スバールバルのコケツンドラに生育するコケ５種の光合成特性

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Photosynthetic characteristics of five moss species in a moss tundra on Svalbard

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Arctic terrestrial ecosystems are vulnerable to climate change, and a major concern is how the carbon balance of the ecosystems will respond to climate change (Schuur et al., 2015). Wet land of tundra ecosystems have been strong sinks for atmospheric CO_2 after last glacial and contain large amounts of accumulated soil organic carbon (SOC)(Lund et al., 2010). Climate change is likely to have huge influence on this SOC pool by changing carbon balance. However little known about carbon cycle in the High Arctic wet land ecosystem. As a part of a carbon cycle study in a wet tundra (moss tundra), we investigated relationship between photosynthesis and abiotic factors for five moss species.

We set a study site at Stuphallet where on the Brøgger peninsula near Ny-Ålesund, Svalbard, Norway (79°N). The area is almost totally covered with mosses including relatively dominant species *Calliergon richadsonii*, *Campylium sp*., *Campyliadelphus stellatus*, *Sanionia uncinata*, and *Tomenthypnum nitens*. A few vascular plants grow in mosses. We collected a green part of five moss species (*Calliergon richardsonii*, *Meesia triquetra*, *Sanionia uncinata*, *Tomenhypnum nitens*, and *Paludella squarrosa*) and brought back to the NIPR station in Ny-Ålesund. The rates of net photosynthesis and dark respiration for the mosses were determined using an open-flow gas exchange system with an infrared gas analyzer. During the measurements, temperature (2–23ºC) and Photosynthetically Active Radiation (0–1500 µmol photons m^{-2} s^{-1}) were changed. After the measurements, the moss samples were dried out to determine dry weight. In order to know environmental condition, temperature of green part of moss layer and PAR were also measured at Stuphallet and on the roof of the station, respectively.

During the growing season in 2014 (9 July – 31 Aug), temperature for green part of moss layer ranged from 0 to 16ºC. The highest frequency in the temperature was observed at 7ºC. 76% of the temperature frequency ranged from 2 to 8ºC. On the other hand, Frequency of PAR showed the highest from 100 to 200 µmol photons m^{-2} s^{-1} (26% of the total). The frequency decreased exponentially with increasing PAR more than 200 µmol photons m^{-2} s^{-1} to 1300 µmol photons m^{-2} s^{-1}.

Net photosynthetic rate for all moss species within the range of 2 to 12ºC did not change significantly when PAR was more than 200 µmol photons m^{-2} s^{-1}. In contrast, the photosysnthesis tended to decrease with increasing temperature under 100 µmol photons m^{-2} s^{-1}. On the other hand, light (PAR) dependence on net photosynthesis tended to be different among the five species. Light saturation point of *C. richardsonii*, *M. triquetra*, and *P. squarrosa* showed approximately 400 µmol photons m^{-2} s^{-1}. In contrast, the point for *S. uncinata* and *T. nitens* showed approximately 200 µmol photons m^{-2} s^{-1}. In comparison to the net photosynthesis per unit moss dry weight between the five moss species at the most likely temperature and PAR condition (7ºC, 200 µmol photons m^{-2} s^{-1}), the highest value showed *P. squarrosa* and the lowest showed *T. nitens*. There was more than twice the difference between them. On the other hand, *S. uncinata* and *M. triquetra* showed the highest net photosynthesis at the same temperature and PAR condition per unit area basis. Although net photosynthesis of *P. squarrosa* per unit dry weight basis showed the highest value, the moss per unit area basis showed the lowest value.

The net photosynthesis per unit area at 7ºC and 200 µmol photons m^{-2} s^{-1} did not completely coincide with degree dominancy of vegetation at the study area. However, higher degree dominancy of mosses tended to be higher net photosynthesis per unit area. As a next step, we will measure respiration rates for brown part of these mosses and estimate net primary production.