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Sung-Hyun Park and Tae Siek Rhee

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KOREAN LONG-TERM OBSERVATION IN THE WESTERN ARCTIC ECOSYSTEM

Sang H. Lee

Polar Environmental Research Division, Korea Polar Research Institute, Incheon 406-840, Republic of Korea
sanglee@kopri.re.kr

ABSTRACT

Recently, it was found that higher temperatures along with a possible increase in the ice export have decreased the extent and thickness of perennial sea ice in the Arctic Ocean over the past 40 years and produced more open water especially in the western Arctic Ocean (Rothrock et al. 2003; Perovich and Richter-Menge 2009). The changes in climate on many scales influence the ecosystems in different regions of the Arctic Ocean. The study regions for the Korean Long-term Observation will be the Bering Strait/Chukchi Sea and Canada Basin in the western Arctic Ocean. Intensive long-term observation for the ecosystem in these regions is specifically urgent because physical environments, especially ice extent and thickness, are currently changing faster than other regions in the Arctic Ocean. The main goals of the Korean program will be to integrate the effects of climate change across spatial and temporal scales based on a long-term observation in the western Arctic Ocean, lay the groundwork for the future monitoring of ecosystem response to ongoing climate and environmental changes, and consequently predict the impacts of current climate and environmental changes on the marine ecosystems in the western Arctic Ocean.

INTRODUCTION AND RATIONALE

Over the past few decades, the environments in the Arctic have been changing at a very rapid rate. The higher temperatures plus a possible increase in ice export have decreased the ice extent and sea-ice thickness in the Arctic Ocean over the past 40 years contributing to more open water, especially in coastal regions (Rothrock et al. 2003). Laxon et al. (2003) expect additional thinning of Arctic sea ice with the continued increase in melt season length. In addition, the average annual discharge of fresh water from the six largest Eurasian rivers to the Arctic Ocean increased by 7 % from 1936 to 1999 (Peterson et al. 2002). These environmental and climate changes may alter the marine ecosystem in the Arctic Ocean. For examples, these changes may alter the relative contributions of sea ice algae and phytoplankton, with respect to the species and/or size composition of primary producers, and the new and total primary production that is occurring. In fact, Melnikov et al. (2002) found the physical-chemical characteristics of sea ice and the biological structure of ice communities in 1997-1998 were very different from conditions during the 1970s, based on comparisons of SHEBA

results with historical data. Moreover, the current environmental changes in the Arctic Ocean might lead to different compositions in photosynthetic-end products of sea ice algae and phytoplankton, which could affect the nutritional status of higher trophic levels. As a consequence, the seasonal distributions, geographic ranges, and nutritional structure of zooplankton and higher trophic levels such as seals and whales have been projected to be altered in the Arctic Ocean (Tynan and DeMaster 1997). Therefore, in order to understand and assess the marine ecosystem response to ongoing environmental changes in the Arctic Ocean, evaluation for many different variations; geographical/seasonal/interannual variations, should be immediately conducted based on a long-term observation.

MAIN STUDY AREAS AND RESEARCHES IN THE ARCTIC OCEAN

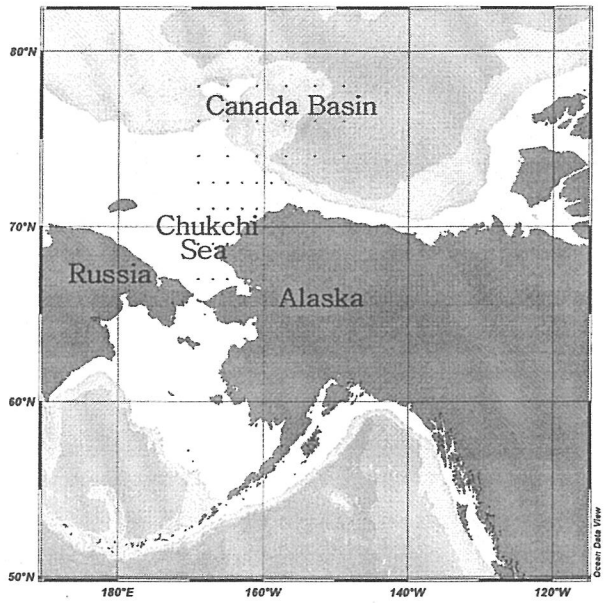

Fig. 1. Proposed main study regions in the western Arctic Ocean

The main study regions for the Korean Arctic Long-term Observation program will be Bering Strait/Chukchi Sea and Canada Basin in the western Arctic Ocean. It is important to understand the ecosystem related to physical and chemical dynamics in the Bering Strait and Chukchi Sea in order to monitor the arctic marine ecosystem, since they are only conduit connecting between the north Pacific and Arctic Oceans. In addition, the understanding of the ecosystem in the Canada Basin, as one of the least known region in the Arctic Ocean which is mostly covered by multi-year or first-year ice, is specifically urgent because of a fast rate of the environment changes in the basin. Thus, the main goal of the Korean program is to understand and predict the impacts of climate and environmental changes on the marine ecosystems of the western Arctic Ocean.

BIOPHYSICAL MECHANISMS OF SEA ICE

The recent reduction of ice-cover is a predominantly spring-summer phenomenon (Chapman and Walsh 1993) and consequently there would be some changes such as the relative amount of primary production, timing of blooms, and physiology of primary producers under the ice cover. However, the underlying mechanisms are not well understood since there have been few recent studies about ice algae or related water column phytoplankton in different locations and different ice

types in the Pacific Arctic Ocean. Therefore, an understanding of how changing sea ice conditions affect phytoplankton production and the importance of sea ice algal production to total primary production will provide insights into the impact of predicted further reductions of sea ice extent and thickness on the primary production and consequently upper trophic levels.

AIMS AND SCOPES

Our specific research objectives are to:

(1) Keep monitoring and thus storing basic physical-chemical-biological parameters such as S/T profiles, major nutrients, Chl-a concentration, productions and species compositions of phytoplankton, ice algae, zooplankton, and benthos.
(2) Quantify seasonal, regional, annual variations of the basic parameters
(3) Assess the marine ecosystem responding to the current and ongoing environmental changes in the Chukchi Sea and Canada basin of the Western Arctic Ocean.
(4) Develop a 3-D coupled ice-ocean-biological model in the Western Arctic Ocean.

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