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STUDY TITLE: Bowhead Whale Feeding Ecology Study (BOWFEST) in the Western Beaufort Sea

REPORT TITLE: Final Report of the Bowhead Whale Feeding Ecology Study

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FY2007 = $1,238,543; FY2008 = $1,549,656; FY2009 = $1,626,586; FY2010 = $1,683,837; FY2011 = $1,578,080; FY 2012 = $510,618 - CUMULATIVE PROJECT COST: $8,187,320

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KEY WORDS: bowhead whale, *Balaena mysticetus*, feeding ecology, distribution, behavior, aerial survey, line transect, oceanography, tagging, benthic sampling, krill, acoustics, Arctic, Alaska, Beaufort Sea, Chukchi Sea, Barrow

BACKGROUND: Bowhead whales (*Balaena mysticetus*) are found in Arctic waters. The stock of bowheads that migrates annually from the Bering Sea through the Chukchi Sea to the Beaufort Sea are of particular interest because these whales, currently listed as endangered under the U.S. Endangered Species Act (ESA), are hunted by Eskimos at several coastal villages along the migratory route, and the whales' migration crosses over areas of interest for petroleum extraction.

During the spring migration, bowheads typically begin arriving in the Barrow area in early April and continue migrating past Barrow until well into June. Most of this migration appears to be a fairly steady flow of whales going from the Chukchi Sea to the Beaufort Sea, but late in the spring there have

occasionally been instances of whales seen feeding. This is evidenced by frequent turns in a small area instead of steady travel in one direction. There have also been many observations of bowheads with mud on their dorsal surfaces during the spring migration, indicating that they were near the sea bottom, presumably collecting epibenthic prey. Bowheads have been reported off Barrow through July and August, and from late-September through mid-November when the fall migration is underway and bowheads leave the Beaufort Sea.

Bowhead whale feeding activity has been well documented in the eastern Beaufort Sea. There are also records of their presence during the summer in the northeastern Chukchi Sea, and feeding activity has been observed in the western Beaufort Sea near Barrow in the spring and summer, behavior which is well known to Alaska Natives of the area. What has been provided by the current study is a more systematic, scientific approach to the scale of feeding and the consistency of this behavior relative to season, year, age-class, etc., along with relevant ecological parameters, such as bathymetry, currents, temperatures, ice conditions, and prey availability. Such a study has become more critical in light of the interests of petroleum development in the area. The more knowledge there is about bowhead use of the western Beaufort Sea, the better we will be able to find ways to minimize human impacts on these whales.

Information from this study will be used by the Bureau of Ocean Energy Management (BOEM) for pre- and post-lease analysis and documentation under the National Environmental Policy Act (NEPA) for Beaufort and Chukchi Sea Lease Sales.

OBJECTIVES: The goal of this study is to facilitate development of future oil and gas development-related mitigation by estimating relationships among oceanographic conditions, bowhead whale prey, and bowhead whale feeding behavior in the western Beaufort Sea, with emphasis on identifying predictable aspects in those relationships. The BOWFEST study had five principal objectives:

1. Document patterns and variability in the timing and locations of bowhead whales feeding in the western Beaufort Sea.
2. Estimate temporal and spatial patterns of habitat use by bowhead whales in the study area.
3. Document bowhead whale prey distributions and abundance in the immediate vicinity of feeding bowhead whales as well as in neighboring areas without whales.
4. Document “fine scale” oceanographic and other relevant environmental conditions both near feeding bowhead whales and in neighboring areas without whales.
5. Characterize oceanographic features on a “coarse scale” relative to the study area.

DESCRIPTION: This study was conducted on the western Beaufort Sea over the continental shelf between approximately 152º -154º west longitudes and from the coastline out to 72º north latitude. Field operations were scheduled for mid-August through mid-September, although acoustic sampling and oceanographic moorings collected data year-round. Most field projects were conducted in 2007-2011 but some were continued in 2012. Information obtained on a broad-scale provided the generalized context in which to interpret findings on the fine-scale. That latter was studied through aerial observations and photography of bowhead groups to better document feeding behavior, timing, and location; boat approaches to sample oceanographic conditions and prey near whales and in other local areas without whales; and tagging that shows whale movement in three dimensions through the prey fields. The primary projects included:

Aerial surveys – Aerial surveys were conducted each year to document patterns in distribution, timing, and behavior of bowhead whales. Photographs taken during aerial surveys were analyzed to identify individual bowhead whales and to assess age classes of bowheads.

Passive acoustic monitoring – Acoustic monitoring occurred each year to provide information on the spatial and temporal distribution of bowhead whales in the study area.

Moorings and broad-scale oceanography – Moorings and oceanographic sampling at stations along designated transect lines occurred each year.

Tagging and fine-scale oceanography – Tagging of bowhead whales and fine scale oceanographic sampling in the proximity of whales occurred each year.

Local boat surveys – Small boat surveys have been conducted each year 2008-2012 to gather distribution data on bowhead whales prior to and during BOWFEST field projects each season.

Diet studies and digestive efficiency – Bowhead whale tissues and stomach contents were sampled yearly from whales taken during the subsistence hunt.

SIGNIFICANT CONCLUSIONS: The BOWFEST study area, northeast of Point Barrow, is characterized by complex bathymetry with shallow shelf waters bordering a deep marine canyon. The canyon provides a conduit for relatively warm water and biological matter into the Arctic Basin as well as onto the Beaufort Shelf. Further complicating the nature of the area, sea ice varies from complete coverage in the winter to partially or totally absent in the summer, and the extent has been changing inter-annually. This variety in habitat characteristics may be elemental to the rich marine fauna found in the area, and accordingly, bowhead whales exploring feeding opportunities throughout the summer. [Detailed results from this study are presented in the Final Report submitted to BOEM for this project].

STUDY PRODUCTS: A Final Report was produced, which included a summary of all data collected in 2007-2012 and analyses of data. Additional products included 5 Annual Reports, 14 oral presentations, 45 poster presentations, and 34 published papers/government reports/thesis presenting data collected during the BOWFEST study.

* P.I.'s affiliation may be different than that listed for Project Manager(s).