Field	Study Information
Title	Ichthyoplankton Entrainment Assessment for High Voltage Direct Current Cooling Systems (PC-25-03)
Administered by	Pacific OCS Region
BOEM Contact(s)	Donna Schroeder (donna.schroeder@boem.gov)
Procurement Type(s)	Interagency Agreement, Cooperative Agreement, or Contract
Performance Period	FY 2025–2029
Final Report Due	TBD
Date Revised	May 2, 2024
Problem	The State of California established a policy that prohibits and/or phases out once-through-cooling (OTC) systems for coastal power plants due to the potential negative effects that entrainment of fish larvae has on fisheries. It is unknown if this policy will be applicable to offshore wind farms that propose OTC, given the different ichthyoplankton communities found on the Outer Continental Shelf (OCS) and slope where farms will be located and the potential to limit intake of seawater to depths that reduce entrainment of fish larvae.
Intervention	Classic (net-based) and genomic sampling of ichthyoplankton communities.
Comparison	Spatial (cross-shelf, latitudinal), temporal (seasonal, diel), and depth (surface, 30 m, 100 m) distribution and abundance of ichthyoplankton communities vulnerable to entrainment from high voltage direct current (HVDC) cooling systems.
Outcome	The outcome of this study will be project design criteria regarding OTC and wind farms (e.g., uptake and discharge depths), information about potential impacts needed for essential fish habitat (EFH) consultations related to construction and operations plans, and guidance needed by industry to successfully meet Coastal Zone Management Act (CZMA) certification and state permitting requirements.
Context	BOEM Planning Areas within the California Current System: Oregon-Washington; Northern California, Central California, Southern California

BOEM Information Need(s): The production and transport of electricity by offshore wind farms may rely on OTC systems that will require millions of gallons of seawater per day. Previous studies examining the effects of OTC in coastal power plants concluded that OTC removes billions of aquatic organisms, including fishes, fish larvae and eggs, crustaceans, shellfish and many other forms of aquatic life (Schwarzenegger, 2005; Ferry, 2010; Raimondi, 2010). Because of this, the State of California established a policy that prohibits and/or phases out OTC systems for coastal power plants due to the potential negative effects that entrainment of fish larvae has on fisheries and ecosystem health. It is unknown if this policy will be applicable to offshore wind farms that propose OTC given the different ichthyoplankton communities found on the outer continental shelf and slope where farms will be located and the potential to limit intake of seawater to deeper depths that could reduce entrainment of fish larvae. Outcomes of this study will include project design criteria regarding OTC and wind farms (e.g.

uptake and discharge depths), information regarding potential impacts required for NEPA documents and EFH consultations related to construction and operations plans, and guidance needed by industry to successfully meet CZMA certification and state permitting requirements.

Background: Offshore wind development on the OCS needs to effectively transport the power produced by the turbines to an onshore electrical power grid. It is expected that an HVDC system will be used to minimize power losses than can occur over long transport distances. When alternating current (produced by wind turbines) is converted into HVDC, heat is generated as a byproduct. This conversion system requires cooling to protect equipment from damage and breakdown, and standard OTC technology used by industry to provide this cooling function requires millions of gallons of seawater per day.

Studies required by the California Energy Commission and other State agencies have shown that coastal power plants that use seawater for OTC are contributing to declining fisheries and the degradation of estuaries, bay and coastal waters. These power plants indiscriminately 'fish' the water in these habitats by killing the eggs, larvae, and adults when water drawn from the natural environment flows through the plant (entrainment impacts) and by killing large adult fish and invertebrates that are trapped on intake screens (impingement impacts). These facilities also affect the coastal environment by discharging heated water back into natural environments.

Concerns have been raised by stakeholders to BOEM about how HVDC systems are cooled and the impacts of the cooling systems to the environment. As of 2022, innovations in cooling systems are being studied and developed, but so far, no new systems are tested and available for use on a commercial scale (Middleton and Barnhart, 2022).

Objective(s): The overall goal of this study is to understand how once-through-cooling systems likely to be proposed by the offshore wind industry may impact outer continental shelf and slope ichthyoplankton communities.

Methods: The study will acquire and compare long term data on ichthyoplankton assemblages in nearshore and offshore environments to guide the future field sampling schedule and identify potential gaps in reference libraries needed for genomic sampling. Direct field sampling of ichthyoplankton by classic (net-based) and genomic methods will quantify the distribution and abundance of larvae at various spatial scales (cross-shelf, latitudinal), temporal scales (seasonal, diel), and depths (surface, 30 m, 100 m). Cost-effective genomic sampling methods will supplement classic sampling methods to improve temporal resolution of data.

Specific Research Question(s): Specific research questions of this study include:

1. What is the distribution and abundance of ichthyoplankton in coastal and offshore environments?
2. Are there data gaps in fish reference libraries used for genomic sampling?
3. What are the spatial, temporal, and depth patterns of ichthyoplankton abundance that could be entrained by HVDC cooling systems?
4. Could OTC impacts be reduced by requiring seawater intakes to be positioned in depths deeper than 30 m or by reducing intake flow speeds?

Current Status: N/A

Publications Completed: N/A

Affiliated WWW Sites: N/A

References:

Ferry L. 2010. Understanding entrainment at coastal power plants: results from the WISER Program for studying impacts and their reduction. California Energy Commission, PIER Energy-Related Environmental Research Program. California Energy Commission, PIER Energy-Related Environmental Research Program. CEC-2010-036.

Middleton P, Barnhart B. 2022. Supporting National Environmental Policy Act documentation for offshore wind energy development related to high voltage direct current cooling systems. Washington (DC): U.S. Department of the Interior, Bureau of Ocean Energy Management. 13 p. Report No.: OCS Study BOEM 2022-023.

Raimondi P. 2010. Variation in entrainment impact estimation based on different measures of acceptable uncertainty. Sacramento (CA): California Energy Commission, PIER Energy-Related Environmental Research Program. CEC-500-2011-020. 44 p.

Schwarzenegger A. 2005. Issues and environmental impacts associated with once-through cooling at California's coastal power plants. Sacramento (CA): California Energy Commission. CEC-700-2005-013. 81 p.