Environmental Studies Program: Studies Development Plan | FY 2022–2023

Title	Linking pelagic and nearshore benthic ecosystems in lower Cook Inlet and Kachemak Bay through meroplankton: Collaborating with the Gulf Watch Alaska Monitoring Program in Cook Inlet (AK-22-05)
Administered by	Alaska Regional Office
BOEM Contact(s)	Dr. Christina Bonsell, christina.bonsell@boem.gov
Procurement Type(s)	Cooperative Agreement
Conducting Organization(s)	TBD
Total BOEM Cost	TBD
Performance Period	FY 2022–2025
Final Report Due	TBD
Date Revised	August 3, 2021
PICOC Summary	
Problem	The current Gulf Watch Alaska (GWA) program considers top-down effects (predation from sea stars, otters, and shore birds) on rocky intertidal community composition, but the influence of larval recruitment (supply-side) is not being investigated. Especially in times of prominent environmental drivers (e.g., heatwaves and resulting ecological responses), the repopulation and genetic mixing provided by larval recruitment is likely to play a vital role in nearshore community recovery and resilience.
Intervention	This study will provide molecular species-level identifications of meroplankton collections to identify patterns in meroplankton abundance and key intertidal species at high taxonomic resolution.
Comparison	The GWA program has monitored the oceanography, phytoplankton, and zooplankton in Kachemak Bay (monthly) and lower Cook Inlet (seasonally), allowing for analysis of spatial and temporal patterns. Nearshore community composition in Kachemak Bay has been monitored systematically since 2012; these data and those from other ongoing studies provide a rich database as a framework for spatial and temporal comparisons. This study will also assess the extent to which Kachemak Bay is a representative system for lower Cook Inlet.
Outcome	Using existing meroplankton data, augmented with new meroplankton collections, this study will provide information on how interannual and seasonal changes in the timing and abundance of meroplankton larval supply affects recruitment of key rocky intertidal species.
Context	Kachemak Bay and lower Cook Inlet. In addition to GWA, this study links to other ongoing efforts in Kachemak Bay

BOEM Information Need(s): Nearshore ecosystems are especially vulnerable to climatic (e.g., heatwaves) and anthropogenic (e.g., oil contamination) disturbances. They also serve as rich feeding grounds for many higher trophic levels and subsistence regions for local human residents. Information on how closely linked intertidal communities are to larval supply will assist BOEM with understanding the recovery potential of these nearshore systems in the Cook Inlet OCS region and providing updated baseline information to support NEPA analysis. This project provides an opportunity for BOEM to partner with the Gulf Watch Alaska (GWA) program, leveraging funding from *Exxon Valdez* Oil Spill Trustees Council.

Background: Nearshore habitats such as rocky intertidal systems are common throughout Cook Inlet and provide many essential ecosystem functions, such as high productivity, high diversity, feeding grounds, and nursery habitats. These systems are also particularly prone to disturbances from natural and anthropogenic sources that can disrupt healthy communities and food webs. For example, loss of macroalgal foundation species with the recent heatwave, and the spread of sea star wasting syndrome has led to dramatic changes in rocky intertidal community composition. Better understanding of possible bottlenecks to the recovery potential of these systems from larval recruitment will help to determine the long-term resilience of these systems and inform decision-making. Building on a rich dataset of meroplankton (benthic invertebrate larvae) and rocky intertidal community composition as well as environmental conditions from ongoing GWA monitoring, patterns can be seen of linkages between the pelagic and the benthic system. However, taxonomic identification of meroplankton based on morphology can only be done on a coarse level (e.g., bivalves, echinoderms). Supplemental analyses using molecular techniques are needed to specifically link abundance in key intertidal species (e.g., mussels, sea stars) to meroplankton availability. Furthermore, we need to evaluate similarities in synchrony and drivers of community composition between Kachemak Bay and the broader lower Cook Inlet to refine and prioritize future study plans.

Objectives:

- Characterize the seasonal progression in meroplankton species composition
- Evaluate spatial meroplankton differences across the estuarine-to-shelf oceanographic gradient in Cook Inlet
- Examine interannual variability both in species composition and seasonal timing of peak abundances of key meroplankton
- Link key meroplankton taxa identified to species level using molecular techniques to patterns in rocky intertidal communities.

Methods: Existing data since 2012 on seasonal meroplankton composition from the GWA Environmental Drivers work will be analyzed in the context of simultaneously collected physical oceanographic data (temperature, salinity). This information will guide new collections of meroplankton during the proposed study for DNA-metabarcoding so that species-level information can be obtained for taxa that cannot be identified at sufficient level using morphological criteria (esp. bivalves and echinoderms). Metabarcoding will target several key taxa as well as composite samples (eDNA) using gene primers for invertebrates (CO1 and16S) followed by high-throughput sequencing. Bioinformatics using the National Center for Biotechnology Information (NCBI) nucleotide and Barcode of Life Data (BOLD) databases will be used to match these meroplankton sequences to known species sequences. Then, meroplankton information can be linked to nearshore community composition, including appropriate lag times

(months, year). Variability in patterns will then be evaluated in the context of environmental conditions using multivariate statistics.

Specific Research Question(s):

1. How do patterns in meroplankton based on large taxonomic groups relate to rocky intertidal community composition since 2012?
2. How does the abundance of specific meroplankton taxa (e.g., mussels, sea stars; identified from DNA barcoding) relate to the abundance of these taxa in rocky intertidal communities?
3. How do temporal patterns and drivers compare between Kachemak Bay and lower Cook Inlet?

Current Status: N/A

Publications Completed: N/A

Affiliated WWW Sites: https://gulfwatchalaska.org/monitoring/