

BOEM ENVIRONMENTAL STUDIES PROGRAM: Ongoing Studies

Region: Alaska

Planning Area(s): Beaufort Sea, Chukchi Sea

Title: Arctic Cod Pilot Genetics and Toxicity Study (AK-11-13a)

BOEM Information Need(s) to be Addressed: A major element of NEPA analyses in the Alaska OCS program is the assessment of effects of accidental releases of oil and gas in arctic waters and on arctic species. A greater understanding of the keystone species Arctic cod is necessary to fully assess the potential effects of offshore development in arctic waters. Arctic cod plays a critical ecological role as key prey species and the primary pathway through which lower trophic production gets funneled to marine mammals, birds and fish. Thus, Arctic cod dynamics are important to EFH- and ESA-related NEPA analyses. In order to assess effects from potential oil and gas development on Arctic cod and the cumulative effects from climate change, it is important to understand the ability of Arctic cod to survive and adapt as the ice retreats. Understanding how Arctic cod are affected by oil and dispersants under arctic conditions will support both impact assessments and development of oil spill response and monitoring protocols. This study addresses aspects of USGS study recommendations 5.15 and 5.17.

Total Cost: \$30,000

Period of Performance: FY 2011-2013

Conducting Organization: USGS-BRD

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Description:

Background: Arctic cod is a key species in Arctic food webs and occupies nearly all depths during its life cycle. Whether Arctic cod is likely to be driven to extinction as the arctic ice retreats is a subject of discussion in scientific circles. Genetics can shed light on whether Arctic cod (*Boreogadus saida*) are truly ice dependent or whether there is potential to adapt to retreating ice through differential expression of existing genes.

The genetics and toxicity testing feasibility analysis will benefit from close association with an ongoing BOEM study and an ongoing international Joint Industry Program (JIP) Arctic species toxicity study. The pilot genetics study has ties to the ongoing Central Beaufort Fish Survey under ice and open water survey (AK-10-09). Opportunistic samples from an international Chukchi Sea fish survey in September 2010 have been committed for the pilot BOEM genetic survey. The genetic study also has ties to an ongoing Canadian Department of Fisheries and Oceans (DFO) Arctic cod genetic study to assess genetic differentiation of the Arctic cod population and provide international collaboration.

A workshop held in Anchorage in March 2008 facilitated the discussion of the effects of dispersed oil on two Arctic species, Arctic Cod and a copepod (*Calanus glacialis*). The workshop was followed by fieldwork in 2009 and 2010. The results of the JIP study of toxicity

to Arctic species at surface pressures could parlay into an assessment of what broader research may prove beneficial in terms of assessing effects at depth.

The effects of subsurface blowouts are receiving renewed focus following the *Deepwater Horizon* explosion and subsequent oil and gas release in the Gulf of Mexico. Although the question of subsurface oil, gas and dispersant behavior in the Gulf of Mexico is currently on the forefront, these same questions need to be addressed separately and proactively under conditions unique to the U.S. Arctic. Assumptions and practices from different geographic locations may not accurately translate to the U.S. Arctic. Carefully designed toxicity laboratory research on Arctic cod at controlled temperatures, pressures (i.e. depth) and light would begin to address some of these complex questions of effects of oil, gas and dispersants on species at various depths in the Arctic. This proposed study will evaluate the feasibility of conducting such research and provide recommendations for study design and implementation.

This genetic and toxicity testing will help analysts respond to basic questions under NEPA review that address future oil and gas developments in the Arctic. Examples of the questions to be answered include: Are Arctic cod a single pan-Arctic population that exhibits varied genetic responses under different conditions or are Arctic cod a number of genetically distinct stocks that are individually at risk to offshore development? How do the oil spill effects on and the responses of Arctic cod vary in relation to a complex of different oil/gas/dispersant mixtures, different life stages, different body mass, different temperatures and different depths typical of the U.S. Arctic? How do the toxicity test results at depth compare to results of the ongoing JIP toxicity study at surface pressure?

Objectives:

- Conduct mitochondrial DNA Assessments of Chukchi and Beaufort Sea Arctic cod.
- Provide recommendations for a pan-arctic genetic stock separation and genetics study of Arctic cod.
- Assess the feasibility of conducting an Arctic cod and zooplankton toxicity study.

Methods: Conduct mitochondrial DNA profiles of Chukchi and Beaufort Sea Arctic cod samples presently held by John Nelson at the BC Canada DFO lab. Provide protocols and sampling supplies for field collection of central Beaufort Sea Arctic cod genetic samples in August 2011. Develop recommendations for a circumpolar effort to evaluate whether all or a portion of Arctic cod are ice dependent. In 2012, conduct mitochondrial DNA on Arctic cod samples collected in the 2011 central Beaufort Sea Marine Fish field survey. Final report to include recommended future directions for Arctic cod genetic research.

Conduct a feasibility analysis for an Arctic cod and zooplankton toxicity study project design based on the results of the JIP study of toxicity to Arctic species at surface pressures. Review the results of the JIP study of toxicity to Arctic species at surface pressures, Arctic Oil Dispersant Toxicity Study. Provide recommendations for design and implementation of controlled laboratory studies to test the toxicity effects of gas/oil/dispersant mixtures on Arctic cod at critical lifestages, and at a range of temperatures and depths (pressures) typical of the U.S. Arctic OCS. Search for and review facilities capable of conducting toxicity tests simulating a minimum of 50 meter depths. Provide a range of recommended options and budgets to assess

the effects on Arctic cod (and perhaps other species) of accidental subsurface release of gas/oil/dispersant mixtures at low temperatures and at pressures and oceanographic conditions typical of the U.S. Arctic OCS.

Current Status: Ongoing

Final Report Due: December 2012

Publications Completed: None

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

Revised Date: July 2012

ESPIS: Environmental Studies Program Information System

All *completed* ESP studies can be found

here: http://www.data.boem.gov/homepg/data_center/other/espis/espisfront.asp