Oceanographic assessment of the planktonic communities in the northeastern Chukchi Sea during 2011

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Introduction

Multidisciplinary studies in the Chukchi Lease area by the industry-funded Chukchi Sea Environmental Studies Program (CSESP) have been establishing environmental baselines since 2008. In the 2011, the study region was expanded more than 3 fold in size, to encompass Hanna Shoal, and provide a better appreciation of the biological backdrop in the region.

Methods

Core sampling conducted annually occurred within a 900 NM^2 grid for 3 survey areas: Burger, Klondike, and Statoil; with an expanded grid added in 2011 to provide broader context (Fig. 1). Each core survey had 22-25 stations that were sampled 2 or 3 times over the ice-free period. The expanded grid added 84 stations sampled only once. Inorganic macronutrients, phytoplankton (as chlorophyll) and zooplankton were sampled on each cruise. Phytoplankton and nutrients were collected with a CTD rosette at 6 depths per station: 0, 5, 10, 20, 30, and 3 m above the sea floor (~37 m). Smaller mesozooplankton were collected by a pair of 150-µm mesh nets hauled vertically from within 3 m of the bottom to the surface. To target larger, more mobile zooplankton, a 505-µm mesh Bongo net was deployed in a double oblique tow with the ship underway at 2 knots.

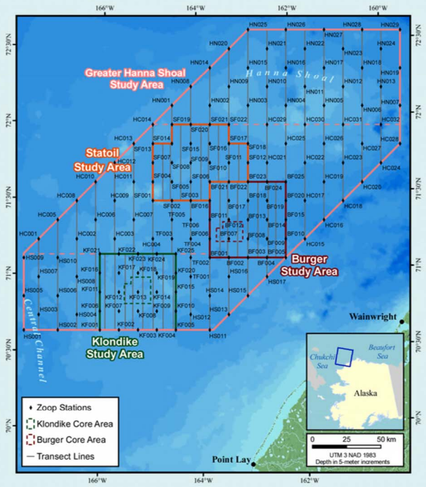

Figure 1. Chukchi Sea Environmental Studies Program survey area

Physical Backdrop

The 2011 sampling season was characterized by high sea surface temperatures in August related to early ice retreat over the sampling area (Fig. 2). In September water temperatures remained warm in Klondike, but cooled moving toward the northeast. This gradient had large effects on the structuring of the planktonic communities.

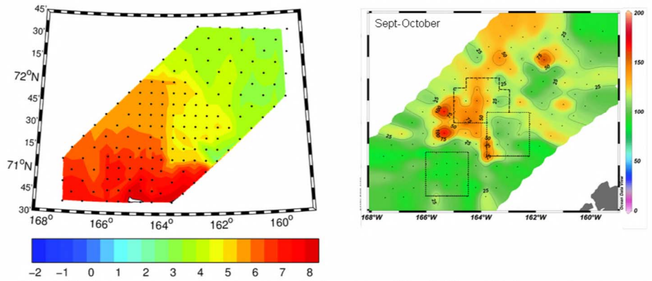

Figure 2. Average water temperatures in the upper 10m (left), and integrated chlorophyll concentrations (right) for the September/October cruise.

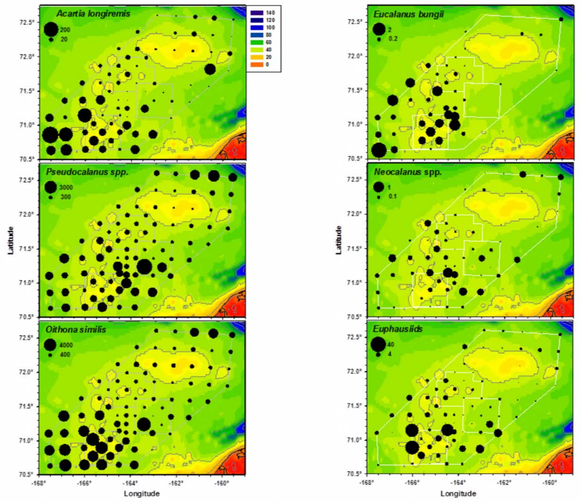

Figure 4. Distribution of the most common shelf (left) and oceanic copepod species and euphausiids (right) originating from the Bering Sea.

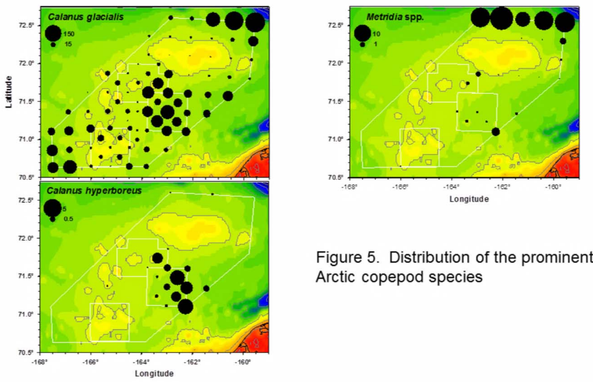

Figure 5. Distribution of the prominent Arctic copepod species

Results

Chlorophyll & Nutrients

In 2011, although surface temperatures were high, nutrients persisted in colder bottom waters. These nutrients supported elevated concentrations of chlorophyll at depth that persisted into September/October (Fig. 2). This pattern was more pronounced compared to previous years.

Zooplankton

In 2011, the expanded survey revealed that the most common neritic (shelf-dwelling) copepod species tend to associate with warmer waters (Fig. 3). This pattern is most pronounced for species strongly advected into the region within Bering Sea water (i.e. ***Eucalanus*** & ***Neocalanus*** copepods, and **euphausiids**).

The most interesting signal occurred within the resident larger-bodied arctic copepod species. ***Calanus glacialis*** is often common on the shelf, but is typically more important in deeper waters. ***Calanus hyperboreus*** inhabits the deeper basin waters and is rarely observed in the core study area. ***Metridia*** species are also oceanic and rarely observed in waters shallower than 50 m. In 2011, all three species were present as expected north of Hanna Shoal, but also occurred over Burger and Statoil. These patterns conflict with the classical northward flow of water currents for this region.

Perspective

Standard oceanographic principles predict that water flowing along the northern edge of Hanna Shoal should follow the bathymetry and turn southward along its eastern edge. Upwelling, and reversal of flow, in Barrow Canyon have also been suggested as a mechanism to move basin waters onto the shelf. Observational support for these possibilities has until recently been weak.

Zooplankton communities have long been recognized as potential biological tracers of water masses and their movements. The observed distribution of arctic copepods on the shelf corresponds to a period of strong and sustained upwelling in Barrow Canyon combined with eastward surface flow as documented by HF Radar (Fig. 5).

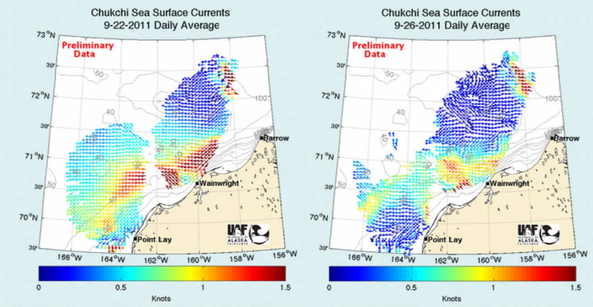

Figure 5. Surface currents determined by HF Radar revised circulation during the dates when Burger was sampled

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