

論文 / 著書情報
Article / Book Information

題目(和文)	北西太平洋地域における熱帯性海草ベニアマモとリュウキュウアマモの遺伝的多様性、集団遺伝構造および繁殖動態に関する研究
Title(English)	Genetic diversity, population structure and reproduction dynamics of tropical seagrasses, <i>Cymodocea rotundata</i> and <i>C. serrulata</i> in the Northwestern Pacific region
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種別(和文)	論文要旨
Type(English)	Summary

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論文要旨

THESIS SUMMARY

専攻 : Department of	Mechanical and Environmental Informatics	専攻	申請学位 (専攻分 博士 野) : Academic Degree Requested	Doctor of (Philosophy)
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要旨 (英文 800 語程度)
Thesis Summary (approx.800 English Words)

The first genetic study of the two dominant species of tropical seagrasses *Cymodocea rotundata* and *C. serrulata* was investigated across the Northwestern Pacific region. The present study covered different aspects of genetic diversity, population structure, clonal architecture, and reproduction dynamics spanning a wide range of conditions in the local and geographical scales within the context of management, conservation and establishment of marine protected area (MPA).

The study reveals that the novel microsatellite (SSR) markers developed for *Cymodocea rotundata* and *C. serrulata*, proved to be powerful tools in assessing genetic study of the tropical *Cymodocea* species in their wide range of conditions. These markers are polymorphic, highly variable and their applicability proved to be useful for estimating genetic parameters and reproduction dynamics of these species for conservation and management programs.

A varying degree of clonal richness across the Northwestern Pacific region, inferred from local and geographical scales is revealed in this study, ranging from 0.0 (single genet) in a disturbed population in Hainan Island to 1.0 (all individuals belonging to different genets) in some diversity hotspot locations in the Philippines. *C. rotundata* and *C. serrulata* show remarkable characteristics to multiply sexually and asexually in response to environmental conditions. Predominant sexual reproduction was exhibited in the Philippine populations, known as the central diversity hotspot, while asexual reproduction was common in Ryukyu and Hainan the range edge of distributions. The low clonal richness obtained from the range edges, coincided the result at the local scale being affected by anthropogenic disturbances. These species exhibit phenotypic plasticity to respond anthropogenic disturbances, exhibiting several growing clones, favoring clonal spread to colonize and form meadows consisting of few dominant genets. On the other hand, the high frequency of young and unique genets suggests that pristine and relatively protected populations are characterized by successful sexual reproduction and low probability of young genets to grow to older/larger clones. These species most likely shaped towards clonal expansion in response to environmental disturbance. Populations thriving at the range edge and disturbed areas rely on clonal growth to survive and, at least clonal spread could be an important gene dispersal vector, equivalent to sexual reproduction. The clonal spread may help populations' persistence in a short term but unrelenting stressful conditions may eventually led to a loss of genetic diversity through selection and certainly do not bode well for any attempted conservation efforts, their genetic diversity may also reduce overtime. This phenomenon is manifested in a genetically impoverished populations in Hainan exposed to human- induced disturbances with lone genet occupying the seagrass bed spanning $\sim 300 \times 40$ m. The dominance of large genets might indicate that these meadows are the result of ecological and evolutionary processes inferred over long time scales, thus, range edges and disturbed areas set by competition can be colonized and dominated by a dominant founding genet.

Despite comparable genetic diversity of *C. rotundata*, populations in the range edges and disturbed areas were showing high degree of negative F_{IS} values (heterozygous excess) indicating natural selection. This phenomenon was clearly revealed by *C. serrulata*, with decreasing genetic diversity in terms of allelic richness and heterozygosity in the range edges. This is attributable to the predominant high negative F_{IS} values, most possibly the effect of drift due to population size, resulting from low sexual reproduction and low dispersal, which could be strengthened by natural selection across life stages that favors clonal reproduction for environmental fitness.

The F_{ST} which is a measure of the degree of genetic separation or differentiation, revealed a large

variations even at the local scale in a varying distance from 0.1 to 6 km which was supported by the pronounced positive isolation by distance (IBD). This is indicative of restricted gene flow of these species within a short distance. Autocorrelation analysis elucidates the significant positive spatial structure inferred within a short distance of approximately 0-800 meters, providing an estimate of the local gene dispersal. This indicates that neighboring individuals are more likely related to each other due to limited seed dispersal potential. This result implies that MPA could be established within a distance of at least 800 meters or on the basis of population level.

The genetic structure maps show a pattern of genetic bioregional affinity which is relevant to delineate the establishment of marine protected areas (MPAs) network. The parsimonious reasons of the genetic similarity across different regions are more likely enhanced by two driving factors: the island integration hypothesis during plate tectonic events and the major water current systems (Kuroshio and Mindanao Currents) existing along the different regions.

Because seagrasses are so rich in species and harbor various endangered marine creatures, establishing protected areas to conserve the habitat also results in species conservation. Genetic diversity is one of the three forms of biodiversity recognized by the International Union for Conservation of Nature (IUCN) as deserving conservation along with species and ecosystem. Population genetic studies over a range of local to geographic scales provide useful indicators of natural history, contemporary changes and offer new projections under environmental disturbances.

備考：論文要旨は、和文 2000 字と英文 300 語を 1 部ずつ提出するか、もしくは英文 800 語を 1 部提出してください。

Note : Thesis Summary should be submitted in either a copy of 2000 Japanese Characters and 300 Words (English) or 1copy of 800 Words (English).

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