Variability in spring phytoplankton blooms associated with ice retreat timing in the Pacific Arctic

Hisatomo Waga[1,2], Hajo Eicken[1], Toru Hirawake[3], and Yasushi Fukamachi[2,4]

[1] International Arctic Research Center, University of Alaska Fairbanks, Fairbanks, AK, USA

[2] Arctic Research Center, Hokkaido University, Sapporo, Japan

[3] Faculty of Fisheries Sciences, Hokkaido University, Hakodate, Japan

[4] Institute of Low Temperature Science, Hokkaido University, Japan

The Pacific Arctic is experiencing rapid changes in sea-ice seasonality and extent, with significant consequences for primary production. Spring phytoplankton blooms in the Arctic have typically been characterized as enhanced growth of phytoplankton populations following the retreating sea-ice edge. However, recent studies reported the presence of phytoplankton blooms beneath sea ice prior to the onset of seasonal ice retreat in the Pacific Arctic. To improve our understanding of spring phytoplankton blooms in this region, this study explores the spatiotemporal variation in spring phytoplankton bloom types, and their relationship with the progression of sea-ice retreat. In this study, spring bloom types are classified into three groups (under-ice blooms, probable under-ice blooms, and marginal ice zone blooms) based on the presence/absence and timing of an evident peak in satellite-retrieved phytoplankton biomass during the marginal ice zone retreat period. Here, time-series of the phytoplankton biomass were modeled using a parametric Gaussian function, as an effective approach to capture the development and decay of phytoplankton blooms. Our findings suggest that under-ice blooms are an important, ubiquitous phenomenon in the Pacific Arctic. In addition, this study identified a key relationship between spring bloom type and timing of sea-ice retreat. Specifically, earlier sea-ice retreat favors a predominance of marginal ice zone blooms while later ice retreat favors under-ice blooms. As a substantial portion of the Pacific Arctic showed a shift of sea-ice retreat timing toward earlier dates, we find the relative contributions of under-ice blooms to have declined and marginal ice zone blooms to have increased between 2003–2019. These shifts may contribute significantly to marine ecosystem shifts in the Pacific Arctic, since the timing of biomass settling out of such blooms is a key factor in many marine organism lifecycles.

Key words: Pacific Arctic; Bering Sea; Chukchi Sea; remote sensing; ocean color; phytoplankton; sea ice

Biotic homogenization and functional biogeographic shift of marine communities under future climate

Irene D. **Alabia**[1], Jorge Garcia Molinos[1], Sei-Ichi Saitoh[1], Takafumi Hirata[1], Toru Hirawake[2] and Franz J. Mueter[3]

[1]Arctic Research Center, Hokkaido University, Sapporo, Japan
E-mail: irenealabia@arc.hokudai.ac.jp

[2]Faculty of Fisheries Sciences, Hokkaido University, Hakodate Japan

[3]University of Alaska Fairbank, Juneau Alaska

Biogeographical transition zones are redistribution hotspots that offer a unique opportunity to understand mechanisms and consequences of climate-driven thermophilization processes in natural communities. We examined the impacts of climate change projections in the 21st century on marine communities in Eastern Bering and Chukchi seas, a climate-sensitive boreal-to-Arctic transition zone. Overall, projected changes in species distributions, resulted in poleward increases in species richness and functional redundancy by century's end. Future poleward shifts of boreal taxa in response to warming and sea ice changes are projected to alter the biogeography of present-day Arctic communities as larger, longer-lived and predatory taxa expand their leading distribution margins. Drawing from the existing evidence from other Arctic regions, these changes are anticipated to increase the future vulnerability of Arctic ecosystems, as trophic connectivity between biotic components increases. Our findings provided insights into relationships between climate change, species composition and ecosystem functioning across marine biogeographic regions.

Key words: Biodiversity; species distributions; climate change; Biogeographic transition zones; Pacific Arctic region