ABSTRACT

In 2008–2010, we conducted an interdisciplinary ecological study (Chukchi Sea Environmental Studies Program; funded by ConocoPhillips, Shell, and Statoil) in and near three proposed exploration oil and gas programs in the offshore northeastern Chukchi Sea during the open-water season. Some aspects of this ecosystem function as a classical pelagic–benthic dichotomy, whereas others suggest a more complex organization involving zonation and patchiness. The Chukchi Sea study areas function as a pelagic system, whereas the Burger and Statoil study areas are both pelagic and benthic systems. The Chukchi Sea has lower benthic abundance and biomass and more diverse zooplankton, fish, and bacteria feeding on phytoplankton than does Burger, which has benthic communities with high abundance and biomass, primarily necrotrophic, and more benthic-feeding marine mammals than Klondike. Statoil has characterized both benthic communities. Various water masses influence all study areas seasonally and interannually, and patterns of sea ice have varied significantly over the past several years. Overall, benthic communities differ greatly among the study areas, with a small number of species occurring in all the study areas, and most of the fish occur in the eastern end of the study area, with high abundance in all the study areas, and biomass in Burger and Statoil are several times that in Klondike. Benthic communities are most similar among Burger and Statoil, and megafaunal communities are largely different among study areas (Fig. 6).

BACKGROUND

There is great interest in offshore oil and gas development in the northeastern Chukchi Sea, off of northeastern 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 on the ecology of the area and provide perspective on long-term environmental change that may have happened, or be happening, in the area.

To help provide this information, we began in 2008 the Chukchi Sea Environmental Studies Program (CSESP), an integrated interdisciplinary, ecosystem-level approach to studying the environmental, social, and economic impacts of offshore development in the Chukchi Sea. This program recently completed its fifth year of study (2008–2011).

We are in the process of publishing a Special Issue of Continental Shelf Research (due out in the first half of 2013) on the ecology of the northeastern Chukchi Sea that synthesizes information across the first 3 years of the study within each of the ecosystem components and for the system as a whole. This paper presents the evidence for our interpretation of two very different ecosystems: Klondike has lower benthic abundance and biomass and more diverse zooplankton, fish, and bacteria feeding on phytoplankton than does Burger, which has benthic communities with high abundance and biomass, primarily necrotrophic, and more benthic-feeding marine mammals than Klondike. Statoil has characterized both benthic communities. Various water masses influence all study areas seasonally and interannually, and patterns of sea ice have varied significantly over the past several years. Overall, benthic communities differ greatly among the study areas, with a small number of species occurring in all the study areas, and most of the fish occur in the eastern end of the study area, with high abundance in all the study areas, and biomass in Burger and Statoil are several times that in Klondike. Benthic communities are most similar among Burger and Statoil, and megafaunal communities are largely different among study areas (Fig. 6).

RESULTS

CHLOROPHYLL AND NITRATE (2010)

Figure 3. Vertical sections of Chlorophyll-a (left) and nitrate (right) in the three study areas, 2008–2010.

ZOOPLANKTON

In general, plankton communities differ among the 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 by more by benthic-type species. In general, abundance is highest in Klondike, although there is great interannual variation (Fig. 4). Although 2009 was the warmest year, 2010 had the highest zooplankton biomass; we suspect that it was cool enough to have a somewhat late bloom but warm enough to have some zooplankton growth

BENTHIC COMMUNITIES

Benthic communities differ greatly among the study areas in both macrourfa and megafauna. The same species occur in the same area, but abundance in Burger and Statoil is so cold that it barely is above the freezing point of seawater, forming an effective thermal barrier. Hence, most of the species in Klondike follow the Central Channel current from the Bering Sea.

DISCUSSION & CONCLUSIONS

Although these study areas are very close, they represent two very different ecosystems. Klondike appears to be a pelagic ecosystem at all times. This is because it is bathed in Bering Sea Water flowing in the Central Channel. Klondike has higher densities of oceanic zooplankton, more zooplankton-feeding seabirds (especially auklets), and generally more pelagic-feeding seals than the other two study areas. Burger appears to be a benthic ecosystem most of the time, although Bering Sea Water occasionally flows over it. Burger has a higher concentration of mud in the sediments, much denser and more robust benthic communities, and generally more benthic-feeding seals than the other two study areas. Statoil is intermediate between the two areas, with high benthic biomass but low epibenthic biomass and generally more benthic-feeding marine mammals than the other two study areas on the benthic side, and most populations having some component of benthic feeding because the western end is along the edge of the Central Channel but the eastern end is over the seamounts off Ridge of Hope.

The demersal fish community shows a pattern similar to that predicted from the benthic data, but it appears that the cold pool of Winter Water over Burger and Statoil forms an effective barrier to these fishes. Although these study areas are very close, they represent two very different ecosystems. Klondike appears to be a pelagic ecosystem at all times. This is because it is bathed in Bering Sea Water flowing in the Central Channel. Klondike has higher densities of oceanic zooplankton, more zooplankton-feeding seabirds (especially auklets), and generally more pelagic-feeding seals than the other two study areas. Burger appears to be a benthic ecosystem most of the time, although Bering Sea Water occasionally flows over it. Burger has a higher concentration of mud in the sediments, much denser and more robust benthic communities, and generally more benthic-feeding seals than the other two study areas. Statoil is intermediate between the two areas, with high benthic biomass but low epibenthic biomass and generally more benthic-feeding marine mammals than the other two study areas on the benthic side, and most populations having some component of benthic feeding because the western end is along the edge of the Central Channel but the eastern end is over the seamounts off Ridge of Hope. The demersal fish community shows a pattern similar to that predicted from the benthic data, but it appears that the cold pool of Winter Water over Burger and Statoil forms an effective barrier to these fishes.

2011 AND BEYOND

Although this poster description will be out in 2010–2011, the study continued and expanded in 2011. Efforts expanded in 2011–2012 include:

- Continued sampling in Klondike, Burger, and Statoil.
- The 2011 expansion of the study area to all of Hanna Shoal (Fig. 11).
- Continued collaboration with local management groups and social sciences studies (e.g., tagging of Belugas, Walruses, and ice seals) and Traditional Ecological Knowledge (e.g., TESA study of Point Barter).
- Production of annual and synthesis reports.
- Production of scientific publications, by discipline and as a synthesis of the ecology of this area (Continental Shelf Research).

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