Dear Member of the Ocean Energy Community:

I would like to request your assistance in gathering information on current research efforts that investigate environmental effects of ocean energy projects (principally tidal, wave, and ocean current energy). This US-led data collection process, known as Annex IV, consists of collecting information on research projects and experiments that investigate potential environmental effects of ocean energy devices, mooring systems, anchors, and power cables on marine animals, habitats, and ecosystem processes. Annex IV has two main goals; to produce a publically accessible database to house project information on the potential environmental impacts of ocean energy development, and to use the database to analyze the current status of environmental issues important to marine renewable energy development worldwide.

We are interested in collecting information from both completed research studies and projects currently in progress (e.g. without final results) that pertain to potential environmental effects of ocean energy technologies. The form attached seeks metadata about projects, that is, information about the studies you are currently engaged in, the issues you are investigating, and a summary of results to date (if applicable).

By choosing to participate in the Annex IV information collection process, you will assist the ocean 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 (consenters) 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/evaluations 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.

An example form is provided demonstrating the types of information requested. Thank you in advance for your consideration and contribution to this valuable effort.

Please fill in the form below, save it, and email it to:

Dr. Andrea Copping

Pacific Northwest National Laboratory

[Andrea.copping@pnnl.gov](mailto:Andrea.copping@pnnl.gov)

Any questions should also be directed to Dr. Copping.

**Environmental Effects of MHK Research Survey Form**

**Form Updated By:**  **Date Submitted:**

**Title of Research:**

**Researcher(s):**

**Website:**

**Contact Information**

**Name:**

**Address:**

**Phone:**

**Email:**

**Institution:**

**Partner Institutions:**

**Funding Source:**

**Location of Research:**

**Start of Research:**

**End of Research:**

|  |  |
| --- | --- |
| **General Description** | |
| **Purpose** |  |
| **Technology** | \_\_\_\_ Wave  \_\_\_\_ Tidal  \_\_\_\_ Ocean Current  \_\_\_\_ Technology Neutral  Description: |
| **Stressor** | \_\_\_\_ Chemical Leaching  \_\_\_\_ EMF  \_\_\_\_ Energy Removal  \_\_\_\_ Noise  \_\_\_\_ Physical Presence of device (static)  \_\_\_\_ Physical Presence of device (dynamic)  \_\_\_\_ Other (please list)  Description: |
| **Receptor** | \_\_\_\_ Bats  \_\_\_\_ Birds  \_\_\_\_ Invertebrates  \_\_\_\_ Fish  \_\_\_\_ Marine Mammals  \_\_\_\_ Sea Turtles  \_\_\_\_ Farfield Environment  \_\_\_\_ Nearfield Habitat  \_\_\_\_ Socio-economics  \_\_\_\_ Other (please list)  Description: |
| **Key Findings** |  |
| **Publications** |  |

**Example: Research Survey Form**

**Name:** Brian Polagye **Date Submitted:** January 16, 2012

**Title of Research:** Acoustic Effects of Tidal Energy

**Researcher(s):** Brian Polagye (PI), Jim Thomson (co-PI), Dom Tollit (co-PI), Christopher Bassett, Jason Wood, Joseph Graber, Rob Cavagnaro

**Website:** <http://depts.washington.edu/nnmrec/index.html>

**Contact Information**

**Name:** Brian Polagye

**Address:** Box 352600

**Phone:** +1 206-543-7544

**Email:** bpolagye@uw.edu

**Institution:** Northwest National Marine Renewable Energy Center; University of Washington

**Partner Institutions:** Snohomish Public Utility District; Pacific Northwest National Laboratory; Sea Mammal Research Unit, Ltd.

**Funding Source:** Subcontract through Snohomish Public Utility District via US Department of Energy competitive solicitation (2009)

**Location of Research:** Admiralty Inlet, Puget Sound, Washington

**Start of Research:** May 2010

**End of Research:** December 2011

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| --- | --- |
| **General Description** | |
| **Purpose** | The purpose of this project is to better understand the acoustic effects  of tidal energy devices through evaluation of the baseline environment (by prototyping several types of bottom-mounted and shore-based instrumentation), evaluating the implications of turbine noise at the site of a proposed pilot project in the context of existing ambient noise, using information from baseline monitoring to evaluate marine mammal behavior and responsiveness to existing sources of noise, and evaluate the effects that turbine noise could have on aquatic species through laboratory studies. |
| **Technology** | \_\_\_\_ Wave  \_\_X\_\_ Tidal  \_\_\_\_ Ocean Current  \_\_\_\_ Technology Neutral  Description: Site of proposed pilot demonstration of two 6 m OpenCentre turbines developed by OpenHydro, Ltd. |
| **Stressor** | \_\_\_\_ Chemical Leaching  \_\_\_\_ EMF  \_\_\_\_ Energy Removal  \_\_X\_\_ Noise  \_\_\_\_ Physical Presence of device (static)  \_\_\_\_ Physical Presence of device (dynamic)  \_\_\_\_ Other (please list)  Description: Noise from device operation, specifically from two 6 m OpenCentre turbines, in the context of existing ambient noise. Noise from operation is generally “red” decreasing in intensity at 13 dB/decade with some higher intensity clusters at frequencies less than 1 kHz. |
| **Receptor** | \_\_\_\_ Bats  \_\_\_\_ Birds  \_\_\_\_ Invertebrates  \_\_X\_\_ Fish  \_\_X\_\_ Marine Mammals  \_\_\_\_ Sea Turtles  \_\_\_\_ Farfield Environment  \_\_\_\_ Nearfield Habitat  \_\_\_\_ Socio-economics  \_\_\_\_ Other (please list)  Description: Several species of cetaceans (with auditory bandwidths that span the full range of expected noise from turbines), pinnipeds, and fish are known to be present in the proposed project area. |
| **Key Findings** | Baseline data collection (UW):  • Bottom-mounted packages may be used to simultaneously deploy Doppler profilers and passive acoustic hydrophones (though some caution is warranted to prevent interference).  • Shore-based AIS systems are effective at quantifying vessel traffic and, when paired with long-term hydrophone data, can be used to quantify the contribution of vessel traffic to the ambient noise budget.  • Shore-based infrared cameras can be extend the periods in which observations can be conducted (night, light fog), but have insufficient resolution to detect and identify marine mammals further than a few hundred meters from shore, while maintaining a reasonably broad field of view.  Turbine noise in the ambient context (UW):  • The noise that would be generated by operating turbines has a considerable overlap with existing anthropogenic noise sources at this site. Any post-installation noise characterization or observations of marine mammal responsiveness to turbine noise must acknowledge this and employ careful study design to avoid confusing turbine noise (or effects thereof) with other sources of noise or stimuli.  Marine mammal behavior (UW and SMRU, Ltd.):  • Harbor porpoise are more commonly present at this site than at other proposed tidal energy developments. Generalized Linear Models suggest that echolocation activity is correlated with the time of day (many more clicks at night), current velocity  (fewer clicks during periods of strong currents), ambient noise levels (fewer clicks during periods of elevated ambient noise), and stage of the tide (fewer clicks during spring than neap). However, such models have a large residual deviance, suggesting that, while these factors are statistically significant, they do not explain the majority of porpoise presence/absence at the site.  • The local population of harbor porpoise may be habituated to periodically elevated noise due to omnipresent shipping and ferry traffic. Consequently, harbor porpoise at this location may not be responsive to turbine noise.  Laboratory study (PNNL):  Juvenile Chinook salmon exposed to high intensity turbine noise continuously for 24 h developed minor and biologically insignificant injuries. Since turbine noise will be cyclic with the tide any effects of actual turbine noise are likely to be more subtle and not result in harm to juvenile or adult salmon. |