

Science, Service, Stewardship



Ecological Effects and Research Needs for Alternative Energy Projects Off the Oregon Coast

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FERC Approach to Ocean Energy Licensing

- Adaptation of FERC's hydropower project process
- Affects projects within a State's Territorial Sea (and potentially out to 12nm)
- Process includes:
 - Conditioned licenses
 - Long-term licenses
 - Pilot projects
 - Settlement agreements
 - Consideration of direct, secondary, and cumulative impacts through NEPA process and short and long-term monitoring of project operations.





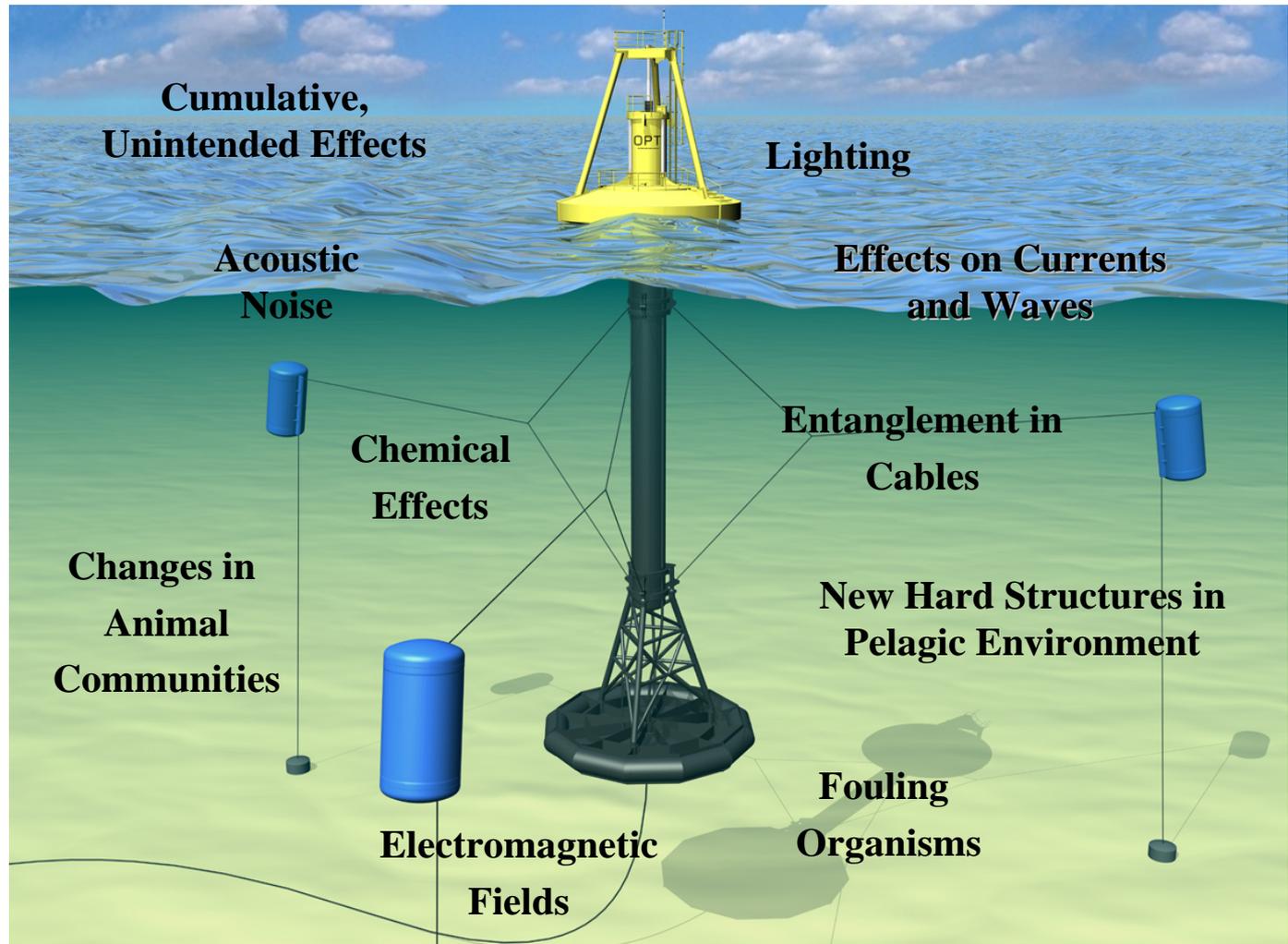
Sensitive Designations (Areas)

- Criteria for using the Hydrokinetic Pilot Licensing Process -
“The pilot licensing process will not be available to projects that would be located in waters with sensitive designations.”
- Types (examples) :
 - Habitat Areas of Particular Concern (HAPC designation pursuant to the MSA)
 - Essential Fish Habitat (pursuant to the MSA)
 - Critical Habitat (pursuant to the ESA)
 - Migration Corridors
 - Feeding grounds
- Sensitive areas can vary from place to place and time of year.





Wave Energy Buoy





Key Studies

- Local Wave Environment
- Ocean Currents
- Local Littoral Transport
- Bathymetry and Surficial Geology
- Physical Characterization of Benthic Habitat
- Characterization of Benthic Infauna
- Characterization of Epibenthic Macrofauna
- Characterization of Pelagic Nekton
- Characterization of Key Forage Plankton
- Site Use/Presence by Salmon
- Characterization of Electrical and Magnetic Fields
- Characterization of Acoustic Noise
- Site Use/Presence of Seabirds
- Site Use/Presence of Cetaceans
- Site Use/Presence of Pinnipeds
- Survey/Presence of Invasive Species



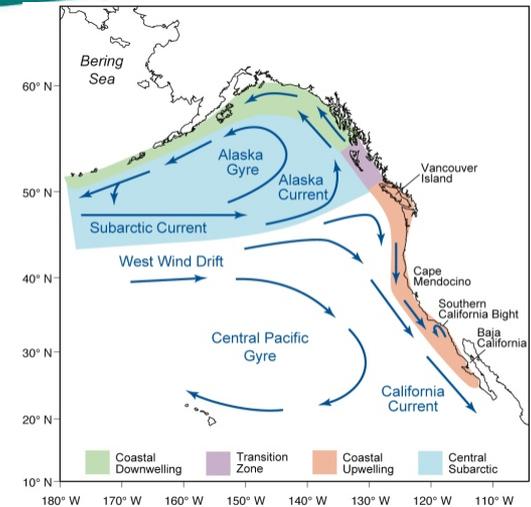


Local Wave Environment

- **Justification:** Characterization of the wave environment is necessary to model array effects on wave height, period, and energy. This information is also necessary to optimize the efficiency of the deployed equipment.
- **Needed Information:** Wave amplitude and frequency/period measurements at the proposed site are needed over at least an annual cycle.



Ocean Currents

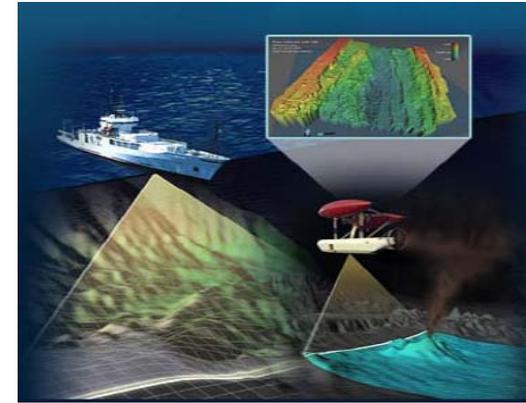


- **Justification:** Ocean currents, along with waves, drive the littoral transport system. Additionally, ocean currents act as the transport system for some biological properties and for any accidental spills. Information on currents, especially seasonal and episodic meteorological responses, will be needed to support transport models.
- **Needed Information:** Surface currents at the project site need to be documented, especially with respect to seasonal and meteorological cycles/episodes.



Local Littoral Transport

- **Justification:** A wave energy facility will likely modify both the wave energy and the ocean currents. Models used to predict effects on the littoral cell transport will require information on local littoral processes, especially areas likely to develop erosive or depositional environments.
- **Needed Information:** High-resolution information on local waves and currents, before and after array deployment.



Bathymetry and Surficial Geology

- **Justification:** Deployment of anchoring systems will require high resolution profiling of the sediment layer and sub-bottom (i.e., underlying hard substrate or basement) to assure adequate sediment depth. Any cultural resources (i.e., shipwrecks) will also need to be identified, if present.
- **Needed Information:** The water depth and sediment depth and type need to be documented with appropriate resolution over the entire site.



Summary View of Plan-view Photography Survey Technique

Application	Data Coverage	Resolution	Image	Key Points
Benthic Imagers	Point Data	Vertical Horizontal	Image	<ul style="list-style-type: none"> Obtains Benthic image, plan-view snapshot of 2 m² of seafloor surface Used in conjunction with GPS, not required to enter survey Discards sampling technique Historical company and cost for acquisition and processing
Data Collection		Raw Data		Processed Data
  <p>The assessment imaging plan-view camera may be mounted with a mechanical probe image frame (IC) if use also be mounted on the own light-weight frame for small boat and/or submersible use (S).</p>		  <p>Discards photographs of benthic habitats viewed from the seafloor surface are taken and analyzed images and frames.</p>		  <p>Subsequent interpretation of plan-view photographic images of the Benthic Data sets of the Benthic Data Processing, the results allow for more than 1000 images.</p>

This table and processed data image images provided by NOAA Coastal Service Center. Raw data images provided by NOAA Coastal Service Center.

NOAA Coastal Service Center Benthic Habitat Mapping Web Site

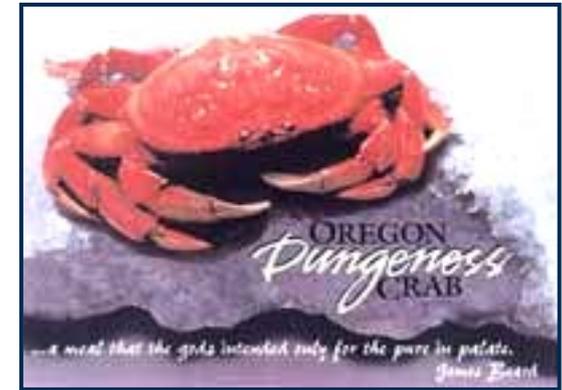
Physical Characterization of Benthic Habitat

- Justification:** The grain size, homogeneity, and amount of organic material in the sediment are prime determinants of habitat use by biota. These characteristics are likely to change as energy is removed from the wave train and deposition of finer sediments is possible. Additionally, more organics may be supplied by the higher density of organisms inhabiting the hard substrates.
- Needed Information:** Need site-specific information before and after array deployment.



Characterization of Benthic Infauna

- **Justification:** The benthic infauna are in large part the basis of the demersal food web. Changes in the physical benthic habitat will likely lead to changes in the infauna.
- **Needed Information:** Need site-specific information before and after array deployment.



Characterization of Epibenthic Macrofauna

- **Justification:** The benthic epifauna are a large part of the basis of the demersal food web. Changes in the physical benthic habitat and infauna will likely lead to changes in the epifauna.
- **Needed Information:** Need site-specific information before and after array deployment.



Characterization of Pelagic Nekton

- **Justification:** The pelagic nekton (swimming fish and invertebrates inhabiting the water column) are expected to change in distribution and abundance due to project effects, especially the provision of physical structure in historically open water.
- **Needed Information:** Need site-specific information before and after array deployment.



Characterization of Key Forage Plankton

- **Justification:** Vertically migrating species of relatively large planktonic crustaceans are an important source of food for fish, seabirds, and whales. The creation of a wave energy facility in previously open water will likely have some effect on the availability of this group as forage in the water column.
- **Needed Information:** Measurements of presence/absence of forage plankton before and after array deployment can provide an indication of change in the area/system while species composition measurements can provide an indication of predators likely present.

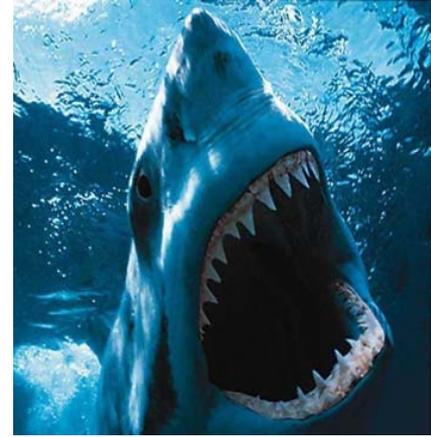


Site Use by/Presence of Salmon

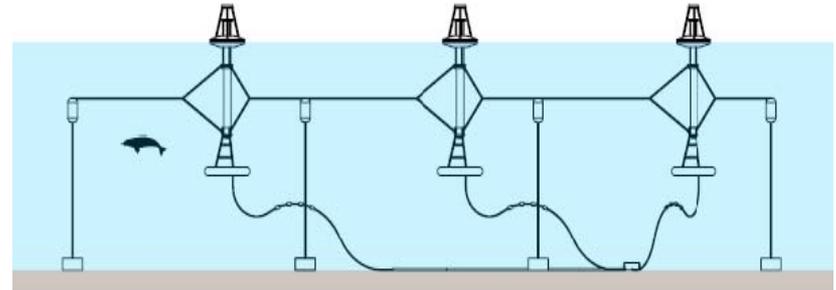
- **Justification:** Wild salmon stocks in the Pacific Northwest are largely diminished and under ESA protection. Hence, any predicted salmon takings by a project will come under great scrutiny.
- **Needed Information:** Need site-specific information on salmon presence, absence, and usage before and after array deployment.



Characterization of Electrical and Magnetic Fields

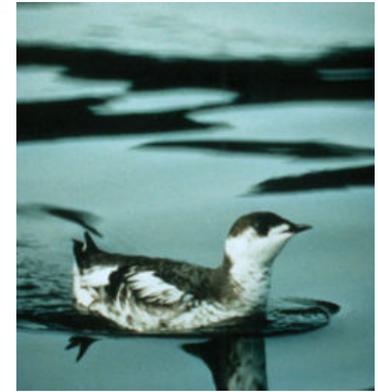


- **Justification:** Any electromagnetic fields emanating from the buoys and transmission system will be superimposed on the background of the earth's magnetic field and induced electrical field generated by the seawater flowing through it. Animals with the EMF sensory capability use it to sense animal motion within the context of this dynamic background.
- **Needed Information:** Need site-specific information before and after array deployment.



Characterization of Acoustic Noise

- **Justification:** Any sound emanating from the buoys and transmission system will be superimposed on the background of the ambient sound field generated by wind and waves, animals and man's activities. Animals with the acoustic sensory capability use it within the context of this background noise.
- **Needed Information:** Need site-specific information before and after array deployment.



Site Use by/Presence of Seabirds

- **Justification:** Use of the site by the various groups of seabirds needs to be documented prior to buoy deployment, in order to provide a baseline for effects evaluation. Seabird use is expected to be strongly seasonal.
- **Needed Information:** Need site-specific information before and after array deployment. This study will need a control site and will need to be of multi-year duration.



Site Use by/Presence of Cetaceans

- **Justification:** Use of the site by cetaceans needs to be documented prior to buoy deployment, in order to provide a baseline for effects evaluation. Cetacean use is expected to be strongly seasonal, especially the spring and fall migrations of gray whale.
- **Needed Information:** Need site-specific information before and after array deployment. This study will need a control site and will also need to be of multi-year duration.



Site Use by/Presence of Pinnipeds

- **Justification:** Use of the site by the various species of seals and sea lions needs to be documented prior to buoy deployment, in order to provide a baseline for effects evaluation. Pinniped use is expected to be strongly seasonal.
- **Needed Information:** Need site-specific information before and after array deployment. This study will need a control site and will need to be of multi-year duration.



Survey/Presence of Invasive Species

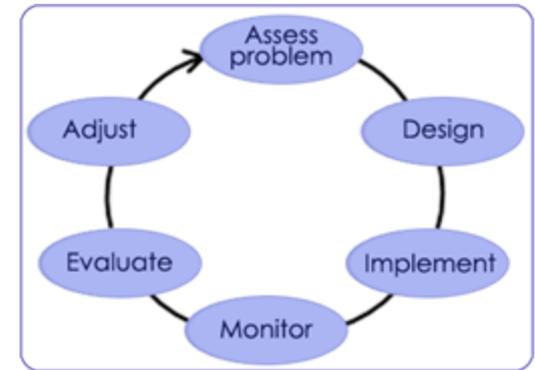
- **Justification:** There is concern that providing hard substrates in an open-water environment may have consequences in the distribution of invasive species. There is also concern that the deployment of many structures in previously open water could affect the recruitment of meroplankton, especially if those surfaces are coated with toxic compounds.
- **Needed Information:** Need site-specific information before and after array deployment.



System-wide and Cumulative Effects

- Effects of size of individual array(s)
- Effects of multiple arrays
- Marine Spatial Planning - Effects of wave energy plus other existing and new uses (e.g., fishing, marine reserves; changing ocean conditions)
- To understand effects, impact thresholds need to be established.
- Two key questions:
 - How big an array is too big?
 - How many arrays is too many in a region?
- Cumulative Effects Study (Oregon Wave Energy Trust)





Adaptive Management: Key Considerations

- Cannot meet regulatory mandates to assess impacts without more information
- Studies are designed to obtain baseline; monitor for effects
- Management decisions are left to future adaptive management team
- Agencies continue to retain authorities during the adaptive management process



References

- Report to Congress: Potential Environmental Effects of Marine and Hydrokinetic Energy Technologies. US Department of Energy. *expected 2009.*
- Developing Wave Energy in Coastal California: Potential Socio-Economic and Environmental Effects. October 2008.
- Ecological Effects of Wave Energy Development in the Pacific Northwest: A Scientific Workshop, October 11-12, 2007. September 2008.

