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SPATIAL ASSOCIATIONS BETWEEN BALEEN WHALES AND THEIR PREY IN THE NORTHERN BERING AND CHUKCHI SEAS

Yuka Iwahara (*Graduate School of Environmental Science, Hokkaido University, Japan*)

Kohei Matsuno (*Arctic Environment Research Center, National Institute of Polar Research, Japan*)

Keiko Sekiguchi (*Graduate School of Arts and Science, International Christian University, Japan*)

Bungo Nishizawa (*Graduate School of Fisheries Sciences, Hokkaido University, Japan*)

Tsubasa Nakano (*Graduate School of Fisheries Sciences, Hokkaido University, Japan*)

Takashi Uyama (*Graduate School of Fisheries Sciences, Hokkaido University, Japan*)

Atsushi Yamaguchi (*Graduate School of Fisheries Sciences, Hokkaido University, Japan*)

Yutaka Watanuki (*Graduate School of Fisheries Sciences, Hokkaido University, Japan*)

Kazushi Miyashita (*Field Science Center for Northern Biosphere, Hokkaido University, Japan*)

Yoko Mitani (*Field Science Center for Northern Biosphere, Hokkaido University, Japan*)

yuka.iw.irk@gmail.com

The ecosystems in the northern Bering and Chukchi Seas have been changing in recent years, due to the decreasing of sea ice with global warming. In order to understand the mechanism of these ecosystems changes, it's important to recognize the relationships between top predators and their prey as well as the relationships between sea-ice, primary production, zooplankton and fish. Baleen whales are important top predators in these regions. They spend summer and fall in higher latitude, feeding on benthos and krill. Krill abundance may increase in the Chukchi Sea due to the increasing of the sea temperature, and this may consequently affect the distribution of baleen whales. However, there are no studies measuring the spatial distribution of whales and their prey simultaneously in these regions.

We measured the encounter rate of baleen whales and the abundance of their prey in the northern Bering and Chukchi Seas. Whale sighting surveys were conducted in August 2007, July 2008, and July 2013 by T/S Oshoro-maru (Hokkaido University, Japan) (summer), in September and October 2012 by R/V Mirai (JAMSTEC, Japan), and in September 2014 by CCGS Amundsen (Canada) (fall). Zooplanktons, including juvenile krill, were sampled with a NORPAC net (mouth diameter 45 cm, mesh size 335 μm) at 31, 28 and 51 stations in 2007, 2008 and 2012, respectively. In 2013, krill were also sampled by Bongo net (mouth diameter 70 cm, mesh size 330 μm) at 12 stations and benthos were sampled by Smith-McIntyre Grab (0.1 m^2) at 17 stations.

Four baleen whale species were identified: 484 gray whales (*Eschrichtius robustus*), 36 bowhead whales (*Balaena mysticetus*), 15 humpback whales (*Megaptera novaeangliae*) and 13 minke whales (*Balaenoptera acutorostrata*). Encounter rates of gray whale were high in northern Bering Strait in 2007 (1.75 ind./km) and northern Chirikov Basin in 2013 (0.69 ind./km) and off Points Hope in 2012 (0.40 individuals/km). The biomasses of benthos, mainly containing amphipods, clams, and sand dollars, were larger in the northern Chirikov Basin (860 WWg/m^2) and off Point Hope (1419 WWg/m^2), where the encounter rate of gray whales were higher. On the other hand, biomasses of benthos were large in Icy Cape (1525 WWg/m^2) where no gray whale was observed. Other baleen whales, bowhead, humpback and minke whales were abundant off Icy cape in 2013 (0.03 ind./km), Points Hope and Barrow in 2012 (0.02 and 0.12 ind./km) where the biomass of krill was high (0.62~1.94 ind./ m^2 , 186.74.47~1845.31 ind./ m^2 and 61.62~417.37 ind./ m^2). Krill were abundant in northern Bering Strait in 2007 and 2013 (137.02~6545.18 ind./ m^2 , 82.93~291.42 ind./ m^2), but no whales have been observed there in these years. Average weight of individual krill sampled by BONGO net in northern Bering Strait in 2013 were smaller (0.096~0.531 mg) than those sampled off Icy Cape in 2013 (3~18.8 mg). So, krill in the northern Bering Strait may be too small as the prey for these baleen whales. Therefore, abundance of benthos as well as abundance and size of the krill could be key factors affecting the distribution of baleen whales.