（学位第３号様式）

学 位 論 文 要 旨

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題　目	The effects of some environmental factors on the photosynthesis of two brown algae, *Sargassum muticum* and *Sargassum macrocarpum* (Fucales) from Japan（日本産褐藻タマハハキモクとノコギリモク（ヒバマタ目）の光合成における環境要因の影響）

The effects of some environmental factors including irradiance, temperature, desiccation, and salinity gradients on the photosynthesis of two brown algae of *Sargassum* (Fucales), *S. muticum* (lower intertidal species) and *S. macrocarpum* (subtidal species) were determined using a PAM-chlorophyll fluorometer and optical dissolved oxygen sensors. In *S. muticum*, net photosynthesis–irradiance (*P–E*) curves at 8, 20, and 28°C showed that the net photosynthetic rate (NP_{max}) and saturation irradiance were highest at 28°C. Gross photosynthesis determined at 8–36°C and 300 µmol photons m^{-2} s^{-1} showed that the maximum gross-photosynthetic rate (GP_{max}) occurred at 19.5°C, which is consistent with the seawater temperature at its peaked abundance in Japan. The maximum quantum yield (F_v/F_m) during the 72-h temperature exposures were above 0.60 at 8–28°C but dropped at higher temperatures. Continuous exposure (12-h) to irradiance of 200 (low) and 1000 (high) µmol photons m^{-2} s^{-1} at three temperatures showed remarkable decline in the effective quantum yields ($\Delta F/F_m'$) under high irradiance at 8°C only; the F_v/F_m measured after 12-h dark acclimation also did not recover to initial values, signifying its sensitivity to photoinhibition at 8°C. In *S. macrocarpum*, *P–E* curves at 24°C under red (660 nm), green (525 nm), blue (450 nm), and white light (metal halide lamp) showed that NP_{max} under blue and white light was greater than under red and green light, indicating the sensitivity and photosynthetic availability of blue light in the subtidal light environment. Temperature responses of the Fv/F_m (in darkness) and $\Delta F/F_m'$ (at 50 µmol photons m^{-2} s^{-1}) during 6-day culture (4–36°C) remained high at 12–28°C but decreased at higher temperatures. Nevertheless, $\Delta F/F_m'$ also dropped at temperatures below 8°C, suggesting light sensitivity under chilling temperatures, since Fv/F_m remained high. In the desiccation experiment, two species showed different responses under dehydrated and rehydrated states. In *S. muticum*, this alga exhibited tolerance to 2-h of desiccation at 20°C and 50% humidity with 80% of water loss (absolute water content, AWC of 20%), and $\Delta F/F_m'$ recovered after 24-h of rehydration in seawater, suggesting potential of photosynthetic recovery at such low hydration threshold. In *S. macrocarpum*, this alga under aerial exposure of up to 8-h at 24°C and 50% humidity showed that $\Delta F/F_m'$ quickly declined after more than 45-min dehydration; furthermore, $\Delta F/F_m'$ also failed to recover to initial levels even after 1-day rehydration in seawater. When AWC is reduced below 50%, $\Delta F/F_m'$ did not return to initial levels, regardless of subsequent re-hydration, suggesting a low capacity of photosynthesis to recover from desiccation. Furthermore, *S. macrocarpum* showed a stenohaline photosynthetic response between 20–40 psu, as their $\Delta F/F_m'$ were dropped at outside range of these salinities in 3-day culture. These results suggest that the reason why these two species are well adapted to each environment in the habitat and the range of distribution in Japan. Furthermore, the adaptation of *S. muticum* to relatively high irradiance, the broad range of temperature, and to desiccation may explain its potentially high invasive capacity.