

Seasonal variation of physiological response by temperate zone corals

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Rising temperature has resulted in a poleward shift/expansion of corals in Japan (Yamano et al., 2011). However corals at high latitude are confronted to environmental conditions that differ from tropical conditions with lower temperature in winter, lower light levels, higher nutrients concentrations, etc. Moreover due to the increase in CO₂, aragonite saturation state of the ocean is decreasing (Kleypas, 1999) and this trend may counter the expansion of corals. We conducted chamber experiment at Shimoda located on the tip of the Izu peninsula, Shizuoka, Japan. To understand the influence of seasonal variation on the physiological response (such as photosynthesis, respiration, calcification, antioxidant enzyme activities, etc.) of temperate corals, colonies of *Porites heronensis* and *Alveopora japonica* were transplanted in the field. Every three months for 1.5 year, three colonies of each species are sacrificed: their metabolisms is first measured in situ and then different physiological parameters are measured. Bleaching during winter was observed for both species. In winter, bleached *A. japonica* and *P. heronensis* showed reduced metabolic rates compared to summer. Once the temperature re-increased, all colonies of *A. japonica* recovered and all except one *P. heronensis* recovered. Antioxidant enzyme superoxide dismutase (SOD) in host coral of both *A. japonica* and *P. heronensis* also clearly increased in summer and decreased in winter.

In *P. heronensis* the mitochondrial electron transport activity per protein ratio was higher in summer than in winter and the zooxanthellae mitotic index reached values as high as 30% during the warmer months. These observations suggest that *A. japonica* is resilient to low temperature with a high chance of recovery after bleaching whereas *P. heronensis* compensate for the reduced growth rates in winter with a highly active metabolism and high growth rate in summer.

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