

Environmental Studies Program: Ongoing Studies

Region: Alaska

Planning Area(s): Beaufort Sea, Chukchi Sea

Title: Fate and Persistence of Oil Spill Response Chemicals in Arctic Seawater (AK-13-03-13)

BOEM Information Need(s) to be Addressed: This study will provide information regarding the fate and effects of oil spills, and of oil spill response methods, on the arctic marine environment. Timely information regarding the fate, persistence, biodegradation, and effects of chemical dispersants (e.g. Corexit 9500) in the arctic marine environment will be valuable to regulators, industry, stakeholders, the scientific community, and the public. BOEM analysts and decision-makers can use this information in NEPA analysis and documentation for potential future lease sales, EPs and DPPs.

Total BOEM Cost: \$216,290
plus Joint Funding (\$211,289)

Period of Performance: FY 2015-2018

Conducting Organization: CMI, UAF

Principal Investigator(s): Dr. Mary Beth Leigh

BOEM Contact: [Rick Raymond](#)

Description:

Background: In the event of an oil spill in the arctic marine environment, the use of chemical dispersants is one potential option for oil spill response. Upon regulatory approval, Corexit 9500 will likely be the principal stockpiled chemical dispersant for application to an oil spill in the Arctic. Before the risks of dispersant use can be fully assessed, there is a critical need to determine the fate and persistence of the chemical components of dispersants in the marine environment. This study will quantify biodegradation rates of the chemical dispersant (Corexit 9500) under laboratory conditions using arctic seawater collected under different seasonal conditions. Collected open and ice-covered seawater will be used to determine how the presence of crude oil alongside dispersants affects the biodegradation of both dispersants and oil. Using advanced molecular tools, microbe activity will be identified in dispersant biodegradation in arctic seawater. Shifts in the microbial community in response to dispersants will be examined and potential effects on microbially-mediated ecological processes will be evaluated. Novel, timely and urgently needed protocols for evaluating the fate of dispersants, as well as oil, in the arctic marine environment and their potential effects on ecological function will be developed.

Objectives:

- Quantify the fate and persistence of the chemical dispersant, Corexit 9500, including its individual chemical constituents, in arctic seawater

- Compare rates of dispersant biodegradation under summer vs. winter conditions
- Determine if dispersant biodegradation is slowed or accelerated by the presence of crude oil
- Assess the effects of dispersants on crude oil biodegradation rates
- Identify microorganisms important to biodegradation of dispersant chemical components in arctic seawater
- Evaluate shifts in microbial communities in response to dispersants in the context of potential changes in ecological function

Methods: This study will apply established laboratory incubation protocols for assessing the biodegradation of dispersants in fresh arctic seawater (including incubations with and without crude oil present), using replicate 1-L incubation vessels temperature controlled cold room held at relevant temperatures determined at the time of seawater sampling. Open water season seawater samples (Aug-Sept) will be collected from the Chukchi Sea and transported by air to UAF for laboratory studies. Summer and winter (under-ice) seawater will be collected from ~1km offshore of Barrow, Alaska. Three incubation series will be conducted and analyzed:

1. Summer 2014 offshore seawater + Corexit (already completed and samples in storage)
2. Winter 2015 under-ice seawater + Corexit
3. Summer 2015 seawater with Corexit +/- ANS crude oil

Replicate incubations will be harvested over a time course for comprehensive dispersant and petroleum chemical analyses (when oil is present). A series of sterile control incubations will be run in parallel to quantify abiotic losses. The chemical components of Corexit 9500 require advanced analytical methods (LC-MS-MS), and will be quantified using methods already optimized in a laboratory setting. Petroleum biodegradation (in oil incubations) will be assessed using extraction and GC-MS analyses in the UAF IAB Core Laboratory. Additional replicate microcosms will be filtered to collect microbial cells for DNA extraction and molecular biological analyses of microbial communities.

Current Status: Completed

Final Report Due: September 2018

Publications Completed:

Leigh, M.B., K. McFarlin, T. Gofstein, M. Perkins and J. Field. 2018. Fate and Persistence of Oil Spill Response Chemicals in Arctic Seawater. Final Report, OCS Study BOEM 2018-036, University of Alaska Coastal Marine Institute and USDO, BOEM Alaska OCS Region.

Affiliated WWW Sites: <http://www.boem.gov/akstudies/>
<http://www.cfos.uaf.edu/cmi/>
<https://marinecadastre.gov/espis/#/search/study/100129>

Revised Date: February 4, 2019