Characteristics of the summer decapod larvae community through Bering and Chukchi Seas

Jose M. Landeira[1], Kohei Matsuno[2], Atsushi Yamaguchi[1], Toru Hirawake[1], Takashi Kikuchi[3]
[1]*Graduate School of Fisheries Science, Hokkaido University*
[2]*National Institute of Polar Research*
[3]*Japan Agency for Marine-Earth Science and Technology*

Arctic Pacific is experiencing profound ecosystem changes due to human (direct and indirect) pressure, including global warming and exploitation of marine resources. In this sense, warming and reduction of summer sea-ice cover have large implications for the ecosystem functioning, likely related with alterations in growth, abundance, distribution and phenology of marine organisms. Moreover, Bering and Chukchi Seas are among the most productive ecosystems and sustain one of the largest fisheries industry. The overfishing has led to the collapse of crab fisheries in the southeastern Bering Sea since early 1980s, closing most of the stocks for harvesting. The new scenario of warming and sea-ice retreat open new fishery perspective, since northern unexploited areas are now more accessible to the fishing vessels. Therefore, it is necessary to study the current state of the Arctic populations to predict ongoing changes related with both global warming and fishing pressure and so, be able to make decisions for ecosystem management. Most studies in this region are mainly based on benthic adult populations while little is known for planktonic larval stages. During the larval phase the highest mortality rate (90%) of the life cycle occurs, so it is a key issue to understand the population dynamics for the fisheries management. Recently, reduction of the ice-covered area during summer become pronounced and its effects on mesozooplankton community has already been reported, while no information is available about how the decapod larvae response to such drastic environmental changes. This study analyzes zooplankton samples from Bering Sea to Chukchi Sea during the consecutive summers of 2007 and 2008 to evaluate changes in decapod larvae community in this region.

Zooplankton samples were collected by vertical tows of NORPAC net (mesh size: 315 μm) at 138 stations in the Bering and Chukchi Seas from 20 July to 13 August of 2007 and from 4 June to 13 July of 2008. Bottom trawls were made at 15 stations covering the same area. At each station, CTD casts were made and chlorophyll concentrations were measured using the water from Niskin bottle samples. Plankton samples were preserved with 5% formalin seawater immediately after collection. Bottom trawl samples were sorted, identified and weighed to calculate the CPUE (kg h^{-1}). In the land laboratory, all decapod larvae were sorted and identified to species level from plankton samples. To compute larval abundance, all counts were converted to total number of individuals per square meter of sea surface area (ind. m^{-2}). For the numerically dominant species: snow crab (*Chionocetes opilio*), the carapace length of zoea I, II, and megalopa (ZI, ZII, M) were measured by eyepiece micrometer.

In total, 8 families, 11 genera, and 18 species were identified. For both years, the most dominant species/taxa were the hermit crabs *Pagurus* spp., followed by the spider crab *Hyas* spp., and the commercially important tanner crab (*Chionoecetes bairdi*) and snow crab (*C. opilio*) were also dominant. For most of the species, the abundances were greater during 2008 than 2007 (mean abundance was 90 ind. m^{-2} in 2008 while 49 ind. m^{-2} in 2007). Species diversity was also higher in 2008. Most of the species occurred throughout the region, while *C. bairdi* was restricted to the southeastern Bering Sea shelf. During 2008, larval abundance of most decapod species were higher in the Chukchi Sea. Regarding larval stages, *C. bairdi*, *C. opilio*, and *Hyas* spp. dominated by earlier development stages in 2008 larval stages than those of 2007 ($p < 0.01$, *U*-test). The body size of *C. opilio* showed a significant latitudinal pattern, in which larger carapace length occurred at higher latitudes for ZI, ZII, M. The analysis of environmental parameters showed that ZI had highly significant negative correlation with temperature ($p < 0.001$), ZII had no correlation with temperature while had positive correlation with chlorophyll *a* ($p < 0.05$), whereas M had no correlation with any of these environmental parameters. Concerning benthic adults collected by bottom trawl, *C. bairdi* dominated the catches in the southeastern Bering Sea shelf, *C. opilio* were particularly abundant around St. Lawrence Islands and hermit crabs dominated the samples in the Chukchi Sea. In general, the distribution and composition of benthic adults corresponded with those of planktonic larvae.

Annual changes in abundance and developmental stage structure of planktonic larvae seem to be related to the one-month delay in sampling period (thus, July-August in 2007 while June-July in 2008) and not determined by the contrast environmental conditions observed in both years. In fact, the results suggest a similar seasonal timing of larval release for both years. To detect phenological changes in response to climate change, a larger time-series sampling is needed in the future. However, it seems clear that changes in temperature conditions can modify the body size of early larvae (ZI) at higher latitudes, and hence their swimming, foraging and predator avoidance in the planktonic phase.