Adaptation strategies of the photosynthetic organisms in polar regions and its diversity

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In the continental Antarctic region, photosynthetic organisms are exposed to severe stressful conditions such as low temperature, drought, strong visible (VIS) and UV light in summer. These environmental factors generally accelerate photoinhibition. Because light quality and light intensity fluctuate dynamically in natural microenvironments, quantitative and qualitative analysis of photoinhibition is important to clarify how this environmental pressure has impacted ecological behaviour in different organisms. In this study, we had two approaches to clarify the adaptation strategies of photosynthetic organisms in Antarctica. First, we carried out micrometeorological observation of their habitats in Antarctica. Second, we determined the reaction coefficients (Epi) of photo-inactivation and compared the wavelength dependency among a green alga (*Prasiola crispa*), a lichen (*Umbilicaria decussata*) and a bryophyte (*Ceratodon purpureus*) that were collected at Langhovde on the Sôya Coast in East Antarctica. *P. crispa* showed ten times higher sensitivity (E_{pi}) to UV-B light than the bryophyte, and the deduced rate coefficients (k_{pi}) of photo-inhibition under ambient sunlight suggested that *P. crispa* needs to pay a greater cost to recover from photo-damage than the lichen or the bryophyte in order to keep sufficient photosynthetic activity under the Antarctic habitat. In addition to the above properties, it was found that the alga has a unique antenna system which enables to utilize far-red light with high efficiency to photosynthesis. It is suggested that this system has a critical role for achieving an efficient photosynthesis as a whole colony under widely fluctuating light condition.

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