

北海道サロマ湖に生息するアイスアルジ群集の光生理特性 ~2009年に観測されたアイスアルジ群集の弱い光順応~

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Photophysiological characteristics of ice algal community in Saroma-ko Lagoon, Hokkaido ~Weak photoacclimation of ice algal community in 2009~

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Introduction

The habitats for ice algal community are located at the bottom surface of sea ice. Because light intensity is usually reduced through layers of snow and sea ice, light availability is a major limiting factor for ice algal production. Ice algae show specific photophysiological acclimation to low light intensity (e.g., Robinson et al. 1998, Lazzara et al. 2007). This study aims to investigate photophysiological characteristics for well established ice algal community in the Saroma-Ko Lagoon, for a better understanding of their photoacclimation. The light condition of sea ice environment, photophysiological characteristics including the pigments composition and the light absorption and species composition were investigated for seven years.

Materials and Methods

Samplings were conducted in early March every year of 2006 to 2012. Ice cores and water samples were collected at the station off the eastern shore of Saroma-ko Lagoon, Hokkaido (44°N, 143°E) with an ice-core sampler CRREL corer (inside diameter 7cm) and a Niskin bottles, respectively. The bottom portions of ice cores (3 cm) were sliced and crushed carefully into a dark bottle filled with seawater filtered through a glass fiber filter (Whatmann GF/F) and allowed to melt slowly at 0 °C under dark condition at near-freezing temperature. Subsamples were divided into one for the analysis of species, pigments and absorption of ice algal community.

Results and Discussion

Ice thickness ranged from 32.8±1.0 cm in 2009 to 50.7±0.8 cm in 2011, while photosynthetically active radiation (PAR) at the undersurface of sea ice varied from 0.7 % of PAR in air in 2012 to 4.0 % of PAR in air in 2009. The ice algal communities were dominated by diatoms (>90%) in all years. The dominated diatoms of ice algal community were centric *Detonula confervacea* and pennate *Achnanthes taeniata* or *Navicula* (Fig.1). Chlorophyll *a* (Chl *a*) concentration at the bottom 3 cm of sea ice, as an index of biomass, ranged from 6.86 mg Chl *a* m⁻³ in 2009 to 1176±212 mg Chl *a* m⁻³ in 2012. The biomass of ice algal community was significantly negatively correlated with PAR at the undersurface of sea ice. This result suggested that ice algal community in Saroma-ko Lagoon had acclimated to low light intensity. Except for 2009, the photosynthetic and photoprotective pigments occupied about 95 % and 5 % of total pigments, respectively. In 2009, the photosynthetic and photoprotective pigments were 93% and 7% of total pigments, respectively. The ratios of accessory pigments to Chl *a* varied about 2-3 fold among ice seasons. The ratios of Fucoxanthin to Chl *a*, Chlorophyll *c* to Chl *a* and diadinoxanthin+diatoxanthin to Chl *a* ranged from 0.5 in 2006 to 1.6 in 2011, 0.2 in 2006 to 0.5 in 2012, 0.09 in 2006 to 0.17 in 2009, respectively. Chl *a* specific absorption coefficients at 440nm, 675nm, and the average of *a*^{*} for PAR varied about 3-4 fold among ice seasons. The maximum values of these Chl *a* specific absorption coefficients in this study obtained in 2009. The blue to red ratios of ice algal community was 1.3 in all years except for 2009 (1.7). The photophysiological characteristics of ice algal community in Saroma-Ko lagoon suggested high variability among ice season. The photophysiological characteristics of ice algal community in 2009 were different from those in other ice seasons. This result suggested that photoacclimation to low light of ice algal community in 2009 might be weaker than other ice seasons.

References

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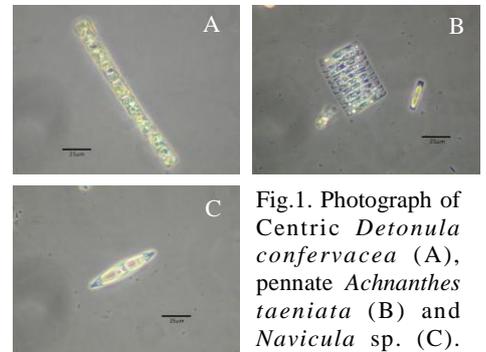


Fig.1. Photograph of Centric *Detonula confervacea* (A), pennate *Achnanthes taeniata* (B) and *Navicula* sp. (C).