Dear Member of the Marine Renewable Energy Community:

I would like to request your assistance in gathering information on current efforts that investigate environmental effects of marine renewable energy projects (principally tidal, wave, and ocean current energy). The [OES-Environmental initiative](https://tethys.pnnl.gov/about-oes-environmental) collects and distributes information, or metadata, on site-specific projects and research studies that investigate potential environmental effects of marine renewable energy on marine animals, habitats, and ecosystem processes. In collecting and distributing metadata, OES-Environmental strives to increase understanding of these impacts, mobilize practitioners, and coordinate research that can progress the industry in an environmentally responsible manner.

**The following form seeks information about** **projects (or test sites) and research studies associated with environmental effects of marine renewable energy**, including a brief summary of the project, methods, and results of research or monitoring. We are interested in collecting information from completed, in-progress, and planned projects and research studies.

By choosing to participate in the OES-Environmental metadata collection process, you will assist the marine renewable energy industry, government agencies, and stakeholders by contributing to the compilation of environmental effects information in a single location to allow for:

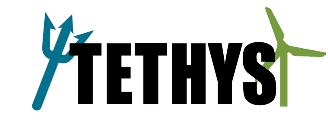
* **Increased awareness** amongst developers and regulators about new and current research efforts, which may inform new investments into monitoring methods and mitigation strategies;
* **Increased efficiency** of the permitting/consenting process by precluding studies shown to yield few results (under certain conditions), allowing for shorter and less costly processes;
* **Reduced uncertainty** for targeted investments of environmental effects by government agencies and other funding sources, further clarifying the permitting/consenting process; and
* **Value added interpretation and knowledge** through the examination of key research findings in conjunction with project monitoring data, informing optimal siting and permitting.

Please provide information about your project or research study on the following pages. An example form is provided at the end of the blank form to demonstrate the type of information requested.

Thank you in advance for your consideration and contribution to this valuable effort!

Dr. Andrea Copping  
Coastal Sciences Division   
Pacific Northwest National Laboratory  
[andrea.copping@pnnl.gov](mailto:andrea.copping@pnnl.gov)

Please email the form and any associated files to [tethys@pnnl.gov](mailto:tethys@pnnl.gov).





# **Project Site metadatA survey form**

Name of Person Updating Form: Date Submitted/Updated:

Metadata Contact Information

*Name:*

*Email:*

Project Details

*Project Name:*

*Project Status:*  Planned  In-Operation  Completed  Cancelled

*Project Manager:*

*Technology Developer:*

*Technology* *Type:*

*Project Coordinates (Mercator in decimal degrees):*

*Physical Site Conditions (Select all that apply)*

*Site:*  Open Coast  Enclosed Bay  Constricted Channel  River

*Water Depth (e.g., 20 m):*

*Channel Width (e.g., 2 km):*

*Noise:*  Noisy Environment (>80 dB)  Isolated/Quiet Environment (<80 dB)

*Benthic Habitat:*  Soft-Bottom Habitat  Hard-bottom Habitat

*Technology Subtype:*  Bottom-Mounted  Floating (Surface)  Floating (Subsurface)  Shore-based

*Support Structure (Select all that apply):*

*Substructure:*  Monopile  Gravity Base  Mooring Lines

*Anchor:*  Rock  Gravity/Deadweight  Drag Embedment  Suction Bucket

*Power Export Cables:*   Buried Seafloor Cables  Unburied Seafloor Cables  Cables in the Water Column

*Project Scale:*  Sub-scale  Single Device  Array  Test Site

*Grid Connection:* ☐ Grid-Connected ☐ Non Grid-Connected ☐ Provides Power at Sea[[1]](#footnote-1)

*Installed Capacity:*

*Device/Array Installation Date:*

*Device/Array Removal Date (if applicable):*

*Project Website:*

Project Description

*Please provide any additional project information.*

Location

*Please provide any additional information about the location of the project (e.g., water body name, country, closest city).*

Project Timeline

*Please provide a brief description of the project’s timeline including current status and future development.*

Licensing Information

*Please provide a brief description listing the organizations involved,* *licenses needed, and duration of the permitting/consenting process. One paragraph should suffice.*

Key Environmental Issues

*Please provide a brief description* *of the most important environmental issues raised in permitting/consenting the project (e.g., sensitive species/habitats/areas that were of particular concern and/or received special protection) and how they were/are being addressed. If available, please provide a link to the project’s official environmental webpage.*

Papers, Reports, and Research Projects

*Please list any key reports or papers that address environmental issues. The files themselves can be made available in downloadable PDF format or via a link to the file or project website.*

Baseline Assessment & Post-Installation Monitoring

*In the tables below, please provide details of the baseline assessment and post-installation monitoring efforts associated with the project, including descriptions of each particular study’s objective, design and methods, results, and status.* *Additional rows may be added to report on other stressors and receptors (e.g., noise and EMF for baseline assessments; social and economic impacts for post-installation monitoring).*

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Baseline Assessment** | | | | |
| **Receptor** | **Study Description** | **Design & Methods** | **Results** | **Status** |
| [Marine Mammals](https://tethys.pnnl.gov/receptor/marine-mammals) |  |  |  |  |
| [Fish](https://tethys.pnnl.gov/receptor/fish) |  |  |  |  |
| [Birds](https://tethys.pnnl.gov/receptor/birds) |  |  |  |  |
| [Invertebrates](https://tethys.pnnl.gov/receptor/invertebrates) |  |  |  |  |
| [Sea Turtles](https://tethys.pnnl.gov/receptor/reptiles) |  |  |  |  |
| [Physical Environment](https://tethys.pnnl.gov/receptor/physical-environment) |  |  |  |  |
| [Ecosystem Processes](https://tethys.pnnl.gov/receptor/ecosystem-processes) |  |  |  |  |
| Other |  |  |  |  |

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Post-Installation Monitoring** | | | | | |
| **Stressor** | **Receptor** | **Study Description** | **Design & Methods** | **Results** | **Status** |
| [Collision](https://tethys.pnnl.gov/stressor/collision) | Marine Mammals |  |  |  |  |
| Fish |  |  |  |  |
| Birds |  |  |  |  |
| Sea Turtles |  |  |  |  |
| [Noise](https://tethys.pnnl.gov/stressor/noise) | Marine Mammals |  |  |  |  |
| Fish |  |  |  |  |
| [Electromagnetic Fields](https://tethys.pnnl.gov/stressor/emf) | Fish |  |  |  |  |
| Invertebrates |  |  |  |  |
| Sea Turtles |  |  |  |  |
| [Habitat Change](https://tethys.pnnl.gov/stressor/habitat-change) | Marine Mammals |  |  |  |  |
| Fish |  |  |  |  |
| Birds |  |  |  |  |
| Invertebrates |  |  |  |  |
| Sea Turtles |  |  |  |  |
| [Displacement](https://tethys.pnnl.gov/stressor/displacement) | Marine Mammals |  |  |  |  |
| Fish |  |  |  |  |
| Birds |  |  |  |  |
| Sea Turtles |  |  |  |  |
| Invertebrates |  |  |  |  |
| [Changes in Flow](https://tethys.pnnl.gov/stressor/changes-flow) | Physical Environment |  |  |  |  |
| Ecosystem Processes |  |  |  |  |
| Other |  |  |  |  |  |

# **EXAMPLE Project Site metadatA survey form**

Project Details

*Project Name:* **Cobscook Bay Tidal Energy Project**

*Project Status:*  Planned  In-Operation  Completed  Cancelled

*Project Manager:* ORPC Maine, LLC

*Technology Developer:* Ocean Renewable Power Company

*Technology* *Type:* Tidal, Cross flow turbine

*Project Coordinates (Mercator in decimal degrees):* 44.9098°, -67.04563°

*Physical Site Conditions (Select all that apply)*

*Site:*  Open Coast  Enclosed Bay  Constricted Channel  River

*Water Depth (e.g., 20 m):* 18-45 m

*Channel Width (e.g., 2 km):*  64 km

*Noise:*  Noisy Environment (>80 dB)  Isolated/Quiet Environment (<80 dB)

*Benthic Habitat:*  Soft-Bottom Habitat  Hard-bottom Habitat

*Technology Subtype:*  Bottom-Mounted  Floating (Surface)  Floating (Subsurface)

*Support Structure (Select all that apply)*

*Substructure:*  Monopile  Gravity Base  Mooring Lines

*Anchor:*  Rock  Gravity/Deadweight  Drag Embedment  Suction Bucket

*Power Export Cables:*  Buried Seafloor Cables  Unburied Seafloor Cables  Draped Cables

*Project Scale:*  Sub-scale  Single Device  Array  Test Site

* Phase 1: Single device TidGen® Power System (Completed)
* Phase 2: 3-device TidGen® Power System (Cancelled)
* Phase 3: Advanced TidGen® Power System (Planned)

*Installed Capacity:* 450 kW

*Device/Array Installation Date:* September 13, 2012

*Device/Array Removal Date (if applicable):*

*Project Website:* <http://www.orpc.co/>

Project Description

ORPC designed the TidGen® Power System to operate in water depths of 60 to 150 ft. The core component of the TidGen® Power System is ORPC’s proprietary turbine generator unit (TGU). The TGU utilized four advanced design cross-flow (ADCF) turbines to drive a permanent magnet generator mounted between the turbines on a common driveshaft. The TGU was 98 ft in length, 17 ft high and 17 ft wide. It was attached to a bottom support frame, which held the TGU in place approximately 15 ft above the sea floor. The bottom support frame was 98 ft long by 50 ft wide by 15 ft high. The bottom support frame was constructed of steel, and the TGU was constructed of steel and composite material. The coupled TGU and bottom support frame comprised the TidGen® device. The TidGen® device was connected to an underwater power consolidation module, which was then connected to an on-shore station through a single underwater power and data cable. The on-shore station was interconnected to the local power grid. The TidGen® device and the related cabling and on-shore station comprised a complete TidGen® Power System.

ORPC’s funded project, Advanced TidGen® Power System, will incorporate a driveline test rig and an advanced encapsulated generator which is currently in production. The proposed system is based on a significant design effort performed in 2016.

Location

The device is located in Cobscook Bay on State of Main submerged lands, near Eastport and Lubec, Maine, United States (44.9098°, -67.04563°).

Project Timeline

In March 2012, ORPC began construction of the Project off the coast of Eastport and Lubec, Maine (Figure 1). Following installation of the initial phase of the Project during the spring and summer of 2012, the Project began delivering electricity to the Emera Maine grid in September 2012. This is the first grid-connected installation of ORPC’s TidGen® Power System.

A single-device TidGen™ Power System with a rated capacity of 150 kW was secured to a bottom support frame, which was fully installed with piles driven on April 8, 2013. The TGU was deployed on August 14, 2012. Subsea power and data cables were deployed on the seafloor and connected to the TidGen™ device. Electricity generated by the TidGen™ Power System was delivered by an underwater power cable to an On-shore Station in Lubec, Maine, where it was power-conditioned and connected to the Bangor Hydro Electric Company (BHE) utility grid on September 13, 2012. ORPC entered into a 20-year agreement with Bangor Hydro Electric Company on January 1, 2013 for up to 5 megawatts at a price of $215/MWh, escalating at 2.0% per year.

Several issues occurred during construction and operation of the TidGen® TGU which necessitated changes to the planned methodology. Retrievals of the TGU were required at more frequent intervals than planned. The significant cost increases incurred during operation and repair of the initial unit necessitated a reduction in number of additional units to be installed. And the sooner than expected retrieval of the TGU and extensive repairs needed for the generator and EC caused a significant loss of operating time. The total amount of time the unit was in operation during the Project was 734 hours. Electrical issues with the TGU electrical brake occurred upon reinstallation of the TGU. The unit was retrieved, repairs made, and then reinstalled on February 22, 2013. The Project assumed that the second retrieval would occur after six months of operation. The TGU retrieval was successfully conducted in the presence of DOE HQ staff on July 15, 2013. The TGUwas transported to shore, placed on blocking and lifted onto a trailer for transfer to the concrete blocking pads on July 16, 2013.

The status of the TidGen® TGU led ORPC to consult with FERC and the Project’s Adaptive Management Team to determine an appropriate level of environmental monitoring while the TGU was out of the water. This effort culminated with the issuance of a temporary variance from environmental monitoring from FERC on October 29, 2013. ORPC continued some opportunistic environmental monitoring at the Project site in 2014 despite the temporary variance. These activities were associated with the deployment of ORPC’s OCGen® Module Mooring Project at the site. Environmental monitoring included review of dive video for benthic growth on subsea components (Section 3.0 of this report). In addition, ORPC and the University of Maine School of Marine Sciences (UMaine) continued fisheries and marine life interaction research at the site in 2014 and 2015 through a separate UMaine funding award from DOE. ORPC then requested a two-year temporary variance extension to environmental monitoring during their technology optimization phase from FERC on December 31, 2015. The request for the two-year extension to the temporary variance for environmental monitoring was granted by FERC on March 2, 2016.

U.S. Senators Susan Collins and Angus King announced on August 31, 2016 that Ocean Renewable Power Company (ORPC) would receive $5,350,000 through the Department of Energy (DOE) to enhance the performance of its tidal turbine system. ORPC was one of 10 organizations across the country to receive funding to support the development of a commercially viable marine and hydrokinetic industry. This contract was signed with DOE on January 3, 2017. The new system will be built, installed, operated, and performance benchmarked in ORPC’s permitted sites in the Eastport and Lubec region, including the Cobscook Bay Tidal Energy Project, and employ local contractors and services providers.

ORPC anticipates that the project infrastructure in place, the environmental monitoring and data analysis efforts, resource information documentation, and collaborative relationships with existing marine users will continue through the duration of the existing pilot license term. With concurrence of the Project Adaptive Management Team, they will be testing new generations of system components and assembled systems at the project site and will keep FERC informed regarding these efforts. While the project site serves as an excellent testing area, ORPC considers the tidal current velocities at the Project site inadequate to justify pursuing a commercial license. In a March 14, 2017 submittal to FERC, ORPC stated that it did not intend to file a notice of intent (NOI) to relicense the project or a Pre-Application Document (PAD) at this time.

Licensing Information

ORPC received a pilot project license for the Cobscook Bay Tidal Energy Project (Project) from the Federal Energy Regulatory Commission (FERC) on February 27, 2012 (FERC Project No. P-12711-005). ORPC obtained a preliminary permit for the Project area in Cobscook Bay from FERC on July 23, 2007; FERC issued a successive preliminary permit on January 13, 2011. Feasibility studies, including environmental surveys, and pre-filing consultation were conducted, resulting in ORPC’s filing of a draft pilot project license application with FERC on July 24, 2009 and subsequently, the final pilot project license application in September 2011.

On June 5, 2015, ORPC filed a request with the Commission to extend its license term for the Cobscook Bay Tidal Energy Project from eight years to ten years. This would extend the expiration date from 2020 to 2022. However, in a March 14, 2017 submittal to FERC, ORPC stated that it did not intend to file a NOI or PAD for the Project at this time.

Key Environmental Issues

**Table 1.** Federal and/or state listed threatened (T) and endangered (E) species with potential to occur in project area.

|  |  |  |
| --- | --- | --- |
| **Species** | **Federal Status** | **State Status** |
| Atlantic sturgeon (Gulf of Maine Distinct Population  Segment (DPS)) (Acipenser oxyrinchus) | T | N/A |
| Atlantic salmon (Gulf of Maine DPS) (Salmo salar) | E | N/A |
| Leatherback sea turtle (Dermochelys coriacea) | E | E |
| Loggerhead sea turtle (Caretta caretta) | T | E |
| Sei whale (Balaenoptera borealis) | E | E |
| Fin whale (Balaenoptera physalus) | E | E |
| North Atlantic right whale (Eubalaena glacialis) | E | E |
| Humpback whale (Megaptera novaeangliae) | E | E |

ORPC designed and carried out the following monitoring plans to ascertain the Cobscook Bay Tidal Energy Project’s environmental effects:

* Acoustic Monitoring
* Benthic and Biofouling Monitoring
* Fisheries and Marine Life Interaction Monitoring
* Hydraulic Monitoring
* Marine Mammal Monitoring
* Bird Monitoring

In addition, as required by ORPC’s FERC License, an Adaptive Management Plan has been implemented that describes and manages the process for evaluating environmental monitoring data and license modifications where appropriate. The Adaptive Management Team is comprised of the jurisdictional federal and state agencies and ORPC.

Environmental Webpage: <http://www.orpc.co/our-approach/environmental-affairs>

Papers, Reports, and Research Projects

Annual Environmental Monitoring Reports

* [2012 Environmental Monitoring Report (ORPC Maine 2013)](https://tethys.pnnl.gov/publications/cobscook-bay-tidal-energy-project-2012-environmental-monitoring-report)
* [2013 Environmental Monitoring Report (ORPC Maine 2014)](https://tethys.pnnl.gov/publications/cobscook-bay-tidal-energy-project-2013-environmental-monitoring-report)
* [2014 Environmental Monitoring Report (ORPC Maine 2015)](https://tethys.pnnl.gov/publications/cobscook-bay-tidal-energy-project-2014-environmental-monitoring-report)
* [2015 Environmental Monitoring Report (ORPC Maine 2016)](https://tethys.pnnl.gov/publications/cobscook-bay-tidal-energy-project-2015-environmental-monitoring-report)
* [2016 Environmental Monitoring Report (ORPC Maine 2017)](https://tethys.pnnl.gov/publications/cobscook-bay-tidal-energy-project-2016-environmental-monitoring-report)

Project Commercialization Technical Report

* [TidGen Power System Commercialization Project Final Technical Report (ORPC Maine 2013)](https://tethys.pnnl.gov/publications/tidgen-power-system-commercialization-project-final-technical-report)

Other Reports and Papers

* [Subtidal Benthic Video and Benthic Infauna Survey and Intertidal Cable Crossing Survey (MER 2012)](https://tethys.pnnl.gov/publications/subtidal-benthic-video-and-benthic-infauna-survey-and-intertidal-cable-crossing-survey)
* [Fish in a Tidally Dynamic Region in Maine: Hydroacoustic Assessments in Relation to Tidal Power Development (Viehman 2012)](https://tethys.pnnl.gov/publications/final-report-acoustic-marine-mammal-and-bird-monitoring-studies-during-phase-1-pile)
* [Final Report on the Acoustic, Marine Mammal and Bird Monitoring Studies During Phase 1 Pile Driving Activities (ORPC Maine 2012)](https://tethys.pnnl.gov/publications/final-report-acoustic-marine-mammal-and-bird-monitoring-studies-during-phase-1-pile)
* [Interactions of aquatic animals with the ORPC OCGen® in Cobscook Bay, Maine: Monitoring behavior change and assessing the probability of encounter with a deployed MHK device (Zydlewski et al. 2016)](https://tethys.pnnl.gov/sites/default/files/publications/Zydlewiski-et-al-2016.pdf)
* [Behavioral Responses of Fish to a Current-Based Hydrokinetic Turbine Under Multiple Operational Conditions: Final Report (Grippo et al. 2017)](https://tethys.pnnl.gov/publications/behavioral-responses-fish-current-based-hydrokinetic-turbine-under-multiple-operational)

Baseline Assessment & Post-Installation Monitoring

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Baseline Assessment** | | | | |
| **Receptor** | **Study Description** | **Design & Methods** | **Results** | **Status** |
| [Marine Mammals](https://tethys.pnnl.gov/receptor/marine-mammals) | Marine mammal presence and interactions | Incidental visual observations; testing of active acoustic monitoring (AAM) system. | Visual observations recorded primarily harbor seals at the project site; AAM testing indicated positive results for detecting and tracking marine mammal sized targets. | Completed |
| [Fish](https://tethys.pnnl.gov/receptor/fish) | Fisheries presence and turbine interactions | Hydroacoustic and trawl surveys of project and control sites; interaction studies around ORPC’s beta turbine. | Hydroacoustic and trawls surveys combined to detail fisheries presence (seasonality, vertical distribution, diurnal patterns, etc.) and speciation. Interaction studies demonstrated fish behavior. | Completed |
| [Birds](https://tethys.pnnl.gov/receptor/birds) | Species presence and behavior | Visual observations. | Species presence, behavior, and seasonality documented. | Completed |
| [Invertebrates](https://tethys.pnnl.gov/receptor/invertebrates) | Benthic community survey | Benthic dive survey of deployment area and cable route. | Species presence and distribution documented. | Completed |
| [Sea Turtles](https://tethys.pnnl.gov/receptor/reptiles) |  |  |  |  |
| [Physical Environment](https://tethys.pnnl.gov/receptor/physical-environment) | Marine Geophysical Survey | Detailed bathymetric mapping, side-scan sonar, sub-bottom profiling and magnetometer surveys. Data used to characterize the bottom and identify potential cultural resources and marine hazards. | Preliminary results led ORPC to change deployment strategy of turbines in Cobscook Bay primarily due to thickness of unconsolidated sediments. | Completed |
| Water Velocity Surveys | Acoustic Doppler Current Profiler (ADCP) surveys. Hydraulic circulation modeling. | ADCP surveys and hydraulic modeling contributed to the selection of turbine deployment locations. | Completed |
| Underwater acoustic survey | Drifting Noise Measurement System (DNMS) at project site and around ORPC’s beta turbine. | Beta turbine operation did not elevate underwater sound levels more than 10 dB above ambient levels and is not expected to cause harassment to marine mammals. | Completed |
| [Ecosystem Processes](https://tethys.pnnl.gov/receptor/ecosystem-processes) |  |  |  |  |
| Other |  |  |  |  |

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Post-Installation Monitoring** | | | | | |
| **Stressor** | **Receptor** | **Study Description** | **Design & Methods** | **Results** | **Status** |
| [Collision](https://tethys.pnnl.gov/stressor/collision) | Marine Mammals | The primary goal of the Marine Mammal Monitoring Plan is to identify the species, number of animals and their behavior to characterize changes in marine mammal use in and around the deployment area due to the presence of hydrokinetic devices. | ORPC conducted visual observations of marine mammals in and around the Project area concurrently with other project-related tasks conducted in 2013. | Marine mammal observations made by trained personnel in 2013, including during periods of operation, maintenance and retrieval did not indicate changes in marine mammal presence or behavior. There is no evidence of marine mammal strike with system components during deployment and retrieval or with TGU foils during operation. | Completed |
| Fish |  |  |  |  |
| Birds |  |  |  |  |
| Sea Turtles |  |  |  |  |
| [Noise](https://tethys.pnnl.gov/stressor/noise) | Marine Mammals |  |  |  |  |
| Fish |  |  |  |  |
| [Electromagnetic Fields](https://tethys.pnnl.gov/stressor/emf) | Fish |  |  |  |  |
| Invertebrates |  |  |  |  |
| Sea Turtles |  |  |  |  |
| [Habitat Change](https://tethys.pnnl.gov/stressor/habitat-change) | Marine Mammals |  |  |  |  |
| Fish |  |  |  |  |
| Birds |  |  |  |  |
| Invertebrates | The primary goals of the Benthic and Biofouling Monitoring Plan are to evaluate the benthic community during the Project and to study whether the structures introduced into the marine system contribute to biofouling accumulation that may alter the habitat within the Deployment Area. | ORPC deployed video transect lines and video recordings were made by scuba divers. Benthic sampling was conducted in situ by the divers along the transect. ORPC performed biofouling assessments. The TidGen® TGU was assessed for percent coverage of biofouling on distinct structural components, and biological samples were taken from representative locations. In 2014, the installation of the OCGen® Module Mooring Project at the Cobscook Bay Tidal Energy Project site provided an opportunity to inspect the TidGen® bottom support frame, shore cable termination anchor, and the Simrad tower for benthic growth. | MER Associates review of ORPC’s November 9, 2013 benthic survey of the cable route concluded that  exposed sections of the cable were causing minimal disturbance to the seabed and were not adversely  impacting the surrounding habitat or benthic epifauna. In addition, the buried portion of the cable was  stationary and was not expected to cause any disturbance impacts. Review of the dive video and visual inspection following retrievals of the TidGen® indicate minimal biofouling of the TidGen® device. The July 2014 observations were generally consistent with those previously recorded and confirmed a continued presence of benthic organisms on subsea structures. | Completed |
| Sea Turtles |  |  |  |  |
| [Displacement](https://tethys.pnnl.gov/stressor/displacement) | Marine Mammals |  |  |  |  |
| Fish | The goal of the Fisheries and Marine Life Interaction Monitoring Plan was to collect pre-deployment and post-deployment information to provide an initial description of fish distribution and relative abundance within Cobscook Bay to supplement existing information for the general  Passamaquoddy Bay area.The Fisheries Monitoring Plan is a continuation of research started by UMaine researchers in 2009. | The study was designed to capture tidal, seasonal and spatial variability in the presence of fish in the area of interest (near the TidGen® device deployment site). The design involved down-looking hydroacoustic surveys during several months of the year, and examined the vertical distribution and relative abundance of fish at the project and control site (for relative comparison). Pre-deployment data were collected in 2010, 2011, and early 2012, and post-deployment data were collected from August 2012 through September 2013. In 2015 UMaine’s Fish Assessment Study Team completed research related to marine life interaction data around the OCGen® Module deployed in 2014. In 2016 UMaine’s Fish Assessment Study Team continued processing, analyzing, and interpreting data collected at the Project site in 2012-2014. | The hydroacoustic surveys indicated that there was a significant decline in fish density closer to the turbine beginning approximately 140 m from the free-spinning OCGen® prototype device. Noise and natural flow patterns appeared to be the most plausible explanations for the observed patterns in fish behaviour. The study provides additional confirmation that a single turbine is unlikely to result in  more than negligible impacts to fish communities. | Completed |
| Birds | The primary goal of the Bird Monitoring Plan was to determine the species, number, and time of peak use of sea and shore birds in the Deployment Area, the onshore landing site where the underwater P&D cables of the TidGen® Power System comes ashore, and the waters immediately off the landing site. | Post-deployment sea and shore bird monitoring was conducted by the Center for Ecological Research (CER) using trained observers familiar with local bird species and behavior. | CER observed a decline in several species of seabirds in the Cobscook Bay study area in 2012- 2013, compared to the previous two winters. It seems unlikely that the operation of the TidGen® Power System affected seabird numbers. CER surveys did not find any federally or state endangered or threatened species. | Completed |
| Sea Turtles |  |  |  |  |
| Invertebrates |  |  |  |  |
| [Changes in Flow](https://tethys.pnnl.gov/stressor/changes-flow) | Physical Environment | The primary goals of the Acoustic Monitoring Plan were to identify and characterize the noise radiated by the TidGen® Power System in the high-velocity environment of the Project site by  gathering acoustic data under various environmental and mechanical conditions prior to and during Project deployment. | Measurements were collected at the project site using a drifting noise measurement system (DNMS). | Measurements of the in-water noise level related to the TidGen® Power System demonstrate that sound levels in the vicinity do not exceed 120 dB re 1 µPa2  /Hz at any frequency while the turbine is rotating, both while generating and when freewheeling. | Completed |
| The primary goal of the Hydraulic Monitoring Plan was to characterize the hydrological zone of  influence, area for the Project. | ORPC worked with Sandia National Laboratories (SNL) and Sea Engineering, Inc. to  apply their SNL-EFDC Model to assess hydrodynamics at the Project site. TidGen®  foundation piles were marked prior to installation for the purpose of measuring changes to seabed elevation from scour. | Results of the scour monitoring indicate minimal change in seabed elevation around the foundation piles. | Completed |
| Ecosystem Processes |  |  |  |  |
| Other |  |  |  |  |  |

1. Includes MRE devices powering applications at sea such as ocean observation, aquaculture, etc. [↑](#footnote-ref-1)