdf. Accessed February 5, 2019.

California Energy Commission (CEC). 2004. Developing Methods to Reduce Bird Mortality in the Altamont Pass Wind Resource Area. 500-01-019. Prepared by K.S. Smallwood and C.G. Thelander. Ojai, CA. pp. 1-363. Available at: https://www.energy.ca.gov/reports/500-04-052/500-04-052_00_EXEC_SUM.PDF. Accessed February 5, 2019.

California Energy Commission (CEC). 2007. Development of a Cost-Effective System to Monitor Wind Turbines for Bird and Bat Collisions, Phase 1: Sensor System Feasibility Study. 500-2007-004. Prepared by EDM International, Inc. pp. 1-21. Available at: https://www.energy.ca.gov/2007publications/CEC-500-2007-004/CEC-500-2007-004.PDF. Accessed February 5, 2019.

Chamberlain, D.E., M.R. Rehfisch, A.D. Fox, M. Desholm, and S.J. Anthony. 2006. The Effect of Avoidance Rates on Bird Mortality Predictions Made by Wind Turbine Collision Risk Models. Ibis. 148:198–202. Available at: https://onlinelibrary.wiley.com/doi/epdf/10.1111/j.1474-919X.2006.00507.x. Accessed February 5, 2019.

Christensen, T.K., J.P. Hounisen, I. Clausager, and I.K. Petersen. 2004. Visual and Radar Observations of Birds in Relation to Collision Risk at the Horns Rev Offshore Wind Farm: Annual Status Report 2003. Prepared by the National Environmental Research Institute. Denmark. pp. 1-53. Available at: http://northstrandcoastalwindteam.org/wp-content/uploads/2010/07/Visual_and_Radar_Observations_of_Birds.pdf. Accessed February 5, 2019.

Clarke, T.L. 2004. An Autonomous Bird Deterrent System. Faculty of Engineering and Surveying. University of Southern Queensland. pp. 1-111. Available at: https://core.ac.uk/download/pdf/11034512.pdf. Accessed February 5, 2019.

Cole, S.G. and E.L. Dahl. 2013. Compensating White-Tailed Eagle Mortality at the Smøla Wind-Power Plant Using Electrocution Prevention Measures. Wildlife Society Bulletin 37(1): 84-93.

Collier, M., S. Dirksen, and K.L. Krijgsveld. 2011. A Review of Methods to Monitor Collisions or Micro-avoidance of Birds with Offshore Wind Turbines. Prepared for The Crown Estate Strategic Ornithological Support Services. Norfolk, UK. pp. 1-38. Available at: https://tethys.pnnl.gov/sites/default/files/publications/Collier-et-al-2011.pdf. Accessed February 5, 2019.

Conover, M.R. 1984. Comparative Effectiveness of Avitrol, Exploders, and Hawk-Kites in Reducing Blackbird Damage to Corn. The Journal of Wildlife Management. 48:109–116. Available at: https://www.researchgate.net/publication/271955187_Comparative_Effectiveness_of_Avitrol_Exploders_and_Hawk-Kites_in_Reducing_Blackbird_Damage_to_Corn. Accessed February 5, 2019.

Cook, A.S.C.P., V.H. Ross-Smith, S. Roos, N.H.K. Burton, N. Beale, C. Coleman, H. Daniel, S. Fitzpatrick, E. Rankin, K. Norman, and G. Martin. 2011. Identifying a Range of Options to Prevent or Reduce Avian Collision with Offshore Wind Farms Using a UK-Based Case Study. Prepared by the British Trust of Ornithology. Norfolk, UK. pp. 1-197. Available at: https://www.bto.org/sites/default/files/shared_documents/publications/research-reports/2011/rr580.pdf. Accessed February 5, 2019.

Crawford, R.L. and R.T. Engstrom. 2001. Characteristics of Avian Mortality at a North Florida Television Tower: A 29-Year Study. Journal of Field Ornithology. 72:380–388.

Cryan, P.M. and R.M.R. Barclay. 2009. Causes of Bat Fatalities at Wind Turbines: Hypotheses and Predictions. Journal of Mammalogy. 90:1330–1340. Available at: https://academic.oup.com/jmammal/article/90/6/1330/898623. Accessed February 5, 2019.

Cryan, P. and A. Brown. 2007. Migration of Bats Past a Remote Island Offers Clues Toward the Problem of Bat Fatalities at Wind Turbines. Biological Conservation. 139:1–11.

Curry, R. and P. Kerlinger. 1998. Avian Mitigation Plan: Kenetech Model Wind Turbines, Altamont Pass WRA, California. In LGL Ltd. (Ed.), Proceedings of the National Avian-Wind Power Planning Meeting III. San Diego, CA. pp. 18–28. Available at: http://www.windrush-energy.com/Update%2015-1-08/A%20WIND%20FOR%20OUR%20LIFE/Supplementary%20EA%20Reference%20Studies/Curry,%20R.C.%20&%20P.Kerlinger%20%282000%29.pdf. Accessed February 5, 2019.

Curtis, P.D., C.R. Smith, and W. Evans. 1993. Techniques for Reducing Bird Use at Nanticoke Landfill Near E.A. Link Airport, Broome County, New York. In Sixth Eastern Wildlife Damage Control Conference. Paper 11. Available at: http://digitalcommons.unl.edu/cgi/viewcontent.cgi?article=1010&context=ewdcc6. Accessed February 5, 2019.

Day, R.H., A.K. Prichard, and J.R. Rose. 2005. Migration and Collision Avoidance of Eiders and Other Birds at Northstar Island, Alaska, 2001-2004. Prepared for BP Exploration (Alaska) Inc. Fairbanks, AK. pp. 1-142. Available at: https://www.arlis.org/docs/vol1/H/887766891.pdf. Accessed February 5, 2019.

de Lucas, M., M. Ferrer, M.J. Bechard, and A.R. Muñoz. 2012. Griffon Vulture Mortality at Wind Farms in Southern Spain: Distribution of Fatalities and Active Mitigation Measures. Biological Conservation. 147:184–189.

Desholm, M. 2003. Thermal Animal Detection System (TADS). Development of a Method for Estimating Collision Frequency of Migrating Birds at Offshore Wind Turbines. NERI Technical Report No. 440. National Environmental Research Institute. Denmark. pp. 1-27. Available at: https://tethys.pnnl.gov/sites/default/files/publications/Thermal_Animal_Detection_System.pdf. Accessed February 5, 2019.

Desholm, M., T. Fox, and P. Beasley. 2004. Best Practice Guidance for the Use of Remote Techniques for Observing Bird Behaviour in Relation to Offshore Windfarms. COWRIE-REMOTE-05-2004. Prepared for the Collaborative Offshore Wind Research into the Environment Consortium. pp. 1-84. Available at: https://www.researchgate.net/publication/228626168_Best_practice_guidance_for_the_use_of_remote_techniques_for_observing_bird_behaviour_in_relation_to_offshore_wind_farms. Accessed February 5, 2019.

Desholm, M., A.D. Fox, P.D.L. Beasley, and J. Kahlert. 2006. Remote Techniques for Counting and Estimating the Number of Bird-Wind Turbine Collisions at Sea: A Review. Ibis. 148:76–89. Available at: https://onlinelibrary.wiley.com/doi/epdf/10.1111/j.1474-919X.2006.00509.x. Accessed February 5, 2019.

Dooling, R.J. 2002. Avian Hearing and the Avoidance of Wind Turbines. NREL/TP-500-30844. Prepared by the National Renewable Energy Laboratory. Golden, CO. pp. 1-84. Available at: https://www.nrel.gov/docs/fy02osti/30844.pdf. Accessed February 5, 2019.

Drewitt, A.L. and R.H.W. Langston. 2006. Assessing the Impacts of Wind Farms on Birds. Ibis. 148:29–42. Available at: https://onlinelibrary.wiley.com/doi/epdf/10.1111/j.1474-919X.2006.00516.x. Accessed February 5, 2019.

Drewitt, A.L. and R.H.W. Langston. 2008. Collision Effects of Wind-Power Generators and Other Obstacles on Birds. Annals of the New York Academy of Sciences. 1134:233–266.

Electric Power Research Institute (EPRI). 2017. Bat Detection and Shutdown System for Utility-Scale Wind Turbines. 3002009038. Prepared by J. Goodrich-Mahoney. Palo Alto, CA. pp. 1-98. Available at: https://tethys.pnnl.gov/sites/default/files/publications/EPRI-2017.pdf. Accessed February 5, 2019.

Eshleman, K.N. and A. Elmore. 2013. Recommended Best Management Practices for Marcellus Shale Gas Development in Maryland. Prepared for the Maryland Department of the Environment. Baltimore, MD. pp. 1-172. Available at: https://mde.maryland.gov/programs/Land/mining/marcellus/Documents/Eshleman_Elmore_Final_BMP_Report_22113_Red.pdf. Accessed February 5, 2019.

Evans, R., Y. Akashi, N.S. Altman, and A.M. Manville. 2007. Response of Night-migrating Songbirds in Cloud to Colored and Flashing Light. North American Birds. 60:476–488. Available at: https://www.fws.gov/migratorybirds/pdf/management/evansetal2007birdsresponseflashinglight.pdf. Accessed February 5, 2019.

Evans Ogden, L.J. 1996. Collision Course: The Hazards of Lighted Structures and Windows to Migrating Birds. Fatal Light Awareness Program (FLAP). pp. 3. Available at: http://digitalcommons.unl.edu/cgi/viewcontent.cgi?article=1002&context=flap. Accessed February 5, 2019.

Everaert, J. and E.W.M. Stienen. 2007. Impact of Wind Turbines on Birds in Zeebrugge (Belgium): Significant Effect on Breeding Tern Colony Due to Collisions. Biodiversity & Conservation. 16:3345–3359. Available at: https://www.researchgate.net/publication/236002710_Impact_of_wind_turbines_on_birds_in_Zeebrugge_Belgium_Significant_effect_on_breeding_tern_colony_due_to_collisions. Accessed February 5, 2019.

Farnsworth, A. and R.W. Russell. 2007. Monitoring Flight Calls of Migrating Birds from an Oil Platform in the Northern Gulf of Mexico. Journal of Field Ornithology. 78:279–289. Available at: https://www.researchgate.net/publication/229919392_Monitoring_flight_calls_of_migrating_birds_from_an_oil_platform_in_the_northern_Gulf_of_Mexico. Accessed February 5, 2019.

Ferrer, M., M. de Lucas, G.F.E. Janss, E. Casado, A.R. Muñoz, M.J. Bechard, and C. P. Calabuig. 2012. Weak Relationship Between Risk Assessment Studies and Recorded Mortality in Wind Farms. Journal of Applied Ecology. 49:38–46. Available at: https://besjournals.onlinelibrary.wiley.com/doi/epdf/10.1111/j.1365-2664.2011.02054.x. Accessed February 5, 2019.

Fijn, R.C., K.L. Krijgsveld, M.J.M. Poot, and S. Dirksen. 2015. Bird Movements at Rotor Heights Measured Continuously with Vertical Radar at a Dutch Offshore Wind Farm. Ibis. 157:558–566. Available at: https://www.researchgate.net/publication/273706714_Bird_movements_at_rotor_heights_measured_continuously_with_vertical_radar_at_a_Dutch_offshore_wind_farm. Accessed February 5, 2019.

Furness, R.W. and S. Wanless. 2014. Quantifying the Impact of Offshore Wind Farms on Gannet Populations: A Strategic Ringing Project. Ringing and Migration. 29(2):81–85. Available at: http://nora.nerc.ac.uk/id/eprint/509504/1/N509504PP.pdf. Accessed February 5, 2019.

U.S. Government Accountability Office (GAO). 2005. Wind Power: Impacts on Wildlife and Government Responsibilities for Regulating Development and Protecting Wildlife. GAO-05-906. Washington, D.C. pp. 1-64. Available at: https://www.gao.gov/assets/250/247787.pdf. Accessed February 5, 2019.

Gartman, V., L. Bulling, M. Dahmen, G. Geißler, and J. Köppel. 2016a. Mitigation Measures for Wildlife in Wind Energy Development, Consolidating the State of Knowledge — Part 1: Planning and Siting, Construction. Journal of Environmental Assessment Policy and Management. 18:1–45. Available at: https://tethys.pnnl.gov/sites/default/files/publications/Gartman-et-al-Part%201-Mitigation-Measures.pdf. Accessed February 5, 2019.

Gartman, V., L. Bulling, M. Dahmen, G. Geißler, and J. Köppel. 2016b. Mitigation Measures for Wildlife in Wind Energy Development, Consolidating the State of Knowledge—Part 2: Operation, Decommissioning. Journal of Environmental Assessment Policy and Management. 18:1–31. Available at: https://www.researchgate.net/publication/305433022_Mitigation_Measures_for_Wildlife_in_Wind_Energy_Development_Consolidating_the_State_of_Knowledge-Part_2_Operation_Decommissioning. Accessed February 5, 2019.

Gauthreaux, S.A. and J.W. Livingston. 2006. Monitoring Bird Migration with a Fixed-Beam Radar and a Thermal-Imaging Camera. Journal of Field Ornithology. 77:319–328. Available at: https://onlinelibrary.wiley.com/doi/epdf/10.1111/j.1557-9263.2006.00060.x. Accessed February 5, 2019.

Gehring, J., P. Kerlinger, and A.M. Manville. 2009. Communication Towers, Lights, and Birds: Successful Methods of Reducing the Frequency of Avian Collisions. Ecological Applications. 19:505–514.

Gilsdorf, J.M., S.E. Hygnstrom, and K.C. VerCauteren. 2003. Use of Frightening Devices in Wildlife Damage Management. USDA National Wildlife Research Center Staff Publications. pp. 227.

Glahn, J.F., G. Ellis, P. Fioranelli, and B.S. Dorr. 2000. Evaluation of Moderate and Low-Powered Lasers for Dispersing Double-Crested Cormorants from Their Night Roosts. Proceedings of the 9th Wildlife Damage Management Conference. 11:34–45. Available at: https://www.researchgate.net/publication/233407742_Evaluation_of_moderate_and_low-powered_lasers_for_dispersing_double-crested_cormorants_from_their_night_roosts. Accessed February 5, 2019.

Gorresen, M.M., P.M. Cryan, D.C. Dalton, S. Wolf, J.A. Johnson, C.M. Todd, and F.J. Bonaccorso. 2015. Dim Ultraviolet Light as a Means of Deterring Activity by the Hawaiian Hoary Bat Lasiurus cinereus semotus. Endangered Species Research. 28:249–257. Available at: https://www.int-res.com/articles/esr2015/28/n028p249.pdf. Accessed February 5, 2019.

Grunkorn, T., J. Blew, T. Coppack, O. Kruger, G. Nehls, A. Potiek, M. Reichenbach, J. von Ronn, H. Timmermann, and S. Weitekamp. 2016. Prognosis and Assessment of Bird Collision Risks at Wind Turbines in Northern Germany. BMWi 0325300 A-D. Prepared for the Federal Ministry for Economic Affairs and Energy. Available at: https://bioconsult-sh.de/site/assets/files/1575/1575.pdf. Accessed February 5, 2019.

Hedd, A., W.A. Montevecchi, L. Mcfarlane Tranquilla, C. M. Burke, D. A. Fifield, G. J. Robertson, R. A. Phillips, C. Gjerdrum, and P. M. Regular. 2011. Reducing Uncertainty on the Grand Bank: Tracking and Vessel Surveys Indicate Mortality Risks for Common Murres in the North-West Atlantic. Animal Conservation. 14:630–641.

Henderson, I.G., R.H.W. Langston, and N.A. Clark. 1996. The Response of Common Terns *Sterna hirundo* to Power Lines: An Assessment of Risk in Relation to Breeding Commitment, Age and Wind Speed. Biological Conservation. 77:185–192.

Hodos, W. 2003. Minimization of Motion Smear: Reducing Avian Collisions with Wind Turbines. NREL/SR-500-33249. Prepared for the National Renewable Energy Laboratory. Golden, CO. pp. 1-301. Available at: http://citeseerx.ist.psu.edu/viewdoc/download?doi=10.1.1.486.885&rep=rep1&type=pdf. Accessed February 5, 2019.

Horn, J.W., E.B. Arnett, and T.H. Kunz. 2008. Behavioral Responses of Bats to Operating Wind Turbines. Journal of Wildlife Management. 72:123–132. Available at: http://batsandwind.org/wp-content/uploads/hornetal2008.pdf. Accessed February 5, 2019.

Hötker, H., K.M. Thomsen, and H. Jeromin. 2006. Impacts on Biodiversity of Exploitation of Renewable Energy Sources: The Example of Birds and Bats. Report by Nature and Biodiversity Conservation Union. Bergenhusen, Germany. pp. 1-65. Available at: https://tethys.pnnl.gov/sites/default/files/publications/Hotker_et_al_Renewable_Energy_on_Biodiversity.pdf. Accessed February 5, 2019.

Howell, J. and J.E. DiDonato. 1991. Assessment of Avian Use and Mortality Related to Wind Turbine Operations. Prepared for U.S. Windpower, Inc. Livermore, CA. pp. 1-72. Available at: https://tethys.pnnl.gov/sites/default/files/publications/Howell-1991.pdf. Accessed February 5, 2019.

Hu, C., R. Albertani, and R.M. Suryan. 2018. Wind Turbine Sensor Array for Monitoring Avian and Bat Collisions. Wind Energy. 21:255–263.

Hüppop, O. and G. Hilgerloh. 2012. Flight Call Rates of Migrating Thrushes: Effects of Wind Conditions, Humidity and Time of Day at an Illuminated Offshore Platform. Journal of Avian Biology. 43:85–90. Available at: https://www.researchgate.net/publication/261976395_Flight_call_rates_of_migrating_thrushes_Effects_of_wind_conditions_humidity_and_time_of_day_at_an_illuminated_offshore_platform. Accessed February 5, 2019.

Hüppop, O., J. Dierschke, K.M. Exo, E. Fredrich, and R. Hill. 2006. Bird Migration Studies and Potential Collision Risk with Offshore Wind Turbines. Ibis. 148:90–109. Available at: https://onlinelibrary.wiley.com/doi/epdf/10.1111/j.1474-919X.2006.00536.x. Accessed February 5, 2019.

Jakle, A. 2012. Wind Development and Wildlife Mitigation in Wyoming: A Primer. Prepared by Ruckelshaus Institute of Environment and Natural Resources. Available at: https://www.uwyo.edu/haub/_files/_docs/ruckelshaus/pubs/2012-wind-wildlife-mitigation-primer.pdf. Accessed February 28, 2020.

Janss, G.F.E. and M. Ferrer. 1998. Rate of Bird Collision with Power Lines: Effects of Conductor-marking and Static Wire-marking. Journal of Field Ornithology. 69:8–17. Available at: https://www.researchgate.net/publication/286980973_Rate_of_bird_collision_with_power_lines_Effects_of_conductor-marking_and_static_wire-marking. Accessed February 5, 2019.

Johnston, A., A.S.C.P. Cook, L.J. Wright, E.M. Humphreys, and N.H.K. Burton. 2014. Modelling Flight Heights of Marine Birds to More Accurately Assess Collision Risk with Offshore Wind Turbines. Journal of Applied Ecology. 51:31–41. Available at: https://besjournals.onlinelibrary.wiley.com/doi/epdf/10.1111/1365-2664.12191. Accessed February 5, 2019.

Kerlinger, P., J.L. Gehring, W.P. Erickson, R. Curry, A. Jain, and J. Guarnaccia. 2010. Night Migrant Fatalities and Obstruction Lighting at Wind Turbines in North America. The Wilson Journal of Ornithology. 122:744–754.

Krijgsveld, K.L., K. Akershoek, F. Schenk, F. Dijk, and S. Dirksen. 2009. Collision Risk of Birds with Modern Large Wind Turbines. Ardea. 97:357–366. Available at: https://www.researchgate.net/publication/232676598_Collision_Risk_of_Birds_with_Modern_Large_Wind_Turbines. Accessed February 5, 2019.

Kunz, T.H., E.B. Arnett, B.M. Cooper, W.P. Erickson, R.P. Larkin, T. Mabee, M.L. Morrison, M.D. Strickland, and J.M. Szewczak. 2007. Assessing Impacts of Wind-Energy Development on Nocturnally Active Birds and Bats: A Guidance Document. Journal of Wildlife Management. 71:2449–2486. Available at: http://altamontsrcarchive.org/alt_doc/assessing_impacts_of_wind_energy_development_on_nocturnally_active_birds_and_bats_a_guidance_document.pdf. Accessed February 5, 2019.

Langston, R.H.W. 2013. Birds and Wind Projects across the Pond: A UK Perspective. Wildlife Society Bulletin. 37:5–18.

Larsen, J.K., and M. Guillemette. 2007. Effects of Wind Turbines on Flight Behaviour of Wintering Common Eiders: Implications for Habitat Use and Collision Risk. Journal of Applied Ecology. 44:516–522. Available at: https://besjournals.onlinelibrary.wiley.com/doi/epdf/10.1111/j.1365-2664.2007.01303.x. Accessed February 5, 2019.

Levrel H., S. Pioch, and R. Spieler. 2012. Compensatory Mitigation in Marine Ecosystems: Which Indicators for Assessing the “No Net Loss” Goal of Ecosystem Services and Ecological Functions? Marine Policy. 36:1202–1210.

Long, C.V., J.A. Flint, and P.A. Lepper. 2011. Insect Attraction to Wind Turbines: Does Colour Play a Role? European Journal of Wildlife Research. 57:323–331. Available at: https://www.researchgate.net/publication/226510052_Insect_attraction_to_wind_turbines_Does_colour_play_a_role. Accessed February 5, 2019.

Lüdeke, J. 2017. Offshore Wind Energy: Good Practice in Impact Assessment, Mitigation and Compensation. Journal of Environmental Assessment Policy and Management. 19:1750005.

Maclean, I.M.D., H. Skov, M. M. Rehfisch, and W. Piper. 2006. Use of Aerial Surveys to Detect Bird Displacement by Offshore Wind Farms. BTO Research Report No 446. Norfolk, UK. pp. 1-45. Available at: https://www.bto.org/sites/default/files/shared_documents/publications/research-reports/2006/rr446.pdf. Accessed February 5, 2019.

Maclean, I.M.D., H. Skov, and M. M. Rehfisch. 2007. Further Use of Aerial Surveys to Detect Bird Displacement by Offshore Windfarms. BTO Research Report No. 484. Thetford, UK. pp. 1-35.

Madders, M. and D.P. Whitfield. 2006. Upland Raptors and the Assessment of Wind Farm Impacts. Ibis. 148:43–56. Available at: https://www.researchgate.net/publication/227628253_Upland_Raptors_and_the_Assessment_of_Windfarm_Impacts. Accessed February 5, 2019.

Marquenie, J., M. Donners, H. Poot, W. Steckel, and B. De Wit. 2013. Bird-Friendly Light Sources: Adapting the Spectral Composition of Artificial Lighting. IEEE Industry Applications Magazine. 19:56–62. Available at: https://www.researchgate.net/publication/260626775_Bird-Friendly_Light_Sources_Adapting_the_Spectral_Composition_of_Artificial_Lighting. Accessed February 5, 2019.

Marques, A.T., H. Batalha, S. Rodrigues, H. Costa, M. João, R. Pereira, C. Fonseca, M. Mascarenhas, and J. Bernardino. 2014. Understanding Bird Collisions at Wind Farms: An Updated Review on the Causes and Possible Mitigation Strategies. Biological Conservation. 179:40–52. Available at: http://www.windaction.org/posts/47260-understanding-bird-collisions-at-wind-farms-an-updated-review-on-the-causes-and-possible-mitigation-strategies#.XFoNTtqWy70. Accessed February 5, 2019.

Martin, C. 2015. Effectiveness of Operational Mitigation in Reducing Bat Mortality and an Assessment of Bat and Bird Fatalities at the Sheffield Wind Facility, Vermont. Wildlife, Aquatic and Wildlands Science and Management, Texas Tech University. pp. 1-183. Available at: https://www.google.com/url?sa=t&rct=j&q=&esrc=s&source=web&cd=2&cad=rja&uact=8&ved=2ahUKEwj16ZHA0aXgAhVPhOAKHd_YBPUQFjABegQICRAC&url=https%3A%2F%2Fttu-ir.tdl.org%2Fttu-ir%2Fbitstream%2Fhandle%2F2346%2F62291%2FMARTIN-THESIS-2015.pdf%253Bsequence%3D1&usg=AOvVaw1W3Dp5ijTyjCebM8YD1sJb. Accessed February 5, 2019.

Martin, C., E. Arnett, and M. Wallace. 2013. Evaluating Bird and Bat Post-Construction Impacts at the Sheffield Wind Facility, Vermont. Prepared for Bat Conservation International and First Wind. Lubbock, TX. pp. 1-58. Available at: http://www.windaction.org/posts/36806-evaluating-bird-and-bat-post-construction-impacts-at-the-sheffield-wind-facility-vermont#.XFoNyNqWy70. Accessed February 5, 2019.

Martin, C.M., E.B. Arnett, R.D. Stevens, and M.C. Wallace. 2017. Reducing Bat Fatalities at Wind Facilities While Improving the Economic Efficiency of Operational Mitigation. Journal of Mammalogy. 98:378–385. Available at: https://academic.oup.com/jmammal/article/98/2/378/3064950. Accessed February 5, 2019.

Masden, E.A., R. Reeve, M. Desholm, A.D. Fox, R.W. Furness, and D.T. Haydon. 2012. Assessing the Impact of Marine Wind Farms on Birds through Movement Modelling. Journal of the Royal Society Interface. 9:2120–2130. Available at: https://royalsocietypublishing.org/doi/pdf/10.1098/rsif.2012.0121. Accessed February 5, 2019.

May, R., O. Reitan, K. Bevanger, S.H. Lorentsen, and T. Nygard. 2015. Mitigating Wind-Turbine Induced Avian Mortality: Sensory, Aerodynamic and Cognitive Constraints and Options. Renewable and Sustainable Energy Reviews. 42:170–181.

May, R., A.B. Gill, K. Johann, R.H.W. Langston, M. Reichenbach, M. Scheidat, S. Smallwood, C.C. Voigt, H. Ommo, and M. Portman. 2017. Future Research Directions to Reconcile Wind Turbine-Wildlife Interactions. In J. Köppel (Eds.), Wind Energy and Wildlife Interactions. Springer International Publishing. pp. 255–276.

McIsaac, H.P. 2001. Raptor Acuity and Wind Turbine Blade Conspicuity. In S.S. Schwartz (Eds.), Proceedings of the National Avian-Wind Power Planning Meeting IV. pp. 59–87. Available at: http://altamontsrcarchive.org/alt_doc/raptor_acuity_and_wind_turbine_blade_conspicuity_mcissac.pdf. Accessed February 5, 2019.

Miles, W., S. Money, R. Luxmoore, and R.W. Furness. 2010. Effects of Artificial Lights and Moonlight on Petrels at St Kilda. Bird Study. 57:244–251.

Marine Management Organisation (MMO). 2014. Review of Environmental Data Associated with Post-Consent Monitoring of License Conditions of Offshore Wind Farms. MMO Project 1031. Prepared by Fugro EMU with support from BRO, NPL and SMRU Marine. pp. 1-194. Available at: https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/317787/1031.pdf. Accessed February 5, 2019.

Montevecchi, W.A. 2006. Influences of Artificial Light on Marine Birds. In C. Rich and T. Longcore (Eds.), Ecological Consequences of Artificial Night Lighting. Washington, D.C. Island Press. pp. 94–113. Available at: https://www.researchgate.net/publication/257922532_Influences_of_artificial_light_on_marine_birds. Accessed February 5, 2019.

Montevecchi, W.A., A. Hedd, L. McFarlane Tranquilla, D.A. Fifield, C.M. Burke, P.M. Regular, G.K. Davoren, S. Garthe, G.J. Robertson, and R.A. Phillips. 2012. Tracking Seabirds to Identify Ecologically Important and High Risk Marine Areas in the Western North Atlantic. Biological Conservation. 156:62–71.

Montoney, A.J. and H.C. Boggs. 1993. Effects of a Bird Hazard Reduction Force on Reducing Bird/Aircraft Strike Hazards At the Atlantic City International Airport, NJ. Proceedings of the 6th Eastern Wildlife Damage Control Conference. pp. 1–8. Available at: https://digitalcommons.unl.edu/cgi/viewcontent.cgi?article=1022&context=ewdcc6. Accessed February 5, 2019.

Mott, D.F. and S.K. Timbrook. 1988. Alleviating Nuisance Canada Goose Problems with Acoustical Stimuli. Proceedings of the 13th Vertebrate Pest Conference. pp. 301-304.

Murphy, R.K., S.M. McPherron, G.D. Wright, and K.L. Serbousek. 2009. Effectiveness of Avian Collision Averters in Preventing Migratory Bird Mortality from Powerline Strikes in the Central Platte River, Nebraska. Kearney, NE. pp. 1-34.

Nicholls, B. and P.A. Racey. 2007. Bats Avoid Radar Installations: Could Electromagnetic Fields Deter Bats From Colliding With Wind Turbines? PLoS ONE 2:e297. Available at: https://journals.plos.org/plosone/article/file?id=10.1371/journal.pone.0000297&type=printable. Accessed February 5, 2019.

Nicholls, B. and P.A. Racey. 2009. The Aversive Effect of Electromagnetic Radiation on Foraging Bats: A Possible Means of Discouraging Bats From Approaching Wind Turbines. PLoS ONE 4:e6246. Available at: https://journals.plos.org/plosone/article/file?id=10.1371/journal.pone.0006246&type=printable. Accessed February 5, 2019.

Evans Ogden, L.J. 1996. Collision Course: The Hazards of Lighted Structures and Windows to Migrating Birds. Fatal Light Awareness Program (FLAP). pp. 3. Available at: http://digitalcommons.unl.edu/cgi/viewcontent.cgi?article=1002&context=flap. Accessed February 5, 2019.

Perrow, M.R., E.R. Skeate, P. Lines, D. Brown, and M.L. Tomlinson. 2006. Radio Telemetry as a Tool For Impact Assessment of Wind Farms: The Case of Little Terns Sterna albifrons at Scroby Sands, Norfolk, UK. Ibis. 148:57–75. Available at: https://onlinelibrary.wiley.com/doi/epdf/10.1111/j.1474-919X.2006.00508.x. Accessed February 5, 2019.

Peste, F., A. Paula, L.P. da Silva, J. Bernardino, P. Pereira, M. Mascarenhas, H. Costa, J. Vieira, C. Bastos, C. Fonseca, and M.J.R. Pereira. 2015. How to Mitigate Impacts of Wind Farms on Bats? A Review of Potential Conservation Measures in the European Context. Environmental Impact Assessment Review. 51:10–22.

Poot, H., B.J. Ens, H. de Vries, M.A.H. Donners, M.R. Wernand, and J.M. Marquenie. 2008. Green Light for Nocturnally Migrating Birds. Ecology & Society. 13:47.

Reed, J.R., J.L. Sincock, and J.P. Hailman. 1985. Light Attraction in Endangered Procellariiform Birds: Reduction by Shielding Upward Radiation. The Auk. 102:377–383. Available at: https://sora.unm.edu/sites/default/files/journals/auk/v102n02/p0377-p0383.pdf. Accessed February 5, 2019.

Rioux, S., J.P.L. Savard, and A.A. Gerick. 2013. Avian Mortalities Due to Transmission Line Collisions: A Review of Current Estimates and Field Methods with an Emphasis on Applications to the Canadian Electric Network. Avian Conservation and Ecology. 8:1–7. Available at: https://www.researchgate.net/publication/261287225_Avian_mortalities_due_to_transmission_line_collisions_A_review_of_current_estimates_and_field_methods_with_an_emphasis_on_applications_to_the_Canadian_electric_network. Accessed February 5, 2019.

Roemer, C., T. Disca, A. Coulon, and Y. Bas. 2017. Bat Flight Height Monitored From Wind Masts Predicts Mortality Risk at Wind Farms. Biological Conservation. 215:116–122. Available at: https://www.researchgate.net/publication/319955210_Bat_flight_height_monitored_from_wind_masts_predicts_mortality_risk_at_wind_farms. Accessed February 5, 2019.

Ronconi, R.A., and C.C. St. Clair. 2002. Management Options to Reduce Boat Disturbance on Foraging Black Guillemots (*Cepphus grylle*) in the Bay of Fundy. Biological Conservation. 108:265–271.

Ronconi, R.A., C.C. St. Clair, P.D. O'Hara, and A.E. Burger. 2004. Waterbird Deterrence at Oil Spills and Other Hazardous Sites: Potential Applications of a Radar-Activated On-Demand Deterrence System. Marine Ornithology. 32:25–33. Available at: https://sora.unm.edu/sites/default/files/32_1_25-33.pdf. Accessed February 5, 2019.

Ronconi, R.A., K.A. Allard, and P.D. Taylor. 2015. Bird Interactions with Offshore Oil and Gas Platforms: Review of Impacts and Monitoring Techniques. Journal of Environmental Management. 147:34–45.

Rydell, J., H. Engström, A. Hedenström, J.K. Larsen, J. Pettersson, and M. Green. 2012. The Effect of Wind Power on Birds and Bats. Prepared for the Swedish Environmental Protection Agency. Stockholm, Sweden. pp. 1-151. Available at: https://www.naturvardsverket.se/Documents/publikationer6400/978-91-620-6511-9.pdf. Accessed February 5, 2019.

Santos, H., L. Rodrigues, G. Jones, and H. Rebelo. 2013. Using Species Distribution Modelling to Predict Bat Fatality Risk at Wind Farms. Biological Conservation 157:178-186.

Schirmacher, M.R., A. Prichard, T. Mabee, and C.D. Hein. 2018. Evaluating a Novel Approach to Optimize Operational Minimization to Reduce Bat Fatalities at the Pinnacle Wind Farm, Mineral County, West Virginia, 2015. Prepared for NRG Energy and the Bats and Wind Energy Cooperative. Austin, TX. pp. 1-52. Available at: https://tethys.pnnl.gov/sites/default/files/publications/Schirmacher-et-al-2018.pdf. Accessed February 5, 2019.

Schroeder, D.M. and M.S. Love. 2004. Ecological and Political Issues Surrounding Decommissioning of Offshore Oil Facilities in the Southern California Bight. Ocean and Coastal Management. 47:21–48.

Schuster, E., L. Bulling, and J. Köppel. 2015. Consolidating the State of Knowledge: A Synoptical Review of Wind Energy's Wildlife Effects. Environmental Management. 56:300–31. Available at: https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4493795/. Accessed February 5, 2019.

Sinclair, K. and E. DeGeorge. 2016. Framework for Testing the Effectiveness of Bat and Eagle Impact-Reduction Strategies at Wind Energy Projects. National Renewable Energy Laboratory. Golden, CO. pp. 1-40. Available at: http://batsandwind.org/pdf/sinclair-and-degeorge-2016.pdf. Accessed February 5, 2019.

Singh, K., E.D. Baker, and M.A. Lackner. 2015. Curtailing Wind Turbine Operations to Reduce Avian Mortality. Renewable Energy. 78:351–356.

Smallwood, K.S. and B. Karas. 2009. Avian and Bat Fatality Rates at Old-Generation and Repowered Wind Turbines in California. Journal of Wildlife Management. 73:1062–1071.

Stevens, G.R., J. Rogue, R. Weber, and L. Clark. 2000. Evaluation of a Radar-activated, Demand-performance Bird Hazing System. International Biodeterioration and Biodegradation. 45:129–137. Available at: https://pdfs.semanticscholar.org/d8ea/9fa68ec00d1b01051cad80ec5340ad48ca60.pdf. Accessed February 5, 2019.

Stickley, A.R. and J.O. King. 1993. Long-Term Trial of An Inflatable Effigy Scare Device for Repelling Cormorants from Catfish Ponds. In Proceedings of the 6th Eastern Wildlife Damage Control Conference. pp. 1–5. Available at: https://pdfs.semanticscholar.org/4227/6f7ed60657d744014ae66c0db0ac41f5f96e.pdf. Accessed February 5, 2019.

Stienen, E., V. Waeyenberghe, E. Kuijken, and J. Seys. 2007. Trapped Within the Corridor of the Southern North Sea: The Potential Impact of Offshore Wind Farms on Seabirds. In M. de Lucas, G.F. Janss, and M. Ferrer, editors. Birds and Wind Farms: Risk Assessment and Mitigation. Madrid. pp. 71–80. Available at: https://www.researchgate.net/publication/267951002_Trapped_within_the_corridor_of_the_Southern_North_Sea_the_potential_impact_of_offshore_wind_farms_on_seabirds. Accessed February 5, 2019.

Taylor, P.D., J.M. Brzustowski, C. Matkovich, M.L. Peckford, and D. Wilson. 2010. radR: An Open-Source Platform for Acquiring and Analysing Data on Biological Targets Observed by Surveillance Radar. BMC Ecology. 10:22. Available at: https://bmcecol.biomedcentral.com/track/pdf/10.1186/1472-6785-10-22. Accessed February 5, 2019.

Thaxter, C.B. and N.H.K. Burton. 2009. High Definition Imagery for Surveying Seabirds and Marine Mammals: A Review of Recent Trials and Development of Protocols. British Trust for Ornithology Report. Prepared for Cowrie Ltd. pp. 1-40. Available at: https://tethys.pnnl.gov/sites/default/files/publications/Thaxter-Burton-2009.pdf. Accessed February 5, 2019.

Tranquilla, L.A.M.F., W.A. Montevecchi, A. Hedd, D.A. Fifield, C.M. Burke, P.A. Smith, P.M. Regular, G.J. Robertson, A.J. Gaston, and R.A. Phillips. 2013. Multiple-Colony Winter Habitat Use by Murres *Uria spp*. in the Northwest Atlantic Ocean: Implications for Marine Risk Assessment. Marine Ecology Progress Series. 472:287–303. Available at: https://www.researchgate.net/publication/236678201_Multiple-colony_winter_habitat_use_of_murres_Uria_spp_in_the_Northwest_Atlantic_Ocean_Implications_for_marine_risk_assessment. Accessed February 5, 2019.

Tulp, I., H. Schekkerman, J.K. Larsen, J. van der Winden, R.J.W. van de Haterd, P. van Horssen, S. Dirksen, and A.L. Spaans. 1999. Nocturnal Flight Activity of Sea Ducks Near the Windfarm Tunø Knob in the Kattegat. Prepared for Novem. Utrecht, Netherlands. pp. 1-70. Available at: http://www.windrush-energy.com/Update%2015-1-08/A%20WIND%20FOR%20OUR%20LIFE/Supplementary%20EA%20Reference%20Studies/Tulp,%20I.,%20et%20al%20(1999).pdf. Accessed February 5, 2019.

U.S. Department of Agriculture (USDA). 2012a. Synthesis of Wind Energy Development and Potential Impacts on Wildlife in the Pacific Northwest, Oregon and Washington. ONW-GTR-863. Prepared by M.H. Mockrin and R.A. Gravenmier. pp. 1-55. Available at: https://www.fs.fed.us/pnw/pubs/pnw_gtr863.pdf. Accessed February 5, 2019.

U.S. Department of Agriculture (USDA). 2012b. Effects of Acoustic Deterrents on Foraging Bats. Research Note NRS-129. Prepared by J.B. Johnson, W.M. Ford, J.L. Rodrigue, and J.W. Edwards. Newtown Square, PA. pp. 1-5. Available at: https://www.nrs.fs.fed.us/pubs/rn/rn_nrs129.pdf. Accessed February 5, 2019.

U.S. Fish and Wildlife Service (USFWS). 2012. Land-Based Wind Energy Guidelines. Report 1018-0148. pp. 1-71. Available at: https://www.fws.gov/migratorybirds/pdf/management/usfwscommtowerguidance.pdf. Accessed February 14, 2019.

U.S. Fish and Wildlife Service (USFWS). 2015. Recommended Best Practices for Communication Tower Design, Siting, Construction, Operation, Maintenance, and Decommissioning. Falls Church, VA. pp. 1-6. Available at: https://www.fws.gov/migratorybirds/pdf/management/usfwscommtowerguidance.pdf. Accessed February 5, 2019.

Vaissière, A.C., H. Levrel, S. Pioch, and A. Carlier. 2014. Biodiversity Offsets for Offshore Wind Farm Projects: The Current Situation in Europe. Marine Policy. 48:172–183. Available at: https://www.researchgate.net/publication/261701183_Biodiversity_offsets_for_offshore_wind_farm_projects_The_current_situation_in_Europe. Accessed February 5, 2019.

van de Laar, I.F.J.T. 2007. Green Light to Birds: Investigation into the Effect of Bird-friendly Lighting. NAM Locatie L15-FA-1. pp. 1-24. Available at: https://www.researchgate.net/publication/46710280_Green_Light_for_Nocturnally_Migrating_Birds. Accessed February 5, 2019.

Vanermen, N., W. Courtens, R. Daelemans, L. Lens, W. Muller, M. Van de walle, H. Verstraete, and E.W.M. Stienen. 2019. Attracted to the Outside: A Meso-scale Response Pattern of Lesser Black-backed Gulls at an Offshore Wind Farm Revealed by GPS Telemetry. ICES Journal of Marine Science. 77:701-710.

Verhoef, J.P., P.J. Eecen, R.J. Nijdam, H. Korterink, and H.H. Scholtens. 2004. WT-Bird A Low Cost Solution for Detecting Bird Collisions. ECN-C-04-046. Prepared for NOVEM and ECN Wind Energy. pp. 1-46. Available at: http://www.ecn.nl/docs/library/report/2004/c04046.pdf. Accessed February 5, 2019.

Villegas-Patraca, R. and L. Herrera-Alsina. 2015. Migration of Franklin's Gull (*Leucophaeus pipixcan*) and Its Variable Annual Risk From Wind Power Facilities Across the Tehuantepec Isthmus. Journal for Nature Conservation. 25:72–76.

Voigt, C.C., K. Rehnig, and O. Lindecke. 2018. Migratory Bats are Attracted by Red Light But Not by Warm-white Light: Implications for the Protection of Nocturnal Migrants. Ecology and Evolution. pp. 1–9. Available at: https://www.researchgate.net/publication/327231742_Migratory_bats_are_attracted_by_red_light_but_not_by_warm-white_light_Implications_for_the_protection_of_nocturnal_migrants. Accessed February 5, 2019.

Welstead, J., R. Hirst, D. Keogh, G. Robb, and R. Bainsfair. 2013. Research and Guidance on Restoration and Decommissioning of Onshore Wind Farms. Report No. 591. Scottish Natural Heritage. pp. 1-103. Available at: http://citeseerx.ist.psu.edu/viewdoc/download?doi=10.1.1.397.2847&rep=rep1&type=pdf. Accessed February 5, 2019.

Werner, S.J. and L. Clark. 2006. Effectiveness of a Motion-activated Laser Hazing System for Repelling Captive Canada Geese. Wildlife Society Bulletin. 34:2–7. Available at: http://digitalcommons.unl.edu/cgi/viewcontent.cgi?article=1120&context=icwdm_usdanwrc. Accessed February 5, 2019.

Whisson, D.A. and J.Y. Takekawa. 2000. Testing the Effectiveness of an Aquatic Hazing Device on Waterbirds in the San Francisco Bay Estuary of California. Waterbirds: The International Journal of Waterbird Biology. 23:56–63. Available at: https://www.researchgate.net/publication/237422098_Testing_the_effectiveness_of_an_aquatic_hazing_device_on_waterbirds_in_the_San_Francisco_Bay_estuary_of_California. Accessed February 5, 2019.

Wiese, F.K., W.A. Montevecchi, G.K. Davoren, F. Huettmann, A.W. Diamond, and J. Linke. 2001. Seabirds at Risk Around Offshore Oil Platforms in the North-west Atlantic. Marine Pollution Bulletin. 42:1285–1290. Available at: https://www.researchgate.net/publication/11533484_Seabirds_at_Risk_around_Offshore_Oil_Platforms_in_the_North-west_Atlantic. Accessed February 5, 2019.

Willsteed E.A., S. Jude, A.B. Gill, and S.N.R. Birchenough. 2018. Obligations and Aspirations: A Critical Evaluation of Offshore Wind Farm Cumulative Impact Assessments. Renew Sustainable Energy Review. 82:2332–2345.

World Bank Group. 2015. Environmental, Health, and Safety Guidelines for Wind Energy. pp. 1-35. Available at: https://www.ifc.org/wps/wcm/connect/2c410700497a7933b04cf1ef20a40540/FINAL_Aug+2015_Wind+Energy_EHS+Guideline.pdf?MOD=AJPERES. Accessed February 5, 2019.

Young, D.P.J., W. Erickson, M. Strickland, R. Good, and K. Sernka. 2003. Comparison of Avian Responses to UV-light-reflective Paint on Wind Turbines. NREL/SR-500-32840. National Renewable Energy Laboratory. Golden, CO. pp. 1-67. Available at: http://www.west-inc.com/reports/fcr_nrel.pdf. Accessed February 5, 2019.

Young, D.P.J., S. Nomani, W.L. Tidhar, and K. Bay. 2011. NedPower Mount Storm Wind Energy Facility Post-Construction Avian and Bat Monitoring: July - October 2010. Prepared for NedPower Mount Storm, LLC. Houston, TX. pp. 1-52. Available at: http://batsandwind.org/pdf/WV%20-%20Young%20et%20al.%202011%20-%20Mount%20Storm%20Fall%202010%20Report(%202-10-11).pdf. Accessed February 5, 2019.

Zakrajsek, E.J. and J.A. Bissonette. 2001. Nocturnal Bird-Avoidance Modeling with Mobile- Marine Radar. In Bird Strike Committee Proceedings. pp. 185–194. Available at: http://digitalcommons.unl.edu/cgi/viewcontent.cgi?article=1029&context=birdstrike2001. Accessed February 5, 2019.

4.2 Marine Mammals and Sea Turtles Literature Cited

50 Code of Federal Regulations (CFR) § 224.103 (c)(1)(i)

50 Code of Federal Regulations (CFR) § 224.105

Ainslie, M. A. and A. M. von Benda-Beckmann. 2012. Optimal Soft Start and Shutdown Procedures or Stationary or Moving Sound Sources. Proceeding of Meetings on Acoustics. ECUA 2012 11th European Conference on Underwater Acoustics. 17(1). Edinburgh, Scotland. DOI: 10.1121/1.4789477. Available at: https://asa.scitation.org/doi/pdf/10.1121/1.4789477. Accessed February 6, 2019.

Alaska LNG. 2016. Application for Incidental Harassment Authorization for the Non-Lethal Harassment of Cetaceans and Pinnipeds: 2016 Geophysical and Geotechnical Program in Cook Inlet. USAI-P2-SGPER-00-000008-001.

Alaska LNG. 2018. Petition for Incidental Take Regulations for Construction of the Alaska LNG Project in Cook Inlet, Alaska. AKLNG-6010-REG-GRD-DOC-00001.

Andersson, M., S. Andersson, J. Ahlsén, B. Andersson, J. Hammar, L. Persson, J. Pihl, P. Sigray, and A. Wikstrom. 2017. A Framework for Regulating Underwater Noise during Pile Driving. Report 6776. Prepared for Swedish Environmental Protection Agency. Stockholm, Sweden. ISBN 978-91-620-6775-5. Available at: https://tethys.pnnl.gov/sites/default/files/publications/Andersson-et-al-2017-Report6775.pdf. Accessed February 6, 2019.

AOCSR. 2017. Marine Mammal Monitoring and Mitigation Plan: SAExploration Colville 3D Seismic Survey Operation. Available at: https://www.boem.gov/17-01-Marine-Mammal-Monitoring-and-Mitigation-Plan/. Accessed February 6, 2019.

Bailey, H., K. Brookes, and P. Thompson. 2014. Assessing Environmental Impacts of Offshore Wind Farms: Lessons Learned and Recommendations for the Future. Aquatic Biosystems. 10(8). Available at: http://www.aquaticbiosystems.org/content/10/1/8. Accessed February 6, 2019.

Bay State Wind LLC. 2018. Request for the Taking of Marine Mammals Incidental to the Site Characterization of the Bay State Wind Offshore Wind Farm. Prepared by Tetra Tech, Inc. Available at: https://www.fisheries.noaa.gov/action/incidental-take-authorization-bay-state-wind-llc-marine-site-characterization-surveys. Accessed February 6, 2019.

Bellmann, M. 2014. Overview of Existing Noise Mitigation Systems for Reducing Pile-driving Noise. Proceedings of the 2014 Internoise Conference. Melbourne, Australia. Available at: https://www.acoustics.asn.au/conference_proceedings/INTERNOISE2014/papers/p358.pdf . Accessed February 6, 2019.

Besnard, F., Fischer, K., and Bertling Tjernberg, L. 2013. A Model for the Optimization of the Maintenance Support Organization for Offshore Wind Farms. IEEE Transactions on Sustainable Energy. 4(2):443-450.

Bureau of Ocean Energy Management (BOEM). 2014a. Atlantic OCS Proposed Geological and Geophysical Activities: Mid-Atlantic and South Atlantic Planning Areas Final Programmatic Environmental Impact Statement. OCS EIS/EA BOEM 2014-001. Available at: https://www.boem.gov/BOEM-2014-001-v1/. Accessed February 6, 2019.

Bureau of Ocean Energy Management (BOEM). 2014b. Quieting Technologies for Reducing Noise during Seismic Surveying and Pile Driving. OCS Report BOEM 2014-061. Available at: https://tethys.pnnl.gov/sites/default/files/publications/Bureau-Ocean-Energy-Management.pdf. Accessed February 6, 2019.

Bureau of Ocean Energy Management (BOEM). 2016a. Notice to Lessees and Operators (NTL) of Federal Oil, Gas, and Sulphur Leases in the OCS, Gulf of Mexico OCS Region: Vessel Strike Avoidance and Injured/Dead Protected Species Reporting. BOEM NTL No. 2016-G01. Available at: https://www.boem.gov/BOEM-NTL-No-2016-G01/. Accessed February 6, 2019.

Bureau of Ocean Energy Management (BOEM). 2016b. Notice to Lessees and Operators (NTL) of Federal Oil, Gas, and Sulphur Lease in the OCS, Gulf of Mexico OCS Region: Implementation of Seismic Survey Mitigation Measures and Protected Species Observer Program. BOEM NTL 2016-G02. Available at: https://www.boem.gov/BOEM-NTL-2016-G02/. Accessed February 6, 2019.

Bureau of Ocean Energy Management (BOEM). 2016c. Commercial Wind Lease Issuance and Site Assessment Activities on the Atlantic Outer Continental Shelf Offshore Rhode Island and Massachusetts: Revised Environmental Assessment. OCS EIS-EA BOEM 2013-1131.

Bureau of Ocean Energy Management (BOEM). 2017. Workshop on Best Management Practices for Atlantic Offshore Wind Facilities and Marine Protected Species, March 7-9, 2017.

Bureau of Ocean Energy Management (BOEM) and Bureau of Safety and Environmental Enforcement (BSEE). 2012a. Notice to Lessees and Operators (NTL) of Federal, Oil, Gas, and Sulphur Leases in the OCS, Gulf of Mexico OCS Region: Vessel Strike Avoidance and Inured/Dead Protected Species Reporting. JOINT NTL No. 2012-G01. Available at: https://www.bsee.gov/sites/bsee.gov/files/notices-to-lessees-ntl/notices-to-lessees/2012-joint-g01-pdf.pdf. Accessed February 6, 2019.

Bureau of Ocean Energy Management (BOEM) and Bureau of Safety and Environmental Enforcement (BSEE). 2012b. Notice to Lessees and Operators (NTL) of Federal, Oil, Gas, and Sulphur Leases in the OCS, Gulf of Mexico OCS Region: Implementation of Seismic Survey Mitigation Measures and Protected Species Observer Program. JOINT NTL No. 2012-G02. Available at: https://www.bsee.gov/sites/bsee.gov/files/notices-to-lessees-ntl/notices-to-lessees/2012-joint-g02-pdf.pdf. Accessed February 6, 2019.

Broker, K., G. Gailey, J. Muir, and R. Racca. 2015. Monitoring and Impact Mitigation During a 4D Seismic Survey Near a Population of Gray Whales Off Sakhalin Island, Russia. Endangered Species Research. 28:187-208.

Bundesamt für Seeschifffahrt und Hydrographie (BSH). 2008. Standards for Offshore Wind Farms in the German Exclusive Economic Zone (EEZ). Nico Nolte, Sigulda. Available at: http://www.balticseaportal.net/media/upload/File/Event.materials/Planning%20ofshore%20wind/10_Nolte_Standards.pdf. Accessed February 6, 2019.

Bundesamt für Seeschifffahrt und Hydrographie (BSH). 2014. The Licensing Procedure for Offshore Wind Farms in the German EEZ. Nico Nolte, Bremerhaven. Available at: https://www.google.com/url?sa=t&rct=j&q=&esrc=s&source=web&cd=1&cad=rja&uact=8&ved=2ahUKEwiG19PWmqfgAhUFGt8KHb0NB_MQFjAAegQICRAC&url=https%3A%2F%2Fenergie-fr-de.eu%2Ffr%2Fmanifestations%2Flecteur%2Fconference-sur-leolien-offshore-en-france-et-en-allemagne.html%3Ffile%3Dfiles%2Fofaenr%2F02-conferences%2F2014%2F140220-leolien%2520offshore%2520en%2520France%2520et%2520en%2520Allemagne%2F3_Nolte_BSH.pdf&usg=AOvVaw2DhqBb_H5kwzCUECVhU0OX. Accessed February 6, 2019.

California Department of Transportation (CALTRANS). 2015. Technical Guidance for Assessment and Mitigation of the Hydroacoustic Effects of Pile Driving on Fish. Report CTHWANP-RT-15-306.01.01.

Cerchio, S., T. Collins., S. Strindberg, C. Bennett, and H. Rosenbaum. 2010. Humpback Whale Singing Activity Off Northern Angola: An Indication of the Migratory Cycle, Breeding Habitat and Impact of Seismic Surveys on Singer Number in Breeding Stock B1 (Vol. 62). Cambridge, UK: International Whaling Commission.

Chen, C. F., S. Guan, L.S. Chou, R.C. Wei, W.W. Hu, J.C. Wu. 2017. Noise Field Characterization in the Habitat of the East Taiwan Strait Indo-Pacific Humpback Dolphin During the Pile Driving Activity of Demonstration Offshore Wind Farm. Industrial Technical Research Institute, Taipei. pp. 1-15.

Chesapeake Tunnel Joint Venture (CTJV). 2018. Request for an Incidental Harassment Authorization Parallel Thimble Shoal Tunnel Project, Virginia Beach, Virginia. Available at: https://www.fisheries.noaa.gov/action/incidental-take-authorization-chesapeake-tunnel-joint-venture-parallel-thimble-shoal-tunnel. Accessed February 6, 2019.

Dahl, P., C. de Jong, and A. Popper. 2015. The Underwater Sound Field from Impact Pile Driving and Its Potential Effects on Marine Life. Journal of the Acoustical Society of America. 11(2). Available at: https://www.researchgate.net/publication/267749405. Accessed February 6, 2019.

Dahl, P., D. Dall'Osto, and J. Laughlin. 2017. Measurements of Pile Driving Noise from Control Piles and Noise Reduced Piles at the Vashon Island Ferry Dock. Washington State Department of Transportation Research Report WA-RD 861.2. Available at: https://www.wsdot.wa.gov/sites/default/files/2017/06/27/Env-Noise-MonRpt-VashonControlNoiseReducedPiles.pdf. Accessed February 6, 2019.

Dähne, M., J. Tougaard, J. Carstensen, A. Rose, and J. Nabe-Nielsen. 2017. Bubble Curtains Attenuate Noise from Offshore Wind Farm Construction and Reduce Temporary Habitat Loss for Harbour Porpoises. Marine Ecology Progress Series. 580: 221–237. Available at: https://www.researchgate.net/publication/318559204_Bubble_curtains_attenuate_noise_from_offshore_wind_farm_construction_and_reduce_temporary_habitat_loss_for_harbour_porpoises. Accessed February 6, 2019.

Dalhoff, P. & Argyriadis, K. 2004. Comparison of Certification Rules for Offshore Wind Turbines and Introduction of New GL Wind Offshore Guidelines. Germanischer Lloyd Windenergie GmbH. pp. 11.

Danish Energy Authority. n.d. Licence for Construction of Bornholm Offshore Wind Farm with Related Offshore Grid in the Baltic Sea (Construction License). Available at: https://ens.dk/sites/ens.dk/files/Vindenergi/bilag_6_model_for_etableringstilladelse_bornholm_eng_final.pdf. Accessed on February 6, 2019.

Danish Maritime Authority. 2015. Summary Report on North Sea Regulation and Standards: Review of the Maritime and Offshore Regulations and Standards for Offshore Wind. Prepared in Cooperation with DNV-GL. Available at: https://www.dma.dk/Documents/Publikationer/ReportOnNorthSeaRegulationAndStandards.pdf. Accessed February 6, 2019.

Deepwater Wind. 2012. Block Island Wind Farm and Block Island Transmission System Environmental Report / Construction and Operations Plan. Available at: http://dwwind.com/wp-content/uploads/2014/08/Environmental-Report-Exec-Summary.pdf. Accessed on December 4, 2018.

Deepwater Wind. 2017. Request for the Incidental Taking of Marine Mammals from the Use of Geophysical and Geotechnical Equipment during Marine Site Characterization. Prepared by AECOM.

Deepwater Wind. 2018. Application for Incidental Harassment Authorization for the Non-Lethal Taking of Marine Mammals: Site Characterization Surveys, Rhode Island-Massachusetts Wind Energy Area. Prepared by CSA Ocean Sciences.

Deepwater Wind/Block Island Wind Farm uses vessel tracking software. Available at https://blog.fleetmon.com/2017/05/11/vessel-tracking-solution-for-americas-first-offshore-wind-farm/

U.S. Department of Energy (DOE). 2012. Environmental Impact Statement (EIS) for the Proposed Cape Wind Energy Project, Nantucket Sound, Offshore of Massachusetts. Final Environmental Impact Statement. U.S. Department of the Interior, Minerals Management Service (MMS) EIS-EA. OCS Publication No. 2008 040, OCS EIS-EA MMS 2010-11 and OCS EIS/EA BOEMRE 2011-024. Adopted as DOE/EIS-0470. Available at: https://www.energy.gov/sites/prod/files/DOE-EIS-0470-Cape_Wind_FEIS_2012.pdf. Accessed February 6, 2019.

DOI MMS. 2009. Template for a Safety Management System for Offshore Wind Farms on the OCS. Prepared by M. Sharples. Houston, Texas. pp. 1-71.

Dominion. 2013. Virginia Offshore Wind Technology Advancement Project (VOWTAP) Safety Management System Requirements. Prepared by KBR

Doc No. DVP-KBR-WT3.6-SOR-0001. Available at: https://www.boem.gov/sites/default/files/renewable-energy-program/State-Activities/VA/Appendix-S_VOWTAP_Safety-Management-System-Requirements_2013-12-06_Rev-Oct-2014.pdf. Accessed February 5, 2019.

Dominion Energy. 2018. Coastal Virginia Offshore Wind (CVOW) Project Request for the Incidental Harassment of Marine Mammals Incidental to the Investigation of Unexploded Ordnance (UXO) in the CVOW Offshore Wind Farm Lease Area. Prepared by Tetra Tech, Inc.

DONG Energy. 2013. Burbo Bank Extension Offshore Wind Farm: Environmental Statement Annex 14 – Marine Mammals. Document Reference 5.1.5.14. Pursuant to APFP 5(2)(a). Prepared by CMACS Ltd., Natural Power Consultants.

DONG Energy. 2017. Ocean Wind Project – Request for the Taking of Marine Mammals Incidental to the Site Characterization of the Ocean Wind Offshore Wind Farm Lease Area (OCS-A 0498). Prepared by Tetra Tech, Inc.

DONG Energy and Vattenfall. 2005. The Danish Offshore Wind Farm Demonstration Project: Horns Rev and Nysted Offshore Wind Farms Environmental Impact Assessment and Monitoring. Prepared for the Environmental Group. Available at: https://tethys.pnnl.gov/sites/default/files/publications/Horns-Rev-Nysted-2006.pdf. Accessed February 6, 2019.

Elmer, K. and J. Savery. 2014. New Hydro Sound Dampers to Reduce Piling Underwater Noise. Proceedings of the 2014 Internoise Conference. Melbourne, Australia. Available at: https://tethys.pnnl.gov/sites/default/files/publications/Elmer_and_Savery_2014.pdf. Accessed February 6, 2019.

Hilcorp. 2019. Marine Mammal Monitoring and Mitigation Plan, Liberty Development and Production Project. Prepared by ECO 49 Consulting, LLC.

Inter-American Convention for the Protection and Conservation of Sea Turtles (AIC). 2001. Text of the Inter-American Convention for the Protection and Conservation of Sea Turtles. Available at: http://www.iacseaturtle.org/eng-docs/Texto-CIT-ENG.pdf. Accessed February 6, 2019.

Institute of Marine Research (IMR). n.d. Havvind - Offshore Wind Power in Norway: A Strategic Environmental Assessment. Presented by C. Kvamme. Available at: http://www.partiseapate.eu/wp-content/uploads/2013/11/07_CecilieKvamme_Havvind_OffshoreWindPower-in-Norway_SEA.pdf. Accessed February 6, 2019.

ION GeoVentures (ION). 2017a. Request by ION GeoVentures for an Incidental Harassment Authorization to Allow the Incidental Take of Marine Mammals during a 2-D Seismic Survey off the U.S. East Coast in Summer–Fall.

ION GeoVentures (ION). 2017b. Request by ION GeoVentures for an Incidental Harassment Authorization to Allow the Incidental Take of Marine Mammals during a 2-D Seismic Survey off the U.S. East Coast in Summer–Fall. Passive Acoustic Monitoring (PAM) Plan.

Joint Nature Conservation Committee (JNCC). 2005. Common Standards Monitoring Guidance for Marine Mammals. ISSN 1743-8160. Available at: http://jncc.defra.gov.uk/pdf/CSM_marine_mammals.pdf. Accessed February 6, 2019.

Joint Nature Conservation Committee (JNCC). 2010. Statutory Nature Conservation Agency Protocol for Minimising the Risk of Injury to Marine Mammals from Piling Noise. Available at: http://jncc.defra.gov.uk/pdf/JNCC_Guidelines_Piling%20protocol_August%202010.pdf. Accessed February 6, 2019.

Johnson, C.W. 2009.Interactions Between Brown-out Accidents and Night Vision Equipment in Military Aviation Accidents. Joint Weapons Systems Safety Conference. Huntsville, Alabama, USA, 2009, pp. 3508-3518.

Kraus, S., S. Leiter, K. Stone, B. Wikgren, C. Mayo, P. Hughes, R. Kenney, C. Clark, A. Rice, B. Estabrook, and J. Tielens. 2016. Northeast Large Pelagic Survey Collaborative Aerial and Acoustic Surveys for Large Whales and Sea Turtles. Final Report. OCS Study BOEM 2016-054. Available at: https://www.boem.gov/RI-MA-Whales-Turtles/. Accessed February 6, 2019.

Laist, D.W., A.R. Knowlton, and D. Pendleton. 2014. Effectiveness of Mandatory Vessel Speed Limits for Protecting North Atlantic Right Whales. Endangered Species Research. 23:133-147

Lippert, S., Lippert, T., Heitmann, K., and Von Estorff, O. 2013. Prediction of Underwater Noise and Far Field Propagation Due to Pile Driving for Offshore Wind Farms. Acoustical Society of America. 11: 070036, https://doi.org/10.1121/1.4800517.

Lucke, K., P.A. Lepper, M. Blanchet, and U. Siebert. 2001. The Use of an Air Bubble Curtain to Reduce the Received Sound Levels for Harbor Porpoises (*Phocoena phocoena*). Acoustic Society of America. 5: 3406–3412.

Macleod, K., C. Lacey, N. Quick, G. Hastie, and J. Wilson. 2011. Guidance on Survey and Monitoring in Relation to Marine Renewables Deployments in Scotland, Volume 2: Cetaceans and Basking Sharks. Unpublished draft report prepared for Scottish Natural Heritage and Marine Scotland. Available at: https://www.nature.scot/sites/default/files/2017-07/A585083%20-%20Guidance%20on%20survey%20and%20monitoring%20in%20relation%20to%20marine%20renewables%20deployments%20in%20Scotland%20-%20Vol%202%20Cetaceans%20and%20Basking%20Sharks.pdf. Accessed February 6, 2019.

Marine Management Organization. 2014. Review of Post-consent Offshore Wind Farm Monitoring Data Associated with License Conditions. MMO Project No: 1031. Prepared for the Marine Management Organisation. ISBN: 978-1-909452-24-4. Available at: https://www.researchgate.net/publication/281507987_Review_of_Post-Consent_Offshore_Wind_Farm_Monitoring_Data_Associated_with_Licence_Conditions. Accessed February 6, 2019.

Merchant, N., K. Brookes, R. Faulkner, A. Bicknell, B. Godley, and M. Witt. 2016. Underwater Noise Levels in UK Waters. Nature Scientific Reports. 6:36942. DOI: 10.1038/srep36942. Available at: https://www.researchgate.net/publication/309811911_Underwater_noise_levels_in_UK_waters. Accessed February 6, 2019.

Merck, T. 2018. Reflection and Outlook on the Development of Offshore Wind Energy in Germany. Abstracts of the International Conference on Noise Mitigation for the Construction of increasingly Large Offshore Wind Turbines. Friedrichstraße, Berlin. p4.

Naval Facilities Engineering Command Southwest (NAVFAC SW). 2017. Monitoring Report for Fuel Pier Replacement Project (P-151) at Naval Base Point Loma, San Diego, CA. 8 October 2016 to 30 April 2017.

Naval Facilities Engineering Command Mid-Atlantic. 2019. Request for an Incidental Harassment of Marine Mammals Resulting from Modification, Expansion, and Future Operations of Dry Dock 1 at Portsmouth Naval Shipyard, Kittery, Maine, October 1, 2019, through September 30, 2020.

National Oceanic and Atmospheric Administration (NOAA), NOAA Fisheries Service, Southeast Region. 2008. Vessel Strike Avoidance Measures and Reporting for Mariners. Available at: https://sero.nmfs.noaa.gov/protected_resources/section_7/guidance_docs/documents/copy_of_vessel_strike_avoidance_february_2008.pdf. Accessed February 6, 2019.

National Oceanic and Atmospheric Administration (NOAA). 2020. Incidental Harassment Authorization for the City of Juneau October 1 2020 to September 30 2021.

National Oceanic and Atmospheric Administration (NOAA), Greater Atlantic Regional Fisheries Office (GARFO). 2016. GARFO Acoustics Tool: Analyzing the Effects of Pile Driving on Endangered Species Act (ESA)-listed Species in the Greater Atlantic Region.

National Oceanic and Atmospheric Administration (NOAA), Greater Atlantic Regional Fisheries Office (GARFO). n.d. Guidance for Carrying Out Endangered Species Act (ESA) Section 7 Consultations with the National Marine Fisheries Service (NMFS) Greater Atlantic Regional Fisheries Office.

National Oceanic and Atmospheric Administration (NOAA) Office of Protected Resources (OPR). 2018. Technical Guidance for Assessing the Effects of Anthropogenic Sound on Marine Mammal Hearing (Version 2.0): Underwater Thresholds for Onset of Permanent and Temporary Threshold Shifts. NOAA Technical Memorandum NMFS-OPR-59. Available at: https://www.fisheries.noaa.gov/resource/document/technical-guidance-assessing-effects-anthropogenic-sound-marine-mammal. Accessed February 6, 2019.

Nowacek, D.P., F. Christiansen, L, Bedjer, J.A. Goldbogen, and A. S. Friedlaender. 2013. Studying Cetacean Behaviour: New Technological Approaches and Conservation Applications. Animal Behaviour. DOI: 10.1016/j.anbehav.2016.07.019.

New York State Energy Research and Development Authority (NYSERDA). 2015. Advancing the Environmentally Responsible Development of Offshore Wind Energy in New York State: A Regulatory Review and Stakeholder Perceptions. Final Report. Prepared by Biodiversity Research Institute. Available at: https://tethys.pnnl.gov/sites/default/files/publications/NYSERDA-2015_15-16.pdf. Accessed February 6, 2019.

Oswald, J., R. Charif, L. Thomas, D. Engelhaupt, and J. Bell. 2018. Assessment of Marine Mammal Vocal Response to Sonar. Cherry Point and Jacksonville Range Complexes 2014-2016. Available at: https://www.navymarinespeciesmonitoring.us/reading-room/project-profiles/assessment-marine-mammal-vocal-response-sonar/. Accessed February 6, 2019.

Parvin, S.J., Nedwell, J.R. and Harland, E. 2007. Lethal and Physical Injury of Marine Mammals, and Requirements for Passive Acoustic Monitoring. Subacoustech Report No. 565R0212.

Port Dolphin Energy LLC (Port Dolphin). 2011. Application for Incidental Harassment Authorization and Letter of Authorization for the Non-Lethal Taking of Marine Mammals-Port Dolphin Energy LLC Deepwater Port. Prepared by CSA International, Inc.

Reinhall, P., T. Dardis, and J. Hampden. 2016. Underwater Noise Reduction of Marine Pile Driving Using a Double Pile: Vashon Ferry Terminal Test. Washington State Department of Transportation Research Report WA-RD 861.1. Available at: https://www.wsdot.wa.gov/research/reports/fullreports/861.1.pdf. Accessed February 6, 2019.

Reyff, J. 2009. Reducing Underwater Sounds with Air Bubble Curtains: Protecting Fish and Marine Mammals from Pile-Driving Noise. TR News 262. May–June 2009. Available at: http://onlinepubs.trb.org/onlinepubs/trnews/trnews262rpo.pdf. Accessed February 6, 2019.

Scheidat, M., J. Tougaard, S. Brasseur, J. Carstensen, T. van Polanen Petel, J. Teilmann, P. Reijnders. 2011. Harbour Porpoises (*Phocoena phocoena*) and Wind Farms: A Case Study in the Dutch North Sea. Environmental Research Letters. 6:2.

Sakhalin Energy Investment Company (SEIC). (Ed.). (2010). Summary of the Joint Okhotsk-Korean Gray Whale Monitoring Program Findings, Sakhalin,Russian Federation, 2002 – 2010. Document Number 0000-S-90-04-T-0366-00-E. Available at: http://www.sakhalin2.ru/media/library/eng/Environmental/GrayWhales/2.13SummaryoftheJointOkhotsk-KoreanGrayWhaleEng.pdf. Accessed August 13, 2019.

Siber4, G.K. & Bettridge, S. 2009. Vessel Operations in Right Whale Protection Areas in 2009. NOAA Technical Memorandum NMFS-OPR-44.

Skipjack WindFarm. 2018. Application for Incidental Harassment Authorization for the Non-Lethal Taking of Marine Mammals: Site Characterization Surveys Lease OCS-A 0482. Prepared by CSA Ocean Sciences.

Spectrum Geo, Inc. (Spectrum). 2017a. Amended National Marine Fisheries Service (NMFS) Incidental Harassment Authorization Application: Spectrum Geo, Inc. Atlantic 2D Geophysical Survey. Prepared by CSA Ocean Sciences, Inc.

Spectrum Geo, Inc. (Spectrum). 2017b. Spectrum Atlantic Passive Acoustic Monitoring Plan. Prepared by RPS Group PLC. Available at: NOAA Fisheries, Office of Protected Resources, 1315 East-West Highway, 13th Floor, Silver Spring, MD 20910, Phone: (301) 427-8400.

Statoil. 2018. Request for the Taking of Marine Mammals Incidental to Site Characterization Survey for the Empire Wind Project. Prepared by Tetra Tech.

Teilmann, J., J. Tourgaard, and J. Carstensen. 2006. Summary on Harbor Porpoise Monitoring 1999-2006 Around Nysted and Horns Rev Offshore Wind Farms. Report to Energi E2 A/S and Vattenfall A/S. Accessed online at: https://tethys.pnnl.gov/sites/default/files/publications/Summary_on_Harbour_Porpoise_Monitoring_1999-2006.pdf. August 9, 2019.

Tetra Tech and Smultea Sciences. 2018. Year 1 Annual Survey Report for New York Bight Whale Monitoring Aerial Surveys March 2017 – February 2018. New York State Department of Environmental Conservation. East Setauket, NY.

TGS. 2017. Request by TGS-NOPEC for an Incidental Harassment Authorization for the Incidental Take of Marine Mammals in Conjunction with a Proposed Marine 2D Seismic Program Mid- and South Atlantic Outer Continental Shelf, 2016-2017. Prepared by Smultea Environmental Sciences LLC.

U.S. Army Corps of Engineers (USACE). 2014. Environmental Assessment and Statement of Findings for CENAE-R Application Numbers: NAE-2009-789 and NAE-20 12-2724. Available at: https://www.nae.usace.army.mil/portals/74/docs/topics/deepwaterwind/ea17sep2014.pdf. Accessed February 6, 2019.

U.S. Department of Commerce (USDOC) and National Oceanic and Atmospheric Administration (NOAA). 2018a. Bay State Wind 2018 Incident Harassment Authorization. National Marine Fisheries Service. Silver Spring, Maryland. pp. 1-10.

U.S. Department of Commerce (USDOC) and National Oceanic and Atmospheric Administration (NOAA). 2018b. Mukilteo 2018 Incident Harassment Authorization. National Marine Fisheries Service. Silver Spring, Maryland. pp. 1-8.

U.S. Department of Commerce (USDOC) and National Oceanic and Atmospheric Administration (NOAA). 2018c. Seattle Multimodal Incident Harassment Authorization 2018. National Marine Fisheries Service. Silver Spring, Maryland. pp.1-8.

Van Parijs, S. 2017. Large-scale Monitoring of Acoustic Soundscapes and Species Distribution Patterns Across the Western Atlantic Ocean. National Oceanic and Atmospheric Administration (NOAA), Northeast Fisheries Science Center.

Vineyard Wind. 2019. Request for an Incidental Harassment Authorization to Allow the Non-lethal Take of Marine Mammals Incidental to Construction Activities in the Vineyard Wind BOEM Lease Area OCS-1 0501. Submitted to the U.S. National Marine Fisheries Service, April 2019.

Vineyard Wind, NRDC, National Wildlife Foundation and Conservation Law Foundation. 2019. North Atlantic Right Whale Mitigation Agreement. Released 24 January 2019. Available at: https://www.nrdc.org/sites/default/files/vineyard-wind-whales-agreement-20190122.pdf. Accessed February 14, 2019.

WesternGeco (WECO). 2017. Request by WesternGeco LLC for an Incidental Harassment Authorization for the Incidental Take of Marine Mammals in Conjunction with a Proposed Marine 2D Seismic Program Mid- and South Atlantic Outer Continental Shelf, 2016-2017. Prepared by Smultea Environmental Sciences LLC.

Weir, C. and S. Dolman. 2007. Comparative Review of the Regional Marine Mammal Mitigation Guidelines Implemented during Industrial Seismic Surveys, and Guidance towards a Worldwide Standard. Journal of International Wildlife Law and Policy. 10:1–27.

Washington State Department Of Transportation. 2010. Wahkiakum County Ferry Terminal Project, Underwater Sound Levels Associated with Driving Steel Piles at the Wahkiakum County Ferry Terminal. March 2010.

Washington State Department Of Transportation. 2015. WSF Underwater Background Monitoring Project, Compendium of Background Sound Levels for Ferry Terminals in Puget Sound. May 2015.

Washington State Department of Transportation (WSDOT). 2016. Mukilteo Multimodal Project – Phase 2 Underwater Noise Monitoring Plan. Prepared by J. Laughlin. Shoreline, WA. pp.1-14.

Washington State Department of Transportation Ferries Division. 2019. Request for an Incidental Harassment Authorization under the Marine Mammal Protection Act-Seattle Multimodal Project at Colman Dock Year 3 Construction 2019-20. May 2019.

4.3 Fish Literature Cited

Anderson, M.H., M. Berggren, D. Wilhelmsson, and M.C. Öhman. 2009. Epibenthic Colonization of Concrete and Steel Pilings in a Cold-Temperate Embayment: A Field Experiment. Helgol Marine Research. 63:249-260.

Andersson, M.H., S.Andersson, J. Ahlsén, B.L. Andersson, J. Hammar, L.K.G. Persson, J. Pihl, P. Sigray, and A. Wikström. 2016. A Framework for Regulating Underwater Noise During Pile Driving. A Technical Vindval Report, ISBN 978-91-620-6775-5, Swedish Environmental Protection Agency, Stockholm, Sweden.

Black, K. 2008. Offshore Wind Farm Developments and Scouring Effects. Available at: https://www.hydro-international.com/content/article/offshore-wind-farm-developments-and-scouring-effects. Accessed on August 9, 2019.

Bureau of Ocean Energy Management (BOEM). 2011. Effects of EMFs from Undersea Power Cables on Elasmobranchs and Other Marine Species. Final Report. OCS BOEMRE-2011-09. Available at: https://www.boem.gov/Environmental-Stewardship/Environmental-Studies/Pacific-Region/Studies/2011-09-EMF-Effects.aspx. Accessed February 6, 2019.

Bureau of Ocean Energy Management (BOEM). 2014a. Development of Mitigation Measures to Address Potential Use Conflicts between Commercial Wind Energy Lessees/Grantees and Commercial Fishermen on the Atlantic Outer Continental Shelf: Final Report on Best Management Practices and Mitigation Measures. Prepared for the U.S. Department of the Interior, Bureau of Ocean Energy Management, Office of Renewal Energy Programs, Herndon, VA. OCS Study BOEM 2014-654. Prepared by Ecology and Environment, Inc. Available at: https://www.boem.gov/OCS-Study-BOEM-2014-654/. Accessed February 6, 2019.

Bureau of Ocean Energy Management (BOEM). 2014b. Fishing and Offshore Energy - Best Management Practices. Presentation prepared by B. Hooker. Available at: https://www.boem.gov/Fishing-and-Offshore-Energy-Best-Practices. Accessed January 2, 2019.

Bureau of Ocean Energy Management (BOEM). 2015a. Guidelines for Providing Information on Fisheries Social and Economic Conditions for Renewable Energy Development on the Atlantic Outer Continental Shelf Pursuant to 30 Code of Federal Regulations (CFR) Part 585. Available at: https://www.boem.gov/Social-and-Economic-Conditions-Fishery-Communication-Guidelines/. Accessed February 6, 2019.

Bureau of Ocean Energy Management (BOEM). 2015b. Identifying Information Needs and Approaches for Assessing Potential Impacts of Offshore Wind Farm Development on Fisheries Resources in the Northeast Region. Prepared for the U.S. Department of the Interior, Bureau of Ocean Energy Management, Office of Renewable Energy Programs, Herndon, VA. OCS Study BOEM 2015-037. Prepared by M. Petruny-Parker, A. Malek, M. Long, D. Spencer, F. Mattera, E. Hasbrouck, J. Scotti, K. Gerbino, and J. Wilson. Available at: https://www.boem.gov/Identifying-Information-Needs-and-Approaches-for-Assessing-Potential-Impacts-of-Offshore-Wind-Farm-Development-on-Fisheries-Resources-in-the-Northeast-Region/. Accessed February 6, 2019.

Bureau of Ocean Energy Management (BOEM). 2016a. Commercial Wind Lease Issuance and Site Assessment Activities on the Atlantic Outer Continental Shelf Offshore New York: Final Environmental Assessment. OCS EIS/EA BOEM 2016-042.

Bureau of Ocean Energy Management (BOEM). 2016b. Guidelines for Information Requirements for a Renewable Energy Construction and Operations Plan (COP). Available at: https://www.boem.gov/COP-Guidelines. Accessed December 4, 2018.

Bureau of Ocean Energy Management (BOEM). 2016c. Guidelines for Information Requirements for a Renewable Energy Site Assessment Plan (SAP). Available at: https://www.boem.gov/Final-SAP-Guidelines. Accessed December 4, 2018.

Bureau of Ocean Energy Management (BOEM). 2016d. Collaborative Fisheries Planning for Virginia's Offshore Wind Energy Area. OCS Study 2016-040. Prepared under BOEM Cooperative Agreement M14AC00029 and Virginia Department of Mines, Minerals, and Energy C13-6030. Prepared by Virginia Coastal Zone Management Program. Available at: https://www.dmme.virginia.gov/de/LinkDocuments/OffshoreWind/Virginia-Wind-Energy-Area-Collaborative-Fisheries%20Planning-Final-Report.pdf. Accessed February 6, 2019.

Bureau of Ocean Energy Management (BOEM). 2018. Summary Report: Best Management Practices Workshop for Atlantic Offshore Wind Facilities and Marine Protected Species. OCS Study BOEM 2018-015. Prepared under Contract D13PC0017 by Kearns & West. Available at: https://www.boem.gov/Final-Summary-Report-for-BMP-Workshop-BOEM/. Accessed February 6, 2019.

Buck, B.H., G. Krause, T. Michler-Cieluch, M. Brenner, C.M. Buchholz, J.A. Busch, R. Fisch, M. Geisen, and O. Zielinski. 2008. Meeting the Quest for Spatial Efficiency: Progress and Prospects of Extensive Aquaculture within Offshore Wind Farms. Helgol Marine Research. 62:269-281.

California Department of Transportation (Caltrans). 2015. Technical Guidance for Assessment and Mitigation of the Hydroacoustic Effects of Pile Driving on Fish. Report Number CTHWANP-RT-15-306.01.01. Division of Environmental Analysis. Available at: http://www.dot.ca.gov/hq/env/bio/files/bio_tech_guidance_hydroacoustic_effects_110215.pdf. Accessed December 10, 2018.

Carroll, A.G., R. Przeslawski, A. Duncan, M. Gunning, and B. Bruce. 2017. A Critical Review of the Potential Impacts of Marine Seisemic Surveys on Fish and Invertebrates. Marine Pollution Bulletin. 114:9-24.

Centre for Marine and Coastal Studies (CMACS). 2003. A Baseline Assessment of Electromagnetic Fields Generated by Offshore Windfarm Cables. COWRIE Report EMF - 01-2002, 66 pages. Available at: https://tethys.pnnl.gov/sites/default/files/publications/COWRIE_EMF_Offshore_Cables.pdf. Accessed on August 9, 2019.

Deepwater Wind. 2012. Block Island Wind Farm and Block Island Transmission System Environmental Report/Construction and Operations Plan. Prepared by Tetra Tech EC, Inc. Available at: http://dwwind.com/wp-content/uploads/2014/08/Environmental-Report-Exec-Summary.pdf. Accessed December 4, 2018.

Deepwater Wind. 2017. Request for the Incidental Taking of Marine Mammals from the Use of Geophysical and Geotechnical Equipment During Marine Site Characterization. Submitted to U.S. National Marine Fisheries Service April 26, 2017 (Rev. 6).

Deepwater Wind. 2019. South Fork Wind Environmental Report / Construction and Operations Plan. Available at: https://www.boem.gov/Volume-I-Construction-and-Operations-Plan/. Accessed on August 8, 2019.

Duguid, L. 2017. Offshore wind farm substructure monitoring and inspection: Final report. Document No. PN000205-LRT-001, 31 pages. Accessed at https://ore.catapult.org.uk/app/uploads/2018/01/Offshore-wind-farm-substructure-monitoring-and-inspection-report-.pdf on August 9, 2019.

Dunlop, E.S., S.M. Reid, and M. Murrant. 2015. Limited influence of a wind power project submarine cable on a Laurentian Great Lakes fish community. Journal of Applied Ichthyology. 32:18-31.

Gartman, V., L. Bulling, M. Dahmen, G. Geibler, and J. Koppel. 2016. Mitigation Measures for Wildlife in Wind Energy Development, Consolidating the State of Knowledge – Part 1: Planning and Siting, Construction. Journal of Environmental Assessment Policy and Management. 18:1–45. Available at: https://tethys.pnnl.gov/sites/default/files/publications/Gartman-et-al-Part%201-Mitigation-Measures.pdf. Accessed February 6, 2019.

Gray, M., P.L. Stromberg, and D. Rodmell. 2016. Changes to Fishing Practices around the UK as a Result of the Development of Offshore Windfarms – Phase 1. Marine Research Report. The Crown Estate. ISBN:978-1-906410-64-3. Available at: https://www.thecrownestate.co.uk/media/2600/final-published-ow-fishing-revised-aug-2016-clean.pdf. Accessed February 6, 2019.

Guernsey Renewable Energy Team. 2011. Guernsey Regional Environmental Assessment of Marine Energy. Prepared by Guernsey Renewable Energy Commission. pp. 59. Available at: https://tethys.pnnl.gov/sites/default/files/publications/Guernsey_Summary.pdf. Accessed February 6, 2019.

Hansen, E.A., A.W. Nielses, H. Hogedal, H.J. Simonsen, and J. Pederson. 2007. Scour Protection Around Offshore Wind Turbine Foundations, Full-Scale Measurements. In: 2007 European Wind Energy Conference Proceedings, Milan, Italy.

Langhamer, O. 2012. Artificial Reef Effect in Relation to Offshore Renewable Energy Conversion: State of the Art. The Scientific World Journal. 2012:Article ID 386713.

Lipsky, A., S. Moura, A. Kenney, and R. Bellavance. 2016. Addressing Interactions Between Fisheries and Offshore Wind Development: The Block Island Wind Farm. Available at: https://www.google.com/url?sa=t&rct=j&q=&esrc=s&source=web&cd=2&cad=rja&uact=8&ved=2ahUKEwjmiIS5rKfgAhWBdd8KHWkGCysQFjABegQICRAC&url=https%3A%2F%2Fosf.io%2F73qhk%2Fdownload%2F&usg=AOvVaw0YpcjPLekq3vulllx9yCI1. Accessed February 6, 2019.

Love, M.S., M.M. Nishimoto, L. Snook, D. Schroeder, and A. Scarborough Bull. 2017. A Comparison of Fishes and Invertebrates Living in the Vicinity of Energized and Unenergized Submarine Power Cables and Natural Sea Floor off Southern California, USA. Journal of Renewable Energy. 2017:Article ID 8727164.

Lucke, K., E. Winter, F. Lam, G. Scowcroft, A. Hawkins, and A. Popper. 2014. Report of the Workshop on International Harmonisation of Approaches to Define Underwater Noise Exposure Criteria. Report C197.13. Available at: http://edepot.wur.nl/288741. Accessed February 6, 2019.

Lüdeke, J. 2015. Strategies for an Environmentally Sound Development of Offshore Wind Energy. Ph.D. Dissertation, University of Berlin. August 15, 2017.

Mid-Atlantic Fishery Management Council (MAFMC) 2014. Offshore Wind Best Management Practices Workshop. Baltimore, Maryland. Available at: https://www.boem.gov/MAFMC-Offshore-Wind-Workshop/. Accessed February 6, 2019.

Minerals Management Service (MMS). 2007. Programmatic Environmental Impact Statement for Alternative Energy Development and Production and Alternate Use Facilities on the Outer Continental Shelf. Final Environmental Impact Statement (October 2007), Volume II: Chapter 5. OCS EIS/EA MMS 2007-046. Available at: https://www.boem.gov/Renewable-Energy-Program/Regulatory-Information/Alt_Energy_FPEIS_VolIIFrontMatter.aspx. Accessed February 6, 2019.

Rhode Island Coastal Resources Management Council. 2010. Rhode Island Ocean Special Area Management Plan, Volume I: Chapter 8, Section 850. Prepared by Jennifer McCann. Prepared for the Rhode Island Coastal Resources Management Council. Available at: https://seagrant.gso.uri.edu/oceansamp/pdf/samp_crmc_revised/800_Renewable.pdf. Accessed February 6, 2019.

SeaPlan. 2015. Options for Cooperation between Commercial Fishing and Offshore Wind Energy Industries: A Review of Relevant Tools and Best Practices. Prepared by S. Moura, A. Lipsky, and M. Morse. Available at: https://www.openchannels.org/sites/default/files/literature/Options%20for%20Cooperation%20between%20Commercial%20Fishing%20and%20Offshore%20Wind%20Energy%20Industries%20-%20A%20Review%20of%20Relevant%20Tools%20and%20Best%20Practices.pdf. Accessed January 2, 2019.

Stenberg, C., M. van Deurs, J. Støttrup, H. Mosegaard, T. Grome, G. Dinesen, A. Christensen, H. Jensen, M. Kaspersen, C. W. Berg, S. B. Leonhard, H. Skov, J. Pedersen, C. B. Hvidt and M. Klaustrup. Effect of the Horns Rev 1 Offshore Wind Farm on Fish Communities: Follow-up Seven Years After Construction. DTU Aqua Report Number 246-2011. Available at: https://orbit.dtu.dk/files/7615058/246_2011_effect_of_the_horns_rev_1_offshore_wind_farm_on_fish_communities.pdf. Accessed on August 9, 2019.

Taormina, B., J. Bald, A. Want, G. Thouzeau, M. Lejart, N. Desroy, and A. Carlier. 2018. A Review of Potential Impacts of Submarine Power Cables on the Marine Environment: Knowledge Gaps, Recommendations and Future Directions. Renewable and Sustainable Energy Reviews. 96:380-391. Available at: https://www.researchgate.net/publication/327079114_A_review_of_potential_impacts_of_submarine_power_cables_on_the_marine_environment_Knowledge_gaps_recommendations_and_future_directions. Accessed February 6, 2019.

United States Army Corps of Engineers (USACE). 2014. Deepwater Wind Block Island Environmental Assessment and Statement of Findings. Available at: https://www.nae.usace.army.mil/portals/74/docs/topics/deepwaterwind/ea17sep2014.pdf. Accessed February 6, 2019.

Van Parijs, S.M., C. W. Clark, R. S. Sousa-Lima, S. E. Parks, S. Rankin, D. Risch, and I. C. Van Opzeeland. 2009. Management and Research Applications of Real-Time and Archival Passive Acoustic Sensors Over Varying Temporal and Spatial Scales. Marine Ecology Progress Series. 395:21-36.

Whitehouse, R.J.S., J.M. Harris, J. Sutherland, and J. Rees. 2011. The Nature of Scour Development and Scour Protection at Offshore Windfarm Foundations. Marine Pollution Bulletin. 62:73-88.

Wilhelmsson, D., T. Malm, R. Thompson, J. Tchou, G. Sarantakos, N. McCormick, S. Luitjens, M. Gullstrom, J. Edwards, O. Amir, and A. Dubi. 2010. Greening Blue Energy: Identifying and Managing the Biodiversity Risks and Opportunities of Offshore Renewable Energy. Report by E.ON and International Union for Conservation of Nature. pp. 104. Available at: https://cmsdata.iucn.org/downloads/2010_014.pdf. Accessed February 6, 2019.

Woodruff, D.L., V.I. Cullinan, A.E. Copping, and K.E. Marshall. 2013. Effects of Electromagnetic Fields on Fish and Invertebrates. Task 2.1.3: Effects on Aquatic Organisms Fiscal Year 2012 Progress Report, Environmental Effects of Marine and Hydrokinetic Energy. Available at: https://www.pnnl.gov/main/publications/external/technical_reports/PNNL-20813Final.pdf. Available on August 9, 2019.

4.4 Fisheries Literature Cited

Anderson, M.H., M. Berggren, D. Wilhelmsson, and M.C. Öhman. 2009. Epibenthic Colonization of Concrete and Steel Pilings in a Cold-Temperate Embayment: A Field Experiment. Helgol Marine Research. 63:249-260.

Bureau of Ocean Energy Management (BOEM). 2012. Identification of Outer Continental Shelf Renewable Energy Space - Use Conflicts and Analysis of Potential Mitigation Measures. U.S. Department of the Interior, BOEM, Herndon, VA. OCS Study BOEM 2012-083. Prepared by Industrial Economics, Inc.

Bureau of Ocean Energy Management (BOEM). 2014a. Development of Mitigation Measures to Address Potential Use Conflicts between Commercial Wind Energy Lessees/Grantees and Commercial Fishermen on the Atlantic Outer Continental Shelf Report on Best Management Practices and Mitigation Measures. Herndon, VA. OCS Study BOEM 2014-654. Prepared by Ecology and Environment, Inc. Available at: https://www.boem.gov/OCS-Study-BOEM-2014-654/. Accessed February 6, 2019.

Bureau of Ocean Energy Management (BOEM). 2014b. Bureau of Ocean Energy Management Fishing and Offshore Energy - Best Management Practices. Presentation by Brian Hooker. Available at: https://www.boem.gov/Fishing-and-Offshore-Energy-Best-Practices. Accessed July 25, 2017.

Bureau of Ocean Energy Management (BOEM). 2015a. Guidelines for Providing Information on Fisheries Social and Economic Conditions for Renewable Energy Development on the Atlantic Outer Continental Shelf Pursuant to 30 CFR Part 585. Available at: https://www.boem.gov/Social-and-Economic-Conditions-Fishery-Communication-Guidelines. Accessed December 10, 2018.

Bureau of Ocean Energy Management (BOEM). 2015b. Identifying Information Needs and Approaches for Assessing Potential Impacts of Offshore Wind Farm Development on Fisheries Resources in the Northeast Region. OCS Study BOEM 2015-037. Prepared by M. Petruny-Parker, A. Malek, M. Long, D. Spencer, F. Mattera, E. Hasbrouck, J. Scotti, K. Gerbino, J. Wilson. Herndon, VA. Available at: https://www.boem.gov/Identifying-Information-Needs-and-Approaches-for-Assessing-Potential-Impacts-of-Offshore-Wind-Farm-Development-on-Fisheries-Resources-in-the-Northeast-Region/. Accessed February 6, 2019.

Bureau of Ocean Energy Management (BOEM). 2016a. Collaborative Fisheries Planning for Virginia's Offshore Wind Energy Area. U.S. Department of the Interior, Bureau of Ocean Energy Management, Office of Renewable Energy Programs. Herndon, VA. OCS Study BOEM 2016-040. Prepared by the Virginia Coastal Zone Management Program. Available at: https://www.dmme.virginia.gov/de/LinkDocuments/OffshoreWind/Virginia-Wind-Energy-Area-Collaborative-Fisheries%20Planning-Final-Report.pdf. Accessed February 6, 2019.

Bureau of Ocean Energy Management (BOEM). 2016b. Guidelines for Information Requirements for a Renewable Energy Construction and Operations Plan (COP). Available at: https://www.boem.gov/COP-Guidelines/. Accessed on December 4, 2018.

Bureau of Ocean Energy Management (BOEM). 2016c. Collaborative Fisheries Planning for Virginia's Offshore Wind Energy Area. U.S. Department of the Interior, Bureau of Ocean Energy Management, Office of Renewable Energy Programs, Herndon. OCS Study BOEM 2016-040. Prepared by the Virginia Coastal Zone Management Program.

Bureau of Ocean Energy Management (BOEM). n.d. Possible Best Management Practices and Mitigation Measures to Reduce Conflicts Between Fishing and Wind Industries. Available at: https://www.boem.gov/uploadedFiles/Fishing%20BMPs.pdf. Accessed December 10, 2018.

B. H. Buck, B.H., G. Krause, T. Michler-Cieluch, M. Brenner, C. M. Buchholz, J. A. Busch, R. Fisch, M. Geisen, and O. Zielinski. 2009. Meeting the Quest for Spatial Efficiency: Progress and Prospects of Extensive Aquaculture Within Offshore Wind Farms. Helgol Mar Res. 62:269–281.

Curtice, C., J. Cleary, E. Schumchenia, and P. Halpin. 2019. Marine-Live Data and Analysis Team (MDAT) Technical Report on the Methods and Development of Marine-Life Data to Support Regional Ocean Planning and Management. Available at: http://seamap.env.duke.edu/models/MDAT/MDAT-Technical-Report.pdf. Accessed on August 6, 2019.

Deepwater Wind. 2012. Block Island Wind Farm and Block Island Transmission System Environmental Report / Construction and Operations Plan. Prepared by Tetra Tech EC, Inc. Available at: http://dwwind.com/wp-content/uploads/2014/08/Environmental-Report-Exec-Summary.pdf. Accessed on December 4, 2018.

Deepwater Wind. 2018. Deepwater Wind Outlines Industry-Leading Approach to Prevent Damage to Fishing Gear at its Offshore Wind Farms. Press Release. Available at: http://dwwind.com/press/deepwater-wind-outlines-industry-leading-approach-prevent-damage-fishing-gear-offshore-wind-farms/. Accessed on August 9, 2019.

Deepwater Wind. 2019. South Fork Wind Environmental Report / Construction and Operations Plan. Available at: https://www.boem.gov/Volume-I-Construction-and-Operations-Plan/. Accessed on August 8, 2019.

Deepwater Wind. n.d. Fishing Gear Conflict Prevention and Claim. Available at: http://dwwind.com/wp-content/uploads/2018/08/GEAR-PLAN-DOC-1.pdf. Accessed January 8, 2019.

Department of the Interior, Minerals Management Service (DOI MMS). 2009. Template for a Safety Management System for Offshore Wind Farms on the OCS. Project Number 633, Contract M09PC00015. Prepared for Minerals Management Service, Department of the Interior. Available at: https://www.bsee.gov/sites/bsee.gov/files/tap-technical-assessment-program/633ac.pdf. Accessed on August 9, 2019.

Dominion 2013. Virginia Offshore Wind Technology Advancement Project (VOWTAP) Safety Management System Requirements. Available at: https://www.osti.gov/servlets/purl/1341588/. Accessed on August 9, 2019.

Duguid, L. 2017. Offshore Wind Farm Substructure Monitoring and Inspection: Final Report. Document No. PN000205-LRT-001, 31 pages. Available at: https://ore.catapult.org.uk/app/uploads/2018/01/Offshore-wind-farm-substructure-monitoring-and-inspection-report-.pdf. Accessed on August 9, 2019.

Fishing Liaison with Offshore Wind and Wet Renewables Group (FLOWW). 2014. Best Practice Guidance for Offshore Renewables Developments: Recommendations for Fisheries Liaison. Available at: https://www.thecrownestate.co.uk/media/5693/floww-best-practice-guidance-for-offshore-renewables-developments-recommendations-for-fisheries-liaison.pdf. Accessed July 26, 2017.

Gray, M., P-L Stromberg, and D. Rodmell. 2016. Changes to Fishing Practices around the UK as a Result of the Development of Offshore Windfarms – Phase 1. The Crown Estate. ISBN: 978-1-906410-64-3. Available at: https://www.thecrownestate.co.uk/media/2600/final-published-ow-fishing-revised-aug-2016-clean.pdf. Accessed February 6, 2019.

International Association of Marine Aids to Navigation and Lighthouse Authorities (IALA). 2008. Recommendation 0-139 on the Marking of Man-Made Offshore Structures. Saint Germain en Laye, FR: IALA. Available at: https://www.iala-aism.org/product/marking-of-man-made-offshore-structures-o-139/. Accessed February 6, 2019.

ICF Incorporated, L.L.C (IFC). 2012. Atlantic Region Wind Energy Development: Recreation and Tourism Economic Baseline Development. U.S. Dept. of the Interior, Bureau of Ocean Energy Management, Office of Renewable Energy Programs, Herndon, VA. OCS Study.

International Maritime Organization (IMO). n.d.a. Available at: http://www.imo.org/en/OurWork/Safety/FireProtection/Pages/History.aspx.

International Maritime Organization (IMO). n.d.b. Available at: http://www.imo.org/en/OurWork/Safety/Navigation/Pages/Default.aspx.

International Maritime Organization (IMO). n.d.c. Available at: http://www.imo.org/en/OurWork/Safety/RadioCommunicationsAndSearchAndRescue/Pages/Default.aspx.

International Maritime Organization (IMO). n.d.d. Available at: http://www.imo.org/en/OurWork/Safety/StabilityAndSubdivision/Pages/Default.aspx.

International Maritime Organization (IMO). n.d.e. Available at: http://www.imo.org/en/OurWork/Environment/Pages/Default.aspx.

Langhamer, O. 2012. Artificial Reef Effect in Relation to Offshore Renewable Energy Conversion: State of the Art. The Scientific World Journal. 2012:Article ID 386713.

Lipsky, A., S. Moura, A. Kenney, and R. Bellavance. 2016. Addressing Interactions between Fisheries and Offshore Wind Development: The Block Island Wind Farm. Available at: https://www.openchannels.org/sites/default/files/literature/Addressing%20Interactions%20between%20Fisheries%20and%20Offshore%20Wind%20Development%20-%20The%20Block%20Island%20Wind%20Farm.pdf. Accessed July 25, 2017.

Mid-Atlantic Fishery Management Council (MAFMC). 2014. Offshore Wind Best Practices Workshop. Available at: https://www.boem.gov/MAFMC-Offshore-Wind-Workshop. Accessed July 28, 2017.

Minerals Management Service (MMS). 2007. Final Programmatic Environmental Impact Statement for Alternative Energy Development and Production and Alternate Use of Facilities on the Outer Continental Shelf. Available at: https://www.boem.gov/Guide-To-EIS. Accessed December 10, 2018.

Moura, S., A. Lipsky, and M. Morse. 2015. Options for Cooperation between Commercial Fishing and Offshore Wind Energy Industries: A Review of Relevant Tools and Best Practices. Available at: https://www.openchannels.org/sites/default/files/literature/Options%20for%20Cooperation%20between%20Commercial%20Fishing%20and%20Offshore%20Wind%20Energy%20Industries%20-%20A%20Review%20of%20Relevant%20Tools%20and%20Best%20Practices.pdf. Accessed July 25, 2017.

New York State Energy Research and Development Authority (NYSERDA). 2017. New York State Offshore Wind Master Plan Fish and Fisheries Study. NYSERDA Report 17-25j. Prepared by Ecology and Environment Engineering, P.C. Available at: https://www.nyserda.ny.gov/All-Programs/Programs/Offshore-Wind/Offshore-Wind-in-New-York-State-Overview/NYS-Offshore-Wind-Master-Plan. Accessed February 6, 2019.

One Ocean Corp. 2013. One Ocean Protocol for Seismic Survey Programs in Newfoundland and Labrador. Available at: http://www.oneocean.ca/pdf/2013%20Seismic%20Protocol%20Document.pdf. Accessed on August 9, 2019

Russell, T. 2015. DONG Support Local Causes with Community Grants. Available at: https://www.4coffshore.com/windfarms/dong-support-local-causes-with-community-grants-nid3032.html. Accessed on August 9, 2019.

Sharp, R. and U.R. Sumaila. 2009. Quantification of U.S. Marine Fisheries Subsidies. North American Journal of Fisheries Management. 29:18-32.

Smythe T., N. Andrescavage, and C. Fox. 2016. The Rhode Island Ocean Special Area Management Plan, 2008 – 2015: From Inception through Implement ation. In McCann, J., Ed. 2016. Case Studies of Marine Spatial Planning R eport Series. Coastal Resources Center and Rhode Island Sea Grant Colleg e Program, URI Graduate School of Oceanography. Narragansett, R.I. 80 pp.

Squires, D. 2010. Fisheries Buybacks: A Review and Guidelines. Fish and Fisheries. 11:366-387.

Vineyard Wind LLC (Vineyard Wind). 2019. Fisheries Communication Plan, Revision 7. Available at: https://vineyardwind.app.box.com/s/dzjgu6cn5juykjmsqlyfd7bngw2j6kbu. Accessed on August 9, 2019.

Whiteley, R. 2016. SR695 UK Shellfish Production and Several, Regulating and Hybrid Orders: The Contribution and Value of Orders in Relation to the Sector's Past Development and Future Growth. Report to Seafish. Available at: https://www.seafish.org/media/publications/FINAL_SRO_REPORT_-_AUGUST_2016_FINAL.pdf. Accessed on August 9, 2019.

4.5 Benthos Literature Cited

Anderson, M.H., M. Berggren, D. Wilhelmsson, and M.C. Öhman. 2009. Epibenthic Colonization of Concrete and Steel Pilings in a Cold-Temperate Embayment: A field Experiment. Helgol Marine Research. 63:249-260.

Ashley, M.C., S.C. Mangi, and L.D. Rodwell. 2014. The Potential of Offshore Windfarms to Act as Marine Protected Areas – A Systematic Review of Current Evidence. Marine Policy. 45:301-309.

Bacci, T., S.F. Rende, O. Nonnis , C. Maggi, A. Izzi, M. Gabellini, F. Massara, and L. Di Tullio. 2013. Effect of Laying Power Cables on a Posidonia Oceanica (L.) Delile Prairie, the Study Case of Fiume Santo (NW Sardinia, Italy). Journal of Coastal Research. 65:868-873.

Bureau of Ocean Energy Management (BOEM). 2011. Effects of EMFs from Undersea Power Cables on Elasmobranchs and Other Marine Species. Final Report. OCS BOEMRE-2011-09. Available at: https://www.boem.gov/Environmental-Stewardship/Environmental-Studies/Pacific-Region/Studies/2011-09-EMF-Effects.aspx. Accessed February 6, 2019.

Bureau of Ocean Energy Management (BOEM). 2015. Identifying Information Needs and Approaches for Assessing Potential Impacts of Offshore Wind Farm Development on Fisheries Resources in the Northeast Region. OCS Study BOEM 2015-037. Prepared by M. Petruny-Parker, A. Malek, M. Long, D. Spencer, F. Mattera, E. Hasbrouck, J. Scotti, K. Gerbino, and J. Wilson. Herndon, VA. Available at: https://www.boem.gov/Identifying-Information-Needs-and-Approaches-for-Assessing-Potential-Impacts-of-Offshore-Wind-Farm-Development-on-Fisheries-Resources-in-the-Northeast-Region/. Accessed February 6, 2019.

Bureau of Ocean Energy Management (BOEM). 2016a. Commercial Wind Lease Issuance and Site Assessment Activities on the Atlantic Outer Continental Shelf Offshore New York: Final Environmental Assessment. OCS EIS/EA BOEM 2016-042.

Bureau of Ocean Energy Management (BOEM). 2016b. Guidelines for Information Requirements for a Renewable Energy Construction and Operations Plan (COP). Available at: https://www.boem.gov/COP-Guidelines. Accessed on December 4, 2018

Bureau of Ocean Energy Management (BOEM). 2016c. Guidelines for Information Requirements for a Renewable Energy Site Assessment Plan (SAP). Available at: https://www.boem.gov/Final-SAP-Guidelines. Accessed on December 4, 2018.

Bureau of Ocean Energy Management (BOEM). 2016d. Collaborative Fisheries Planning for Virginia's Offshore Wind Energy Area. U.S. Department of the Interior, Bureau of Ocean Energy Management, Office of Renewable Energy Programs, Herndon, VA. OCS Study BOEM 2016-040. Prepared by the Virginia Coastal Zone Management Program. Available at: https://www.dmme.virginia.gov/de/LinkDocuments/OffshoreWind/Virginia-Wind-Energy-Area-Collaborative-Fisheries%20Planning-Final-Report.pdf. Accessed February 6, 2019.

Bureau of Ocean Energy Management (BOEM). 2018. Summary Report: Best Management Practices Workshop for Atlantic Offshore Wind Facilities and Marine Protected Species (2017). U.S. Department of the Interior, Bureau of Ocean Energy Management, Atlantic OCS Region, Washington, D.C. Sterling, VA. OCS Study BOEM 2018-015. Prepared by Kearns & West. Available at: https://www.boem.gov/Final-Summary-Report-for-BMP-Workshop-BOEM/. Accessed February 6, 2019.

California Department of Transportation (Caltrans). 2015. Technical Guidance for Assessment and Mitigation of the Hydroacoustic Effects of Pile Driving on Fish. Division of Environmental Analysis. Report Number CTHWANP-RT-15-306.01.01. Available at: http://www.dot.ca.gov/hq/env/bio/files/bio_tech_guidance_hydroacoustic_effects_110215.pdf. Accessed December 10, 2018.

Deepwater Wind. 2012. Block Island Wind Farm and Block Island Transmission System Environmental Report / Construction and Operations Plan. Available at: http://dwwind.com/wp-content/uploads/2014/08/Environmental-Report-Exec-Summary.pdf. Accessed on December 4, 2018.

Deepwater Wind. 2019. South Fork Wind Environmental Report / Construction and Operations Plan. Available at: https://www.boem.gov/Volume-I-Construction-and-Operations-Plan/. Accessed on August 8, 2019.

Gartman, V., L. Bulling, M. Dahmen, G. Geibler, and J. Koppel. 2016. Mitigation Measures for Wildlife in Wind Energy Development, Consolidating the State of Knowledge – Part 1: Planning and Siting, Construction. Journal of Environmental Assessment Policy and Management. 18:1–45. Available at: https://tethys.pnnl.gov/sites/default/files/publications/Gartman-et-al-Part%201-Mitigation-Measures.pdf. Accessed February 6, 2019.

Guernsey Renewable Energy Team. 2011. Guernsey Regional Environmental Assessment of Marine Energy. Report by Guernsey Renewable Energy Commission. pp. 59. Available at: https://tethys.pnnl.gov/sites/default/files/publications/Guernsey_Summary.pdf. Accessed February 6, 2019.

Hansen, E.A., A.W. Nielses, H. Hogedal, H.J. Simonsen, and J. Pederson. 2007. Scour Protection Around Offshore Wind Turbine Foundations, Full-Scale Measurements. In: 2007 European Wind Energy Conference Proceedings. Milan, Italy, 2007.

Jak, R., and S.T. Glorius, 2017. Marcobenthos in Offshore Wind Farms; A Review of Research, Results, and Relevance for Future Developments. Wageningen, Wageningen Marine Research (University & Research Centre), Wageningen Marine Research report C043/17. pp. 477.

Langhamer, O. 2012. Artificial Reef Effect in Relation to Offshore Renewable Energy Conversion: State of the Art. The Scientific World Journal. 2012:Article ID 386713.

Minerals Management Service (MMS). 2007. Programmatic Environmental Impact Statement for Alternative Energy Development and Production and Alternate Use Facilities on the Outer Continental Shelf, Final Environmental Impact Statement, Volume II: Chapter 5. U.S. Department of the Interior. OCS EIS/EA MMS 2007-046. Available at: https://www.boem.gov/Renewable-Energy-Program/Regulatory-Information/Alt_Energy_FPEIS_VolIIFrontMatter.aspx. Accessed February 6, 2019.

Öhman, M.C., P. Sigray, and H. Westerberg. 2007. Offshore Windmills and the Effects of Electromagnetic Fields on Fish. Ambio 36:630-633.

Rhode Island Coastal Resources Management Council. 2010. Rhode Island Ocean Special Area Management Plan, Volume I: Chapter 8, Section 850. Prepared by Jennifer McCann. Prepared for the Rhode Island Coastal Resources Management Council. Available at: https://seagrant.gso.uri.edu/oceansamp/pdf/samp_crmc_revised/800_Renewable.pdf. Accessed February 6, 2019.

SeaPlan. 2015. Options for Cooperation between Commercial Fishing and Offshore Wind Energy Industries: A Review of Relevant Tools and Best Practices. Prepared by S. Moura, A. Lipsky, and M. Morse. Available at: https://www.openchannels.org/sites/default/files/literature/Options%20for%20Cooperation%20between%20Commercial%20Fishing%20and%20Offshore%20Wind%20Energy%20Industries%20-%20A%20Review%20of%20Relevant%20Tools%20and%20Best%20Practices.pdf. Accessed January 2, 2019.

Southeast Florida Coral Reef Initiative. 2008. Best Management Practices (MMPs) for Construction, Dredge and Fill and Other Activities Adjacent to Coral Reefs. Prepared by PBS&J. Available at: ftp://ftp.library.noaa.gov/noaa_documents.lib/CoRIS/MMP_constructions_coral-reef_manual_2009.pdf. Accessed January 3, 2018.

Taormina, B., J. Bald, A. Want, G. Thouzeau, M. Lejart, N. Desroy, and A. Carlier. 2018. A Review of Potential Impacts of Submarine Power Cables on the Marine Environment: Knowledge Gaps, Recommendations and Future Directions. Renewable and Sustainable Energy Reviews. 96: 380-391.

United States Army Corps of Engineers (USACE). 2014. Deepwater Wind Block Island Environmental Assessment and Statement of Findings. Available at: https://www.nae.usace.army.mil/portals/74/docs/topics/deepwaterwind/ea17sep2014.pdf. Accessed February 6, 2019.

Weilgart, L. 2018. The Impact of Ocean Noise Pollution on Fish and Invertebrates. Available at: https://www.oceancare.org/wpcontent/uploads/2017/10/OceanNoise_FishInvertebrates_May2018.pdf. Accessed on August 8, 2019.

Whitehouse, R.J.S., J.M. Harris, J. Sutherland, and J. Rees. 2011. The Nature of Scour Development and Scour Protection at Offshore Windfarm Foundations. Marine Pollution Bulletin. 62:73-88.

Wilhelmsson, D. T. Malm, R. Thompson, J. Tchou, G. Sarantakos, N. McCormick, S. Luitjens, M. Gullstrom, J. Edwards, O. Amir, and A. Dubi. 2010. Greening Blue Energy: Identifying and Managing the Biodiversity Risks and Opportunities of Offshore Renewable Energy. Report by E.ON and International Union for Conservation of Nature. pp. 104. Available at: https://cmsdata.iucn.org/downloads/2010_014.pdf. Accessed February 6, 2019.

A Examples of Quantitative Ranking Approaches for MMPs

Appendix A provides examples of how to apply a quantifiable process to sorting and ranking MMPs to inform development of BMPs. This process has not been applied to the current iteration of the Tool; the Tool does not apply judgements to the relative value of different MMPs (that is left up to the User to assess). However, a ranking feature could be implemented in the future to help Users identify which MMPs may be most useful or broadly applicable, to help identify data gaps and research needs, or to explicitly identify the criteria and value judgements being used in the selection and application of BMPs to specific development projects.

To create a quantifiable set of criteria, first the User will determine the goals of applying BMPs. For example, a goal could be very specific, like avoiding right whale impacts by minimizing exposure to sound. It could be very broad, such as minimizing impacts on fisheries. Multiple goals can be considered concurrently, but it is important to understand what is meant to be achieved by the BMPs to set up relevant criteria to meet the goals.

As an example, if a goal were to maximize the likelihood that BMPs will achieve minimization and avoidance of impacts, a criterion may be the implementation status and demonstration of efficacy, which are available in the Tool. The Tool provides five relevant categories
(see definitions in Section 2.2.5):

1. Not implemented;
2. Field tested;
3. Implemented;
4. Implemented with evidence of effectiveness; and
5. Unknown.

To create a rating system for this criterion, numerical values could be assigned to each of these categories, with a higher value indicating the condition of higher preference. An example of the quantitative values could be the following:

- Not implemented = 1;
- Unknown = 1;

- Field tested = 2;
- Implemented = 3; and
- Implemented with evidence of effectiveness = 4.

Note that the same value can be applied to more than one category. A zero could also be applied if appropriate. Also note that this is not a recommendation on how to quantify this criterion; it is just an example of how numbers can be applied to categories within a criterion.

In cases in which a criterion is more qualitative, it may be appropriate to create quantitative criteria out of qualitative measures. For instance, if a criterion can be ranked as high, medium, or low, numerical values could be assigned to those categories within the criterion. It is generally better to use numerical values when possible.

Bins of values can be used for categories to avoid having too many categories for a given criterion. For example, if the criterion is "protects endangered species," an example quantitative set of categories might be the following bins:

- MMP affects no endangered species = 0;
- One endangered species = 1;
- Two to four endangered species = 2; and
- Five or more endangered species = 3.

Generally, ranking systems do not extend to more than about three to five categories for simplicity and agreement purposes, but any number of categories can be used if fine-scale information is available to inform the ranking. Quantitative ranking helps to remove some of the biases of subjective ranking criteria. Ideally, criteria and scoring are developed in such a way that most people, regardless of their personal beliefs, would choose the same score for a given MMP. Some examples of application of criteria and ranking (thought more technically complex than described here) can be found in Gosenheimer (2012)[3], Hasan (2013)[4], and Shafiee (2015)[5].

Criteria can also be yes/no or positive/negative. For example, if a criterion is related to whether species protected under the Marine Mammal Protect Act are

[3] Gosenheimer, C. 2012. Project prioritization: A structured approach to working on what matters most. Office of Quality Improvement. University of Wisconsin. Retrieved from https://www.ssc.coop/cms/lib/MN06000837/Centricity/Domain/9/ProjectPrioritizationGuide.pdf on February 19, 2019.

[4] Hasan, E. 2013. Proposing mitigation strategies for reducing the impact of rice cultivation on climate change in Egypt. Water Science. 27:69-77.

[5] Shafiee, M. 2015. A fuzzy analytic network process model to mitigate the risks associated with offshore wind farms. Expert Systems with Applications. 42:2143-2152.

affected by the MMP, this could be assigned a 1/0 for yes/no (or a higher positive number if the criterion is deemed more important than a "1"). If a criterion were related to whether the MMP affects other human uses (like fishing or tourism), it could be assigned a -1/0 for yes/no, reducing the total for MMPs that fall in the "yes" category. Any positive or negative number can be assigned against a zero to raise or lower the ranking of an MMP relative to a yes/no criterion.

When multiple criteria are developed with sets of numerical values attached to different categories, each MMP can be ranked for each criterion. The sum of the values across all the criteria for each MMP can indicate general scores in terms of how MMPs rate against each other (relative to the criteria being used). This can inform which MMPs may be most useful (i.e. may be BMPs). This can also provide feedback on the criteria themselves. For example, if an MMP does not have a high total number, but the stakeholders would expect it to rank higher, are there criteria missing? Are there qualitative criteria that suggest that MMP should still be considered of high value? In some cases, it is not possible to make a good quantitative score of a qualitative criterion, so qualitative considerations may be added to adjust the outcome of ranking. Ranking MMPs in this way may be a valuable tool to identify MMPs that may cover multiple criteria of concern and refine quantitative and qualitative criteria to best meet wildlife, fisheries, and stakeholder needs.

Finally, qualitatively, there may be consideration for whether an MMP is a mitigation or monitoring practice or how the activity informs risk prioritization feedback loops, including baseline studies, mitigation, monitoring for mitigation efficiency, and monitoring to assess impacts. For example, if most of the MMPs that rank highly are direct mitigation, and monitoring MMPs all come out lower, it may be appropriate to make sure some of the top monitoring approaches are considered even if they are in the middle of the ranking. This could potentially be addressed by including additional criteria, separating mitigation and monitoring into two ranking exercises, or application of other qualitative insight.

B Examples of Criteria Not in Tool

Reduction of Population-Level Consequences. Population-level consequences of potential impacts are not described in the Tool and can be extremely difficult to assess, particularly for non-lethal impacts. Expert elicitation and disturbance models (e.g., King et al. 2015[6]) have attempted to connect behavioral and physiological disturbance to population outcomes. However, the relationship between disturbance and fitness remains difficult and complicated to determine.

Cost. Cost of MMPs is not included in the Tool but is a component of practicability under law and may affect which MMPs are implemented. It is difficult to assess the cost of individual MMPs and suites of MMPs without project-specific details.

Feasibility. Feasibility is also a component of practicability. An example of an infeasible MMP might be shutdown of dynamic positioning thrusters during coring to minimize sound impacts when a marine mammal is within a given distance. This could pose a safety hazard to people on the vessel, making it infeasible to do this. Human safety is given priority over wildlife impacts, even for MMPs required by agencies. Another example might be efforts to model an activity for which there are no data to inform model parameters, or to report on information that cannot be collected by the existing technology. Feasibility of MMPs is difficult to assess and is not addressed in the Tool. If the MMP upon which a project is relying to minimize impacts is infeasible, it will not be implemented and impacts will not be minimized.

Ease of Implementation. In some cases, more than one MMP option may achieve the same goal. Ease may affect choices in that case. The Tool does not assess ease of implementation, and it can be difficult to determine how easy it is to implement MMPs relative to each other, particularly those that are theoretical.

Relationship to Statute/Regulation. The Tool does not assess whether MMPs address key components of statutes or regulations. An example of a key component in a statute is, under the Marine Mammal Protection Act, NOAA has to make findings of small numbers of harassments and negligible impacts on

[6] King, S.L., R.S. Schick, C. Donovan, C.G. Booth, M. Burgman, L. Thomas and J. Harwood. 2015. An interim framework for assessing the population consequences of disturbance. Methods in Ecology and Evolution. 6:1150-1158.

stocks in order to issue an Incidental Harassment Authorization. MMPs that minimize sound received by marine mammals would directly address this regulatory requirement. Although it is clear which MMPs are directly required by law, it is potentially challenging to know exactly which MMPs will be approved as indirectly meeting legal requirements by achieving a particular legal bar, such as "small numbers" or "not likely to affect."