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ABSTRACT

In 2008, we began a multi-year, interdisciplinary ecological study (CSESP) in the vicinity of proposed exploration oil and gas prospects in the northeastern Chukchi Sea. This study, which was supported by ConocoPhillips, Shell Exploration and Production Company, and Statoil, was designed to collect information on the ecosystem prior to exploration to fill data gaps in this area and to provide baseline environmental data that can be used for permit applications and as baseline data for post-development comparisons. CSESP focuses on intensive studies conducted within two nearby study-area boxes (Klondike and Burger) that are 30x30 NM (~55x55 km) in size, ~40 NM (~70 km) apart, and located ~60–90 NM (~100–160 km) off of the coast of northwestern Alaska. The integrated studies consisted of the following components: physical oceanography; nutrients, primary productivity, and zooplankton ecology; benthic ecology; fisheries oceanography (2009 only); seabird ecology; marine-mammal ecology; hydroacoustics; and baseline chemistry (primarily 2008). We sampled the two study areas primarily during three research cruises that matched seasons within this arctic area: late summer, early fall, and late fall. We also deployed oceanographic and hydroacoustic moorings before and after these three cruises, during the open-water period, and deployed some over the winter. We describe the study background and study design to provide an overview for the various presentations on this study.

BACKGROUND

There is great interest in offshore oil and gas development in the northeastern Chukchi Sea, off of northwestern Alaska. Because of this interest, there is a need for recent information on the oceanography and ecology of the region, both new information and information needed to update historical data sets. This information can help to provide a better understanding of the ecology of the area and to provide perspective on long-term environmental change that may have happened in the area.

To help to provide this information, we began in 2008 the Chukchi Sea Environmental Studies Program (CSESP), an integrated interdisciplinary, ecosystem-level approach to studying the environment in this area. This program recently completed its third year of studies (2008–2010).

OBJECTIVES

The objectives of this program are:

- (1) to provide data for pre-exploration and development-related activities;
- (2) to provide data for permit applications;
- (3) to provide input to planning of future operations and associated mitigation; and
- (4) to provide additional baseline data that can be used to assess and measure the potential environmental effects of offshore oil and gas exploration and development in the northeastern Chukchi Sea.

PRELIMINARY RESULTS

Although we do not yet have all three years of data and samples analyzed, we believe that the oceanography and ecology of the two study areas differs greatly. We believe that the boundary between the two water-masses generally lies between the two study-area boxes, partitioning the area into different environments—an oceanic pelagic system and a shelf-type benthic system.

PHYSICAL OCEANOGRAPHY

Oceanic water generally lies over Klondike and to the west, southwest, and south of Burger, whereas shelf-type water generally lies over Burger most of the time. In some years, however, the flow of oceanic water is so strong that it floods both study areas, such as was seen in 2009 (Figure 4).

ZOOPLANKTON

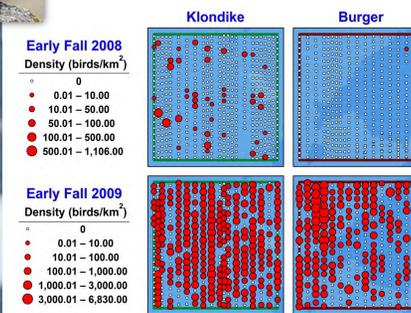
In general, zooplankton communities differ between the two study areas, although there is obvious leakage of organisms between the two areas. Most oceanic zooplankton occur in Klondike, whereas the Burger area is dominated more by shelf-type species.

BENTHIC INFAUNA

Benthic communities differ greatly between the two study areas in both abundance and biomass. The same species occur in the same area, but abundance in Burger is 4 times that in Klondike and biomass in Burger is 2 times that in Klondike (Figure 5).



Figure 6. Abundance of Crested Auklets in Klondike and Burger study areas, early fall cruise 2008-2009.



Discipline*	2008			2009		
	C1	C2	C3	C1	C2	C3
Physical Oceanography	X	X	X	X	X	X
Nutrients/PP/Zooplankton	X	X	X	X	X	X
Benthic Infauna		X			X	
Benthic Epifauna				X		
Baseline Chemistry	X			X*		X
Fisheries				X	X	X
Seabirds	X	X	X	X	X	X
Marine Mammals	X	X	X	X	X	X

* Around historic well locations; conducted by COMIDA CAB Scientists.

SAMPLING TYPES

We collected data with 3 main sampling types: (1) oceanographic stations; (2) bird and mammal survey lines; and (3) acoustic and oceanographic moorings.

OCEANOGRAPHIC STATIONS

We had 25 fixed-location oceanographic stations and 13 random-location oceanographic stations, plus 5 baseline-chemistry and benthic-ecology stations located at each former drilling location (Figure 2). The two components that sampled physical oceanography and nutrients, chlorophyll-a, and zooplankton sampled all 25 of the fixed stations on every cruise. The two components that sampled benthic infauna and baseline chemistry (both sediments and biota) sampled 13 of the 25 fixed stations (the odd-numbered ones) and all 13 of the random stations on one cruise/year; in addition, baseline chemistry also was sampled as part of the COMIDA program in 2009, and fishes also were collected as part of this program for analyses of baseline chemistry. The two components that sampled benthic epifauna and midwater and demersal fishes sampled the same 13 fixed stations on 2 of the 3 cruises/year, starting in 2009.

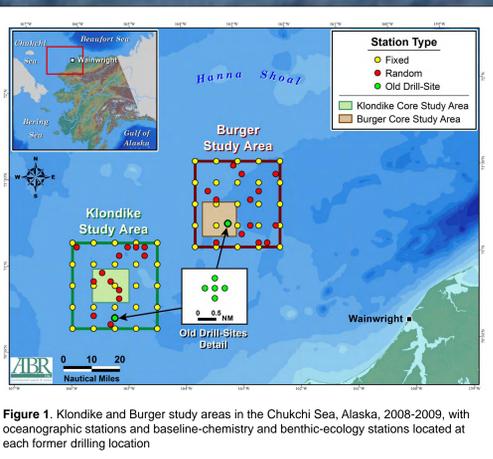


Figure 1. Klondike and Burger study areas in the Chukchi Sea, Alaska, 2008-2009, with oceanographic stations and baseline-chemistry and benthic-ecology stations located at each former drilling location

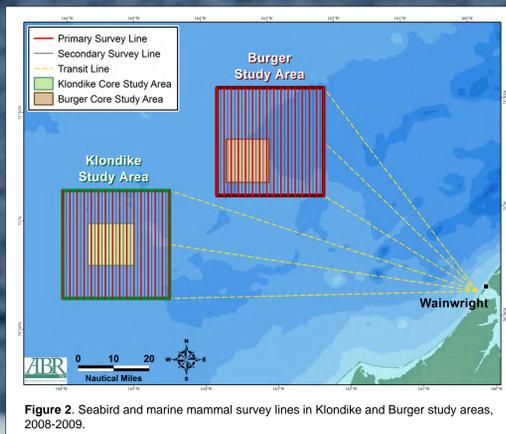


Figure 2. Seabird and marine mammal survey lines in Klondike and Burger study areas, 2008-2009.

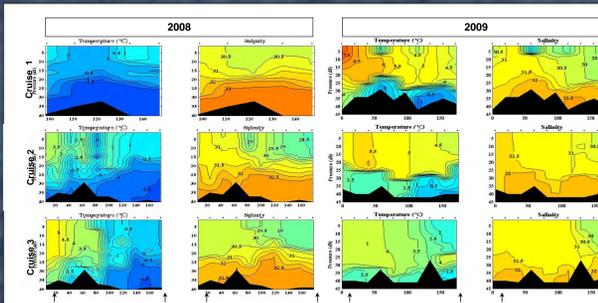


Figure 4. Vertical sections of temperature (°C), and salinity (psu) in the Klondike and Burger study areas for the three cruises in 2008 and 2009 (Weingartner and Danielson, unpubl. data).

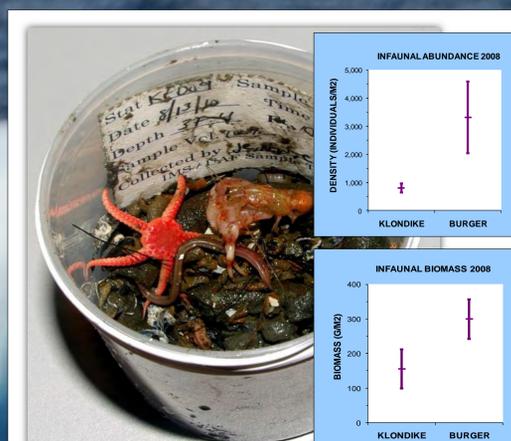


Figure 5. Abundance and biomass of the infauna benthic communities in Klondike and Burger study areas, 2008 (A. Blanchard, unpubl. data).

SEABIRDS

Seabird communities have the same species in the two study areas, but abundance differs between the two areas, and the birds' high mobility allows them to take advantage of interannual variation in oceanography. For example, Crested Auklets, which feed on larger oceanic zooplankton, occurred primarily in Klondike in 2008, whereas they spread over both study areas as oceanic water flooded them in 2009 (Figure 6).

MARINE MAMMALS

Marine mammals respond both to the oceanography of the area and to indirect effects such as sea ice, which is affected by the oceanography of the area. Similar to what was seen for the benthic data, benthic-feeding marine mammals such as Walruses and Bearded Seals are more common in Burger than in Klondike; in contrast, pelagic-feeding seals are more common in Klondike than in Burger in most years but may be equally common in both study areas in years in which oceanic water floods the entire study area (Figure 7).

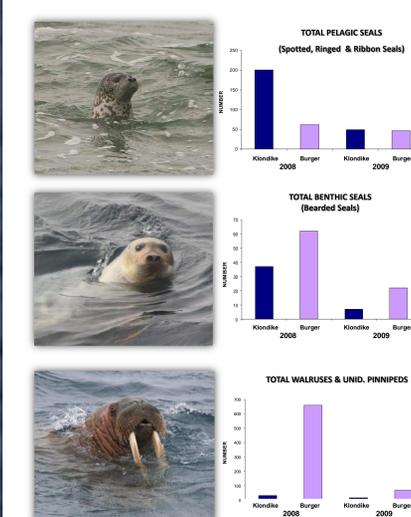


Figure 7. Abundance of pelagic-feeding seals (Ringed, Spotted, and Ribbon seals) and benthic-feeding marine mammals (Bearded Seals and Walruses) in Klondike and Burger study areas, 2008-2009 (J. Bruggeman, Canyon Creek Consulting, unpubl. data).

METHODS

STUDY AREAS

In 2008 and 2009, we sampled two study-area boxes in the northeastern Chukchi Sea known as Klondike and Burger (Figure 1). Each study-area box is 30x30 NM in size and contains within it a smaller box that represents the area of greatest interest for oil exploration. Klondike lies ~100 NM (~185 km) west of the village of Wainwright, and Burger lies ~60 NM (~110 km) northwest of the village of Wainwright.

Oceanographically, Klondike lies in oceanic water on the edge of the Central Channel Current, whereas Burger lies in more shelf-like on the southern slope of Hanna Shoal; however, oceanic water sometimes covers this area too. Both study areas lie in waters ~40 m (~20 f) deep.

DATA COLLECTION

In each year, we collected data during each of three cruises that sampled both study areas; we also deployed acoustic and oceanographic moorings within the study area as a whole. During the oceanographic cruises, we sampled a suite of environmental characteristics on each cruise and sampled others on only one or two cruises (Table 1). Characteristics sampled on every cruise were those that could change rapidly over time, such as physical oceanography (CTD casts), zooplankton (both vertical tows and diagonal bongo tows), seabirds, and marine mammals. Characteristics sampled less intensively were those that would exhibit less variation, including fisheries and benthic epifauna (begun in 2009), which were sampled on 2 of 3 cruises, and baseline chemistry (sampled only in 2008) and benthic infauna, both of which were sampled on 1 of 3 cruises in each year. We also deployed acoustic moorings for intensive surveys of marine-mammal calls over the summer and less-intensive surveys over the winter and deployed oceanographic moorings that studied currents and ice thickness and movements over the winter.

SEABIRD AND MARINE-MAMMAL LINES

We sampled the distribution and abundance of birds and mammals on a series of north-south lines within each study-area box (Figure 2). These lines were prioritized as primary and secondary lines, with all 16 primary lines in a box being sampled on every cruise. If possible, we sampled as many of the 15 secondary lines as possible on every cruise. In addition, we sampled as much as possible when moving between study-area boxes and between the study-area boxes and our anchorage off of the village of Wainwright, out of which we staged these cruises.

ACOUSTIC AND OCEANOGRAPHIC MOORINGS

We conducted acoustic sampling of marine-mammal calls and measured ambient noise in the environment in and near both study areas (Figure 3). The acoustic moorings were laid out as (1) arrays centered within the areas of greatest interest for oil exploration and (2) mooring lines that sampled synoptically across the entire area in general.

In addition, we conducted passive oceanographic sampling of the water-column with oceanographic moorings that sampled the over-winter environment (Figure 3). These oceanographic moorings used upward-looking ADCP to quantify movements of water in various layers in the water-column and to measure ice thickness and movements at the surface.

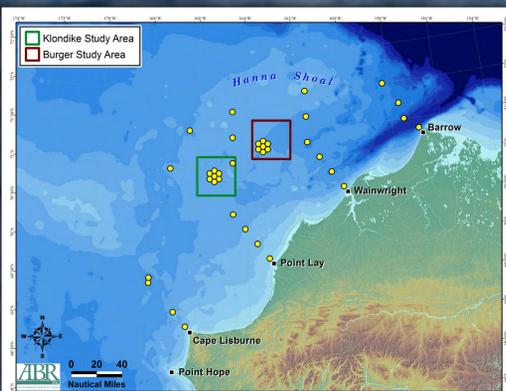


Figure 3. Acoustic mooring arrays within Klondike and Burger study areas and mooring lines in the Chukchi Sea, 2008-2009.

2010 AND BEYOND

Although this poster describes activities in 2008–2009, the study continued and expanded in 2010. Efforts expended in 2010 and the future includes:

- Continued sampling in Klondike and Burger in 2010.
- The 2010 addition of a third study area (Statoil), which lies off of the northwestern corner of the Burger study area box (Figure 8).
- The 2010 addition of Transitional Stations to delineate better the ecological boundary between the Klondike and Burger study areas.
- Shell Exploration and Production Company (SEPCO) Exploration Plan submitted in late 2009.
- ConocoPhillips (COP) Exploration Plan to be submitted in June 2011.
- SEPCO exploratory drilling to occur in 2012.
- COP exploratory drilling to occur in 2013 at the earliest.
- Continued collaboration with local co-management groups on scientific studies (e.g., tagging of Belugas, Walruses, and ice seals) and Traditional Ecological Knowledge (e.g., TEK study of Polar Bears).
- Production of annual and synthesis reports.
- Production of scientific publications, both by discipline and as a synthesis of the ecology of this area.

ACKNOWLEDGMENTS

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