

ARCTIC WHALE ECOLOGY STUDY
(ARCWEST):
USE OF THE CHUKCHI SEA BY
ENDANGERED BALEEN AND
OTHER WHALES
(WESTWARD EXTENSION OF THE BOWFEST)

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Executive Summary

Through an Inter-Agency agreement (IA) between the National Marine Mammal Laboratory (NMML) and the Bureau of Ocean Energy Management (BOEM), NMML is conducting a dedicated multi-year study to determine relationships between dominant currents passing from the Bering Sea into and through the Chukchi Sea and prey resources delivered to the Barrow Arch area (an area of high bowhead whale and prey concentrations between Wainwright and Smith Bay), and to provide information about the dynamic nature of those relationships relative to whale distribution and habitat utilization in the eastern Chukchi and extreme western Beaufort Seas. This study will also provide important baseline data on the occurrence, distribution and habitat use of large whales in an area that is subject to rapid change in climate and human industrial development. This quarterly report covers the first period of this study between 25 July and 30 September 2012.

The major activity during this period consisted of purchasing equipment, deploying the first set of long-term moorings, and opportunistically tagging a gray whale during the Chukchi Sea Acoustics, Oceanography, and Zooplankton (CHAOZ) cruise on 25 August, 2012. The CHAOZ cruise took place from 8 August through 7 September on the chartered research vessel R/V *Aquila*. Seventeen scientists, technicians, and observers from eight different laboratories and institutions participated on the CHAOZ cruise.

Introduction and objectives

The western Arctic physical climate is rapidly changing. The summer minimum sea ice extent in 2007 and 2008 covered an area which was 37% less than that of two decades ago. Summer minimum ice extent essentially tied 2007 with lowest ice extent recorded. The speed of these changes was unexpected, as the consensus of the climate research community just a few years ago was that such changes would not be seen for another thirty years. As sea temperature, oceanographic currents, and prey availability are altered by climate change, parallel changes in baleen whale species composition, abundance and distribution are expected (and evidenced already by local knowledge and opportunistic sightings). In addition, the observed northward retreat of the minimum extent of summer sea ice has the potential to create opportunities for the expansion of oil and gas-related exploration and development into previously closed seasons and localities in the Alaskan Arctic. It will also open maritime transportation lanes across the Arctic adding (to a potentially dramatic degree) to the ambient noise in the environment. This combination of increasing anthropogenic impacts, coupled with the steadily increasing abundance and related seasonal range expansion by bowhead (*Balaena mysticetus*), gray (*Eschrichtius robustus*), humpback (*Megaptera novaeangliae*) and fin whales (*Balaenoptera physalus*), mandates that more complete information on the year-round presence of large whales is needed in the Chukchi Sea planning area. Timing and location of whale migrations may play an important role in assessing where, when or how exploration or access to petroleum reserves may be conducted, to mitigate or minimize the impact on protected species.

The ARCWEST study has five component projects: visual observation, satellite tagging, passive acoustics, lower trophic level sampling, and physical oceanographic sampling. Each component project is a technical discipline and is coordinated by a Project Leader with extensive experience in that discipline. Visual surveys, along with sonobuoy deployments, will provide distributional data on baleen whales and other marine mammals. Satellite tagging will provide valuable information on both large- and fine-scale movements and habitat use of baleen whales. Passive acoustic moorings will provide year-round

assessments of the seasonal occurrence of baleen whales. Concurrently deployed bio-physical moorings offer the potential of correlating whale distribution with biological and physical oceanographic conditions and indices of potential prey density. Satellite-tracked drifters will examine potential pathways to the areas of high biological importance. Our goal is to use these tools to understand the mechanisms responsible for the high biological activity so that we can predict, in a qualitative way, the effects of climate change on these preferred habitats.

The overall goal of this multi-year IA is to use passive acoustic recorder deployments, visual and passive acoustic surveys, and satellite tagging to explore the distribution and movements of baleen whales in the Bering and Chukchi Seas, particularly the Chukchi Sea planning areas. In addition, oceanographic and lower trophic level sampling and moorings will be used to explore the relationships between currents passing through the Bering Strait and resources delivered to the Barrow Arch area, and the dynamic nature of those relationships relative to whale distribution and habitat utilization in the eastern Chukchi and extreme western Beaufort Seas.

The specific objectives are:

1. Assess patterns of spatial and temporal use of the Chukchi Sea by endangered bowhead, fin and humpback whales, and beluga and gray whales.
2. Assess the population structure and origin of whales in the region.
3. Evaluate ecological relationships for the species, including physical and biological oceanography that affect critical habitat for these species.
4. Conduct physical and biological oceanographic sampling to further understand the transport and advection of krill and nutrients from the northern Bering Sea through the Bering Strait and to the Barrow Arch area.

Cruise activities and summary

Please see the 2012 CHAOZ cruise report (Appendix A) for a full summary of activities and progress made during the cruise.

Post-cruise data analysis results and planning

Visual Observations Component:

Sightings made during the CHAOZ survey are detailed in the 2012 CHAOZ cruise report (Appendix A).

Satellite Tagging Component:

Satellite telemetry was conducted on an opportunistic basis at the discretion of the chief scientist, taking weather, time of day, and oceanographic operations planning into consideration. Satellite tagging operations were conducted following the protocols approved under permit #14245 issued by the NMFS to the National Marine Mammal Laboratory and are detailed in the CHAOZ cruise report (Appendix A). One gray whale was tagged during the CHAOZ survey, 16 miles offshore from Wainwright,

Alaska, on 25 August. The whale was judged to be a juvenile based on size. This whale transmitted for 48 days until 11 October 2012 (Fig. 1). The animal remained within 25nm of the deployment site for the duration of the tag and occupied relatively shallow waters (20-50m in depth) to the south of Hanna Shoal. Given that there were several animals in the area during deployment and many visible mud plumes, it is highly likely that this whale has been feeding in a particularly dense prey patch.



Fig 1: August and September locations (red dots) of a gray whale satellite tagged off Wainwright, AK during the CHAOZ 2012 survey. The yellow star marks the tagging location of this individual (70.8N, 160.5W).

Passive Acoustic Component:

NMML Long-term moorings:

All long-term passive acoustic recorders deployed as part of the CHAOZ and BOWFEST in 2011 have been retrieved and redeployed as ARCWEST moorings (Fig. 2). Analysis of the 2011-2012 data sets will be completed under the CHAOZ and BOWFEST projects.

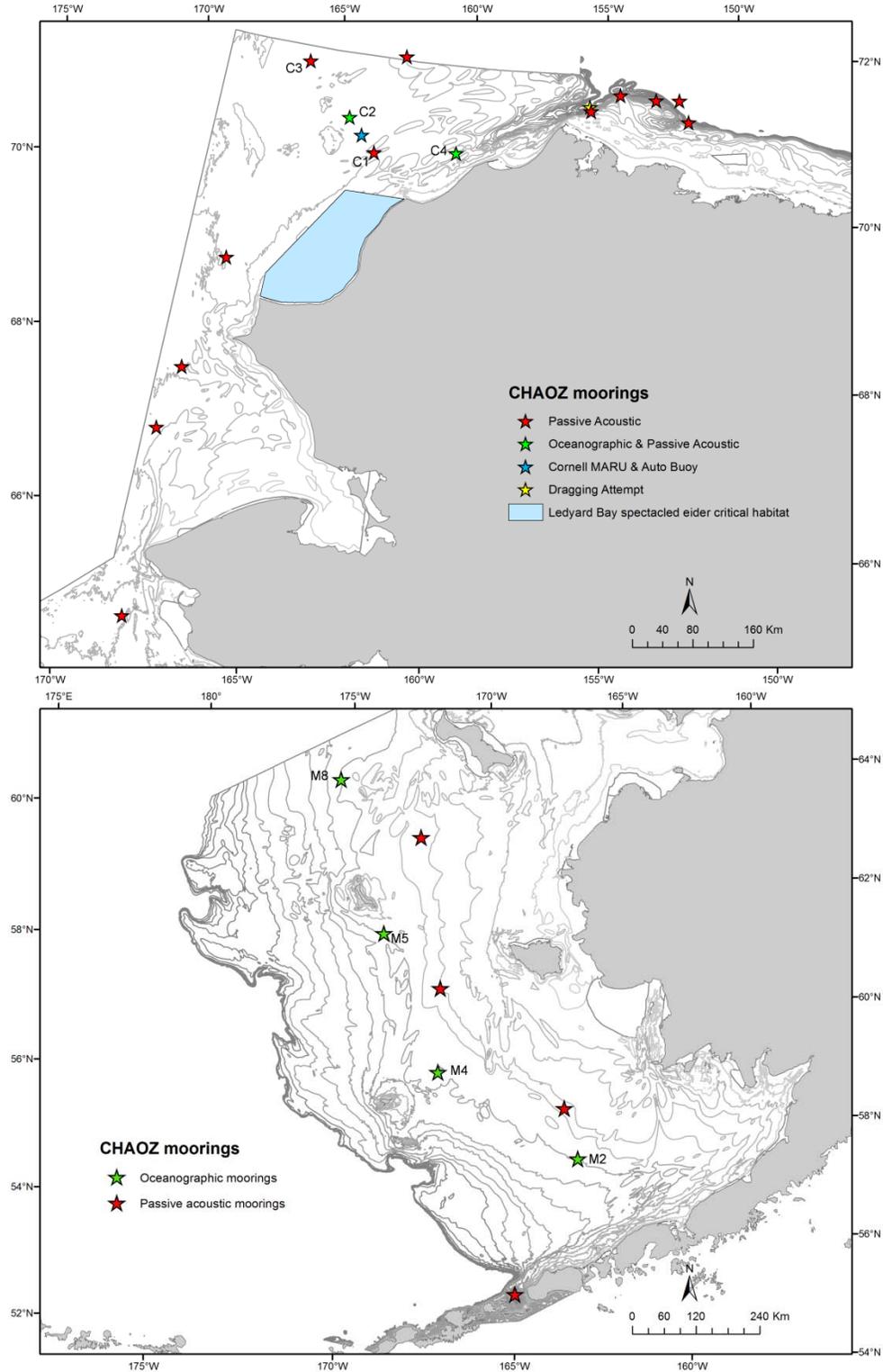


Figure 2. Passive acoustic and oceanographic moorings deployed in the Chukchi and Beaufort Seas (upper panel) and in the Bering Sea (lower panel). 2011 and 2012 NOAA oceanographic moorings are labeled.

Sonobuoys:

Sonobuoys were used during the CHAOZ survey to acoustically monitor for whales. Acoustic detections made during the CHAOZ survey are detailed in the 2012 CHAOZ cruise report (Appendix A).

Oceanographic and Lower Trophic Level Component:*Moorings:*

All CHAOZ moorings deployed in 2011 were successfully retrieved (C1, C2, and C3), as well as the retrieval and redeployment of the Bering Sea oceanographic moorings (M2, M4, M5, and M8). Two clusters of moorings were deployed for ARCWEST (Fig. 2); site C2 (midway along the Icy Cape Line) is a redeployment to continue the time series begun during CHAOZ and site C4 is a new deployment, just west of the Wainwright Line. Site C4 is along the axis of Barrow Canyon and was placed at that location to determine when and how often the flow up the canyon reaches the shelf. Each cluster consisted of an "ice mooring" containing an ASL upward-looking ice profiler and an RCM9 current meter (which also measures temperature and oxygen, and either salinity or turbidity), and a "Bio mooring" containing a 600 KHz RDI ADCP, and a linked set of instruments (a Seacat, an eco-fluorometer, a PAR sensor, and an ISUS nitrate meter), and an upward looking TAPS-6NG (Tracor Acoustic Profiling System Next Generation) instrument to measure zooplankton bio-volume and size distribution. These moorings collect various oceanographic measurements for a full year. Analysis of the 2011-2012 data is part of CHAOZ.

Satellite Tracked Drifters:

At eight locations in the northern Bering and Chukchi Seas, ARGOS drifters were deployed off the stern of the ship (Fig. 3). These free-floating instruments were drogued at 30 m and drift along with the currents; their location is determined via satellite. The first drifter was deployed in the northern Bering Sea, near the site of the M8 oceanographic mooring. The remaining seven were deployed in the Chukchi Sea: one in the Bering Strait, one southwest of Point Hope, one northwest of Cape Lisburne, and four off Icy Cape. These drifters will look at the advection of water from the Bering into the Chukchi Sea. The farthest offshore drifter was deployed near Hanna Shoal to examine the circulation around this bathymetric feature. A movie of the drifters can found at <http://www.pmel.noaa.gov/foci/visualizations/drifter/chuk2012.html>. The first month of movie shows trajectory of drifters deployed last year and were caught in the ice. The length of "tail" of each drifter is five days.

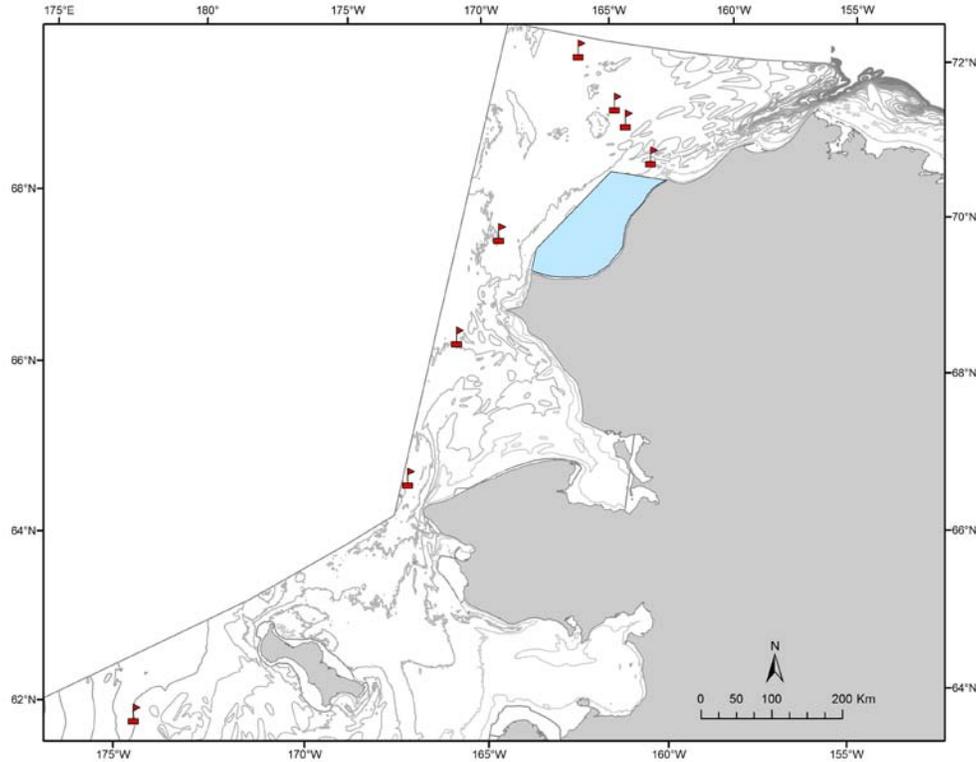


Figure 3. Deployment location of ARGOS drifters (red flags).

Active Acoustics:

Newly constructed TAPS-6NG instruments were deployed at both C2 and C4 (one each) (Fig. 2). A Purchase Order was issued to obtain 5 additional sets of transducers to begin to build the next set of instruments. In addition, Purchase Orders were successfully awarded to attempt to improve the controller board for the TAPS-6NG. We anticipate that the new design will use much less power than the present board and will provide enough data storage capacity to store the returns from each ping rather than ensembles as we presently do.

Lower Trophic Level Sample and Data Analyses:

No lower trophic level sampling or data analyses occurred as part of ARCWEST this year.

Physical/Chemical Oceanographic Sampling:

No physical/chemical oceanographic sampling occurred as part of ARCWEST this year.

Significant technical, schedule, or cost problems encountered

None

Significant meetings held or other contacts made

None

Presentations and Publications

None