Environmental Studies Program: Ongoing Study

Title	Lower Cook Inlet Fish and Invertebrate Community Composition, Distribution, and Density (AK-22-01)
Administered by	Alaska Regional Office
BOEM Contact(s)	Sean Burril (sean.burril@boem.gov)
Procurement Type(s)	Interagency Agreement
Conducting Organization(s)	United States Geological Survey (USGS)
Total BOEM Cost	$1,199,986 (plus in-kind support)
Performance Period	FY 2022–2027
Final Report Due	September 2027
Date Revised	September 22, 2022
PICOC Summary	
Problem	Recent observations document large-scale changes to some components of the lower Cook Inlet marine ecosystem. Evidence indicates a warming climate as a driving variable of these changes. Data on the fish and invertebrates of Cook Inlet is limited and much of it is dated, which limits our understanding of the current community structure and our ability to assess if any large-scale shifts have occurred. This information is necessary to analyze what effects resource development activities might have on these communities.
Intervention	This study will conduct systematic and comprehensive research to collect benchmark data on the fish and invertebrate community composition, distribution, relative abundance, diet, and energy density, as well as physical variables in the lower Cook Inlet region.
Comparison	This data will provide context for understanding the driving forces influencing changes to the current ecosystem.
Outcome	Products will include a current description of the fish and invertebrate community structure and distribution in lower Cook Inlet integrated with existing fish and mammal databases. A future monitoring plan will provide the tools and resolution needed to track future changes to these resources.
Context	Cook Inlet Region

BOEM Information Need(s): BOEM needs to know what the current fish and invertebrate community composition is for lower Cook Inlet and to better understand how the natural environment drives variation of these community structures. A better understanding of how the natural environment influences the level of variation in these communities will allow BOEM to develop better tools to accurately assess potential effects from resource development activities. Information from this study will inform NEPA analyses, Essential Fish Habitat (EFH) Assessments, Endangered Species Act (ESA)

consultations, and Oil Spill Risk Analysis (OSRA) and bring BOEM one step closer towards developing an ecosystem-based model to help guide future management of Cook Inlet resource and development activities.

Background: To differentiate environmental changes and anthropogenic effects on marine populations, we must have a good understanding of the current marine ecosystem, how trophic levels interact, and how physical factors and oceanography influence biota. In the 1970s, the coastal ecosystem of the Gulf of Alaska and lower Cook Inlet shifted from a community dominated largely by crustaceans to one dominated by fish (Anderson, 2000; Anderson and Piatt, 1999; Ware, 1995). It is difficult to predict what the fish and invertebrate communities will look like in the future, but changes in the lower trophic community due to regime shifts are likely to echo throughout the food web (Hare and Mantua, 2000). In Cook Inlet, sea bird die-offs have been linked to depressions in forage fish communities (Piatt et al. 2020; AK-20-10). These forage fish provide food for other fish, and those community interactions haven't been studied in depth. Potential changes in groundfish community structure will have echoing effects on commercial, subsistence, and recreational fishing in the area. Documenting these changes will help BOEM to adequately analyze effects of potential resource development activities for NEPA analyses and EFH consultations. By examining the fish and invertebrate communities of Cook Inlet, we will grow our understanding of the region and increase the accuracy of our regulatory analyses.

Objectives:

- Establish new benchmark descriptions for fish and invertebrates in Cook Inlet by assessing current composition, distribution, relative abundance, and energy density, as well as the current diet of fish
- Identify indicators and drivers of community shifts and assess seasonal and interannual changes in zooplankton, invertebrate, and fish distribution, relative abundance and diet data
- Develop a database to support a multi-species or full ecosystem model
- Provide recommendations for a future monitoring plan

Methods: This project will take a stepwise approach to addressing the objectives.

1. *Establish New Benchmark Descriptions for Fish and Invertebrates*: A systematic survey design with a sampling grid covering lower Cook Inlet will be developed. The design will include the sampling approaches necessary to describe the benthic and pelagic fish and invertebrate communities. Sampling will occur interannually and cover a temporal scale consisting of spring, summer/fall, and winter. For all fish and invertebrates captured, researchers will record the species composition, distribution, and relative abundance. The diet and energy density will also be determined for all fish species captured. Some invertebrates, such as shrimp, squid, and krill may also be analyzed for energy density and histology. At all sampling stations CTD casts and plankton sampling will occur.
2. *Identify Indicators/Drivers of Community of Shift*: Using data collected from this study and by compiling existing relevant biological, physical and, oceanographic datasets, assess seasonal and interannual changes to the fish, invertebrate, and zooplankton communities as well as the physical and oceanographic factors correlated with those changes.

3. *Database Development*: Develop a database structure to support a multispecies or full ecosystem model for Cook Inlet.
4. *Provide Recommendations for a Future Monitoring Plan*: Develop an ecosystem-based model for predicting future changes to the fish and lower trophic communities. Using results from this study, provide a recommended monitoring plan that will provide the resolution needed to detect future regime shifts to the fish and lower trophic communities of lower Cook Inlet.

Specific Research Question(s):

1. What is the current fish and invertebrate community structure of lower Cook Inlet?
2. How can we better assess environmental variation on the fish and invertebrate communities of lower Cook Inlet?
3. How can we better understand ecosystem change resulting from a regime shift?
4. How can we better predict future changes to the lower Cook Inlet ecosystem using oceanographic and biological monitoring data?

Current Status: Awarded

Publications Completed: None

Affiliated WWW Sites: http://www.boem.gov/akstudies/

References:

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