Environmental Studies Program: Ongoing Study

Title	Monitoring the Recovery of Seabirds and Forage Fish Following a Major Ecosystem Disruption in Lower Cook Inlet (LCI) (AK-20-10)
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Conducting Organizations(s)	USGS
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PICOC Summary	
Problem	Monitoring of forage fish and seabird populations during and following the North Pacific marine heat wave indicates the Gulf of Alaska (GOA) marine ecosystem is undergoing dramatic changes, including massive seabird die-offs, breeding failures, low at-sea density, and depleted prey resources.
Intervention	Continued monitoring of seabird and forage fish populations at sea including using emerging technology such as Unmanned Aircraft Systems (UAS) is important to understanding the natural variability of the ecosystem and determine the status of resources in areas of oil and gas development.
Comparison	Data will be compared to the same measures collected in previous years.
Outcome	This study will inform resource assessments and facilitate an understanding of ecosystem resilience to development.
Context	Lower Cook Inlet

BOEM Information Need(s): Monitoring of seabird populations and forage fish stocks in potential oil and gas lease areas is important to mitigate impacts of development and to assess the impact of potential oil spills and environmental change. Results from this study will support National Environmental Policy Act (NEPA) analyses for future oil and gas-related activities in Cook Inlet. The study will be especially useful for cumulative effects evaluation in the context of recent seabird die-offs in the GOA.

Background: The USGS has been monitoring seabirds and forage fish in LCI intermittently since 1995 (1995–2001, 2016–2018). Recently, a prolonged marine heat wave caused a major disruption in the GOA marine ecosystem. In 2015–2016, hundreds of thousands of common murres died from starvation, and seabirds failed to produce offspring at multiple colonies in the GOA, including several in LCI. Despite a return to normal water temperatures in 2017–2018 from the extremely high temperatures realized in 2014–2016, food webs still had not recovered in LCI by 2018. Forage fish were patchier and depleted, and densities of seabirds at sea were the lowest ever documented. Common murres failed to produce any young for at least the third year in a row, population counts at colonies remain well below historic

levels, and emaciated murres were commonly observed at colonies—a heretofore unknown phenomenon. Predator disturbances at colonies were also unusually frequent. To date, there are no obvious explanations for all these aberrant observations, but their occurrence makes clear the need to monitor recovery (or failure) of these populations with greater precision to facilitate a better understanding of the mechanisms of change.

Traditional survey methods often include the visual census of marine birds and mammals on transects at sea, co-spatial trawl and hydroacoustic surveys of forage fish, aerial assessments of fish schools, and concurrent measurements of seabird population trends and breeding biology at nearby colonies (Piatt 2002). However, vessel-based survey methods for assessing seabirds and forage fish are costly and time consuming. Advances in seabird and forage fish survey methods using innovative technology such as UAS may provide cost-efficient, precise, and accurate indices of population abundance compared to traditional vessel-based surveys. Incorporating UAS capabilities into existing sampling methods will enable BOEM to leverage ongoing studies through increased data collection, while allowing for comparisons of efficiency and cost with traditional methods.

Objectives: The objectives of this study are to:

- Assess seabird and forage fish status, trends, and ecology in LCI.
- Develop UAS survey protocols to monitor seabird and forage fish populations in LCI.

Methods: Researchers will follow protocols for monitoring forage fish and seabirds in LCI developed during the 1995–2001 colony surveys for BOEM, including at-sea surveys for forage fish (hydroacoustics, trawling, seining and associated oceanographic measurements) and concurrent measurements of seabird breeding biology (egg and chick production, chick growth, population status and trends) and foraging behavior (diets, feeding rates, foraging time). At-sea work will be conducted along fixed transects within 50 km of two colonies, Gull Island and Chisik Island.

Researchers will develop UAS protocols for monitoring seabirds and forage fish in offshore areas of LCI and Kachemak Bay. UAS data collection will be tested for efficiency, safety, and comparability to ongoing vessel-based work. For at-sea seabird density estimates from UAS, various transect widths and viewing angles will be tested with the purpose of maximizing sampling efficiency. Concurrent sampling of Black-legged Kittiwake and Common Murre colonies with still photography and a UAS will allow a direct comparison of accuracy and precision between the two methods.

Automated techniques and the latest imagery software will be used to classify fish school characteristics (shape, color, size, *etc.*), which will help to reduce observer bias and uncertainty in species composition and school size estimates as compared to earlier techniques. Innovative digital image processing techniques, such as “fluid-lensing” to provide clearer images under the water surface, will also be evaluated.

Specific Research Question(s):

1. What analyses are best for contrasting the functional responses of seabirds to prey fluctuations and changes in the environment within and between decades?
2. What sources will be used to quantify natural variability to evaluate possible future trends to distinguish these from potential direct human impacts of OCS oil and gas exploration and development or oil spills in Cook Inlet?

3. What tests will be used to identify the utility of UAS surveys to provide at-sea and colony-based census data for seabirds to augment and/or replace traditional protocols in the future?
4. How will imagery be collected using a UAS in conjunction with traditional fisheries sampling methods to assess the ability of UASs to provide species identification, count forage fish schools, and quantitatively measure fish school surface areas?

Current Status: Ongoing, fieldwork underway

Publications Completed: None

Affiliated WWW Sites:

http://www.boem.gov/akstudies/

https://marinecadastre.gov/espis/#/search/study/100275

References:

Piatt JF (Ed.) (2002) Response of Seabirds to Fluctuations in Forage Fish Density. Final Report to *Exxon Valdez* Oil Spill Trustee Council and Minerals Management Service. U.S. Geological Survey, Anchorage, AK. 406 pp.