Abstract (in English)

Name	Tengku Zia Ulqodry (テンク　ジア　ウルコドリ)
Title	Studies on Mangrove Photosynthetic Performances in Relationship with Zonation and Productivity (光合成特性からみたマングローブ林の帯状構造と生産特性に関する研究)

Mangroves are the unique C_3 coastal plant living in specific habitat in the intertidal zone, and show high productivity and specific zonation. Mangrove provide substantial services in regard to shoreline protection, sustainable fisheries, and carbon fixation capacity. Leaf O_2 evolution and CO_2 uptake are fundamental mechanisms from individual plant to the global scale. The objective of this study is to investigate photosynthetic performance in mangrove as regards their productivity and adaptability mechanisms. This information is important to explain mangrove productivity, elucidate the zonation and diagnose successful mangrove within tropic intertidal zone, managed or natural.

As regards light competition, gas exchange and chlorophyll fluorescence of *Rhizophora mucronata*, has been investigated seasonally under full sunlight (HL), 50% shading (ML) and 80% shading (LL) conditions. The carboxylation efficiency significantly affected the seasonal change of photosynthetic capacity. The photosynthetic rate (P_N) of *R. mucronata* seedlings under shade regimes could not be attributed to variability in chlorophyll, intercellular CO_2 concentration, quantum yield of photosystem II, electron transport rate or photochemical quenching values but more to differences in carboxylation efficiency, maximum stomatal conductance (g_{max}), and maximum transpiration rate (E_{max}). HL and ML had higher P_N, $g_{max\,s}$ and E_{max} than the LL. Nevertheless, LL leaves exhibited low photoinhibition susceptibility.

Traditional method for P_N has been estimated by either O_2 evolution or CO_2 uptake. We used a liquid-phase O_2 electrode combined with CO_2 optodes to examine simultaneously P_N in intact mangrove leaves. Photosynthetic O_2 evolution and CO_2 uptake in response to pH exhibited a higher rates were associated with intermediate pH compared with low and high pH. P_N estimated by O_2 evolution showed a tendency to be higher than those by CO_2 uptake in all treatment.

We clarified photosynthetic performance of different mangrove zonation species (*Avicennia marina*, *R. mucronata*, and *Bruguiera gymnorrhiza*) under combination of salinity and NaCl soaking stress. Photosynthetic performance in *B. gymnorrhiza* was decreased significantly as compared with other species. In other side, photosynthetic performance of *A. marina* was uniquely increased with increasing the soaking period and NaCl concentration. It showed that *A. marina* maintained high P_N even under the soaking condition. *R. mucronata* had an intermediate response to NaCl concentration during the soaking periods.

Our study conclude that seedling of *R. mucronata* grown under moderate shade condition provided better condition to obtain such carbon fixation capacity than deep shade condition. This result clarified the suitable shading level during nurse phase of *R. mucronata* upon reforestation and cultivation. Simultaneous measurements of O_2 evolution and CO_2 uptake is useful to explore the photosynthetic quotient (PQ) values of mangrove. Based on the rank order of the photosynthetic performance and PQ values to saline and the soaking periods was, from most to least tolerant, *A. marina* > *R. mucronata* > *B. gymnorrhiza*. Our result proposed that the ability of *A. marina* to gain high PQ values under high salinity and flooding conditions could be as potential plant for mangrove rehabilitation and productivity in the future especially during increasing of sea level due to global warming.