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Diversity of symbiotic algae (Symbiodiniaceae) from *Palythoa tuberculosa* across different spatial and environmental scales

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Abstract

Title Diversity of symbiotic algae (Symbiodiniaceae) from *Palythoa tuberculosa* across different spatial and environmental scales
異なる空間・環境に生息するイワスナギンチャク (*Palythoa tuberculosa*) の共生藻 (Symbiodiniaceae) の多様性に関する研究

The marine symbiotic dinoflagellate Symbiodiniaceae (Lajeunesse et al., 2018) are extensively studied due to their relationship with key-stone anthozoan (Anthozoa) which are crucial for coral reef resilience. There are three main drivers to the diversity of Symbiodiniaceae: environmental tolerance, geographical barrier and host specificity. This thesis examined the genetic diversity of Symbiodiniaceae in a widely distributed specific host *Palythoa tuberculosa* at different environments of the Indo-Pacific region. The genetic diversity of Symbiodiniaceae were resolved using molecular approach with sequences of the conservative internal transcribed spacer region 2 of rDNA (ITS2) and the hypervariable non-coding region of the chloroplast psbA gene (psbA^{ncr}).

The ITS2 managed to delineate two genera of Symbiodiniaceae hosted by *P. tuberculosa*: the widespread *Cladocopium* (C1/C1-related) and thermotolerant *Durusdinium*. *Durusdinium* was only recorded at warm environments near the equator, whereas *Cladocopium* was widespread across the latitude.

Studies at acidified reef (Iwotorishima: CO₂ bubble vent with high pCO₂), Red Sea (warmest sea), river mouth (Mizugama: temperature, salinity, pH and turbidity) showed significant difference between microenvironments within each study locations. This also correlates with significantly different Symbiodiniaceae *Cladocopium* psbA^{ncr} lineages between microenvironments. Some *Cladocopium* psbA^{ncr} lineages also showed higher prevalence and improved the resilience of holobionts (host-symbiont) at specific microenvironments. Study at Dongsha Atoll showed no significant differences of seawater temperature and light intensity, and Symbiodiniaceae diversity between spurs (depth = 5.95±0.23 m) and within grooves (depth = 8.11±0.47 m). These studies had shown the consistency of the *Cladocopium* psbA^{ncr} lineages corresponding only with significant variations between microenvironments.

Mantel tests and Spatial structure analyses showed that microenvironments (< 1km) had the same driving force as large geographical distances (>100 km) in determining the diversity and prevalence of Symbiodiniaceae hosted by *P. tuberculosa*. Hence, future studies should be focused fine-scale environmental differences with higher resolution markers, which often gets over looked at.

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