

Bringing CHAOZ to the Arctic

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Abstract

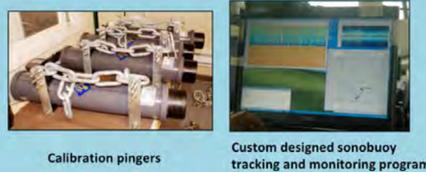
The physical climate of the Pacific Arctic is rapidly changing. Recent extremes in the minimum extent of summer sea ice has created opportunities for the expansion of oil and gas-related exploration and development in the Chukchi and Beaufort seas. This combination of increasing anthropogenic impacts coupled with the steadily increasing abundance and related seasonal range expansion of bowhead, gray, humpback, and fin whales, predicated the need for current information on the year-round presence of large whales, especially in the Chukchi Sea planning area. In 2010, the NOAA Alaska Fisheries Science Center (AFSC) and the Pacific Marine Environmental Laboratory (PMEL) entered into a multi-year Inter-Agency agreement with the Bureau of Ocean Energy Management, Regulation, and Enforcement (BOEMRE/MMS) to document the distribution and relative abundance of whales in areas of potential oil and gas exploration and to relate changes in those variables to oceanographic conditions, indices of potential prey density, and level of anthropogenic activities. The first CHAOZ (CHukchi Acoustic, Oceanographic, and Zooplankton) cruise was conducted on board the F/V *Alaskan Enterprise* from 24 Aug-20 Sep, 2010. A total of 15 passive acoustic and 7 biophysical moorings were deployed in three arrays off Icy Cape. In addition, 50 hydrographic and zooplankton stations were conducted along five transect lines (Point Hope, Cape Lisburne, Point Lay, Icy Cape, and Wainwright) and in the Bering Strait. Over 1,750 miles were surveyed by visual (marine mammal and bird) observers and monitored by passive acoustic technicians, via sonobuoy deployments every three hours.

Passive acoustic component

- 3 arrays of long-term passive acoustic AURAL recorders (Autonomous Underwater Recorder for Acoustic Listening, Multi-Électronique Inc.)
- 5 recorders per array to reduce localization errors
- Sampling rate of 16 kHz; duty cycle of 1.5 h on every 5 h (recording period advances by 1 h each day)

AURAL recorder (left) and mooring (right)

- Pingers placed on 4 moorings of each array to provide calibration signals
- Sonobuoy deployments every 3 h during cruise



Calibration pingers

Custom designed sonobuoy tracking and monitoring program

See poster by Crance et al.

Oceanographic component

3 biophysical mooring clusters deployed in center of passive acoustic arrays:

- Ice mooring: ASL ice profiler (measures ice thickness), current meter (RCM9) with oxygen sensor
- Biophysical mooring: Upward looking 600 kHz ADCP (RDI), SeaCAT, eco-fluorometer, PAR sensor, ISUS nitrate meter



Ice mooring



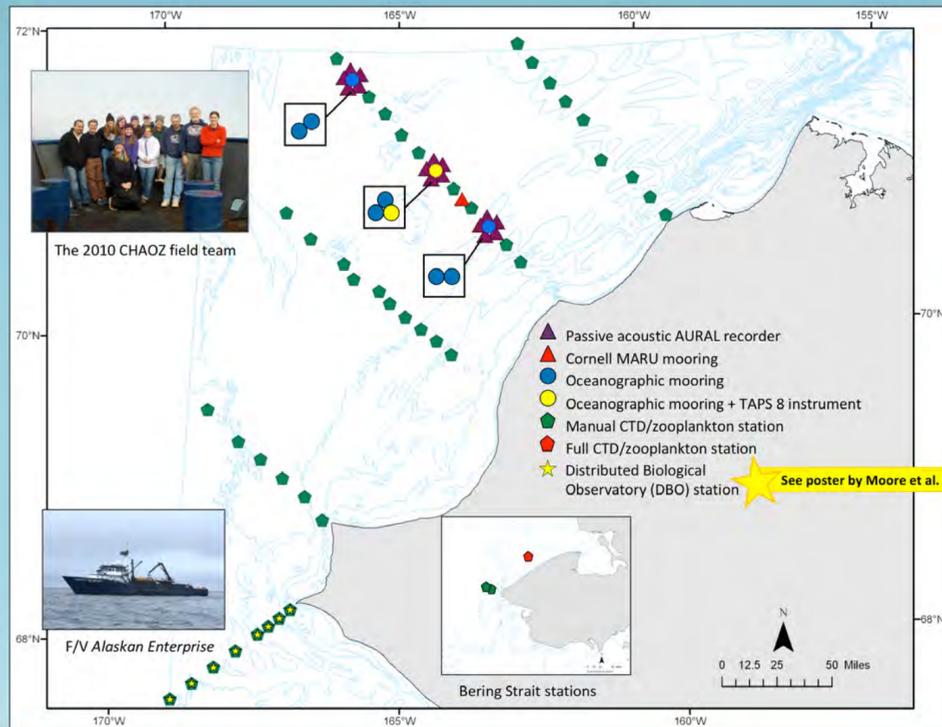
CTD (left) and manual deployment of Niskin bottles (right)

- TAPS (Tracor Acoustic Profiling System) instrument on middle cluster to measure zooplankton bio-volume and size distribution

Oceanographic sampling stations:

- Initially, high-resolution vertical profiles of water properties collected using a Seabird 911Plus CTD
- After winch failure, full water column CTD (SeaBird, SBE 19plus) and manual deployment of 3 Niskin bottles (1, 15, and 25 m) for nutrients and chlorophyll

See poster by Napp and Stabeno



The 2010 CHAOZ field team

F/V *Alaskan Enterprise*

Bering Strait stations

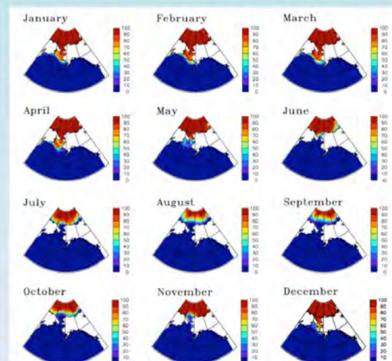
- ▲ Passive acoustic AURAL recorder
- ▲ Cornell MARU mooring
- Oceanographic mooring
- Oceanographic mooring + TAPS 8 instrument
- Manual CTD/zooplankton station
- Full CTD/zooplankton station
- ★ Distributed Biological Observatory (DBO) station

See poster by Moore et al.

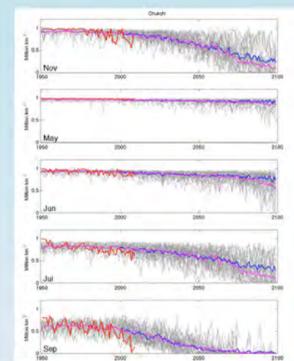
Climate Modeling component

See poster by Wang et al.

- Run the National Center for Atmospheric Research (NCAR) climate model (Community Climate System Model: CCSM) for future projections using the sea ice extents from 2007/2008 as initial conditions
- Analyze multiple ensemble members from the NCAR model and other IPCC models to assess the future variability of sea ice cover and extended sea ice free seasons during fall for the Chukchi Sea



Decadal mean sea ice concentration over Chukchi and Bering Sea for each month based on Hadley Sea ice analysis



Simulated sea ice extent by the climate models in the last part of 20th century and the 21st century (each grey - one model realization, thick blue - ensemble mean based on A1B emission scenario, magenta - ensemble mean based on A2 emissions scenario, thick red - based on Hadley sea ice analysis)

Zooplankton component

See poster by Napp and Stabeno



Tucker sled being deployed (left) and preparing for deployment with SeaCAT on top of frame (above)

- Samples for mesozooplankton and micronekton collected with a 1m² Tucker Sled with 0.333mm mesh
- Primary net had a 25cm diameter Clarke-Bumpus net frame inside (0.150mm mesh) to capture small zooplankton
- A TAPS-6 was mounted on top of the Tucker Sled to detect the biovolume and size of zooplankton in front of the net mouth
- TAPS-8 instrument deployed in center of middle passive acoustic array (see Oceanographic section for more details)



Lisa DeForest preserving samples

Visual Observations

See poster by Crance et al.



Observer using 'Big-Eyes'

- 1478 miles surveyed
- 25x 'Big-Eyes' binoculars with reticles used
- Rotating team of 3 marine mammal observers worked from 9am-9pm while vessel was underway

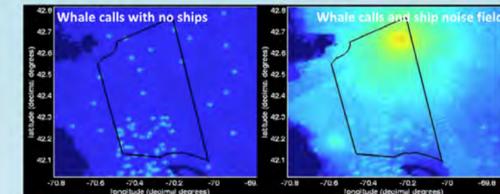


Walrus off Icy Cape

- 139 sightings (173 individuals) of 12 confirmed marine mammal species; (bowhead, fin, humpback, gray, and minke whales, Dall's and harbor porpoise, walrus, bearded, ringed, spotted and fur seals)
- 96 sightings (128 individuals) of unidentified large and small whales, porpoise, and pinnipeds
- 1 bird observer onboard from US Fish and Wildlife (see Kathy Kuletz for details)

Noise modeling/ Auto-detection buoy

- Bioacoustics Research Program/Cornell University
- Develop and apply method to quantify the contributions of anthropogenic sounds from industrial activities
- Assess cumulative effects of these sounds on the acoustic habitats of arctic marine mammals



Example of spatial noise field distributions (71-224 Hz, RMS re 1 µPa) during two 10-minute samples for calling North Atlantic right whales without ships (left) and calling North Atlantic right whales with noise from discrete AIS-identified ships (right) Data from NCFP research project Cornell University, NOAA Stellwagen Bank National Marine Sanctuary, and NOAA Fisheries Service Northeast



Near-real time auto buoy system



MARU recorder

- Auto-detection buoy system will be deployed in fall 2011 to report the occurrence of marine mammals and background noise conditions in near-real time
- Double-capacity MARU deployed fall 2010-11, will be redeployed with the auto-detection buoy in 2011 to evaluate the performance of the near real-time system

Acknowledgements

This study was funded in part by the U. S. Department of the Interior, Bureau of Ocean Energy Management, Regulation and Enforcement), through Inter-agency Agreement No. M09PG00016 with the U. S. Department of the Commerce, National Oceanographic and Atmospheric Administration /Alaska Fisheries Science Center, as part of the MMS Alaska Environmental Studies Program (Chuck Monnett). We are also extremely grateful to Jeff Leonard & Todd Mequet (Naval Surface Warfare Center, Crane Division), Theresa Yost (Naval Operational Logistics Support Center), and Capt. Robin Brake (I&E Director Marine Science, Office of the Assistant Secretary of the Navy) for providing newer surplus DIFAR buoys, which had an extremely high success rate.