# 北海道サロマ湖におけるアイスアルジーの生物量と光合成特性の空間的変動性

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# Spatial Variability in Biomass and Photosynthetic Characteristics of Bottom Ice Algae in Saroma-Ko Lagoon, Hokkaido

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## Introduction

Ice algae can grow to an extremely high biomass by acclimation to the low irradiance in the brine channels notably at the bottom surface layer (Arrigo and Sullivan 1992). Although the size of horizontal patch of ice algal biomass in the sea ice in Saroma-Ko Lagoon has been reported as about 1 $m^2$ based on the chlorophyll *a* analysis (Ronineau *et al*. 1997), variability in photosynthetic characteristics is not well known. The spatial variability in the photosynthetic characteristics of ice algae based on two observations, the initial slope ($\alpha$) and the maximum electron transport rate (r$ETR_{max}$) of *ETR* vs Irradiance curve and the adaptation index ($E_k$), and the maximum quantum yield for photosystem II (PSII) ($F_v/F_m$) by using Chlorophyll *a* fluorescence (Schreiber 2004) within 1$m^2$ was studied during sea ice seasons in Saroma-Ko Lagoon, Hokkaido in 2010, 2011, and 2012.

## Materials and Methods

Samplings were conducted on March in 2010, 2011, and 2012 at the station off Sakae-Ura in Saroma-Ko Lagoon (44 $^oN$, 143 $^oE$). A whole ice core was taken at the four corners (St. 1, 2, 3, and 4) of 1 $m^2$ surface area. Each ice core was cut 3 cm from the bottom of ice core. Sliced ice core subsamples were melted in the filtered sea water under dark condition. Photosynthetically active radiation (PAR) in the air and at the undersurface of the sea ice, snow depth and ice thickness were measured as the environmental factors. Concentration of Chl *a* was examined as an index of biomass. The $F_v/F_m$, $\alpha$, r$ETR_{max}$, and $E_k$ were determined as photosynthetic characteristics. The terms 'spatial variability' means variability among four stations.

## Results and Discussions

Relative PAR at the undersurface of sea ice to that in the air was 2.05% in 2010, 0.97% in 2011, and 0.68% in 2012, respectively. Average Chl *a* concentration at four stations in 2012 was 1768±371 mg $m^{-3}$, which was 48 times and 6 times higher than that in 2010 and 2011, respectively. Spatial coefficient of variation (CV) of Chl *a* concentration at four stations was commonly highest among variables and ranged 0.210-0.352 in three years. Although spatial variability in light-dependent photosynthetic characteristics such as $\alpha$, r$ETR_{max}$, and $E_k$ were also higher, CV of $F_v/F_m$ was commonly lowest among variables and ranged 0.014-0.143. This indicates that spatial variability in potential photosynthetic capacity of ice algae has not changed during ice season regardless of the variability in Chl *a* concentration among years and stations within a year. Lowest spatial variability in $F_v/F_m$ in 2012 indicates that ice algae in 2012 is well acclimated to low light, and as a results biomass might increase the most. In conclusion, high spatial variability in $\alpha$, r$ETR_{max}$, and $E_k$ could be due to change in ambient light intensity and subsequently result in higher spatial variability in Chl *a* concentration. Low variability in $F_v/F_m$ results from photoacclimation of ice algae to low light and may be related to well development of ice algal community.

## References

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