

Fourteen-year trend of above-ground biomass in a *Sonneratia alba* forest in Pohnpei, Federated States of Micronesia

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I Introduction

On Pohnpei, an island in the Federated States of Micronesia (FSM), remains natural mangrove forests where the environment has been maintained without being subjected to large-scale development and remarkable human disturbance. From 1994 to 2003, tree species were monitored in fixed plots to predict sustainable management in the mangrove forests, with four communities of multiple species composition. Many years later, the monitoring survey has revealed the location of the mangrove and the stand structure (Fujimoto *et al*, 1995), the changes in the biomass of the aboveground part and productivity (Fujimoto *et al*, 2013), and the biomass dynamics of the above-ground part (Nishino *et al*, 2015), among others parameters. In this research presentation, in order to verify the growth characteristics of the *Sonneratia alba* forest in Pohnpei, FSM and the biomass dynamics of the above-ground part, the species composition of the *Sonneratia alba* forest, the tree density, the growth rate of the stem cross-section, the total amount of and the increase in above-ground biomass, we examined the transition of speed, the relationship between the change in location and ground height, and the annual growth rate of stem cross-sections.

II Survey Method

Fixed plots of width 20 m × depth 100 m were set in 2002 in the *Sonneratia alba* community established in the northern part of the Pohnpei State island of Pohnpei (hereinafter referred to as the PS fixed plot). Every tree investigation, for all individuals above breast height in each plot, the diameter of trees in the *Rhizophora* genus that were 30 cm above the pillar roots, and that of other tree species that were breast height (ground height 1.3 m) were measured. The survey was conducted in 2002, 2004, 2012, and 2016. Using measurement data from 2002 and 2016, the cross-sectional area, growth volume, and growth rate in each year were calculated from the diameter of the tree species. To calculate the above-ground biomass, the tree height was estimated by substituting the diameter value of all the individuals in the plot obtained in each tree survey into the relational expression of Tabuchi *et al.* (2006b), and each of the above-ground parts. The biomass of the site (weight of stem [wS], branch [wB], leaf [wL], seeds [wF]) was calculated using the relative growth relation of Komiyama *et al.* (1988). To estimate the aerial part biomass (wP) of the respiratory roots, the total height of the respiratory roots in the 1 m × 1 m rectangular section arranged in plural in the plot was substituted into the relational expression of Tabuchi *et al.* (2006a).

III Results and Discussion

PS fixed plots for three species were established: *S. alba*, *Rhizophora apiculata*, and *Bruguiera gymnorhiza*. The majority of *S. alba* was distributed on the seaward side (shoreline area), and *R. apiculata* and *B. gymnorhiza* tended to be distributed toward the inland side. The tree density decreased from 1,885 number/ha measured in 2002 to 1,280 number/ha in 2016, a decrease of 605 number/ha in 14 years: in 2004 it was 1,795 number/ha, and in 2012 it was 1,385 number/ha. In terms of tree type, *S. alba* has decreased by 190 number/ha (2002, 870 number/ha; 2016, 680 number/ha). *R. apiculata* has decreased by 365 number/ha (2002, 840 number/ha; 2016, 475 number/ha). *B. gymnorhiza* has

decreased to 40 number /ha (2002: 165 number/ha, 2016: 125 number/ha). Especially, *R. apiculata* decreased by nearly half the number of standing trees. *S. alba*, with size composition in the large diameter trees, accounted for nearly 90% of the stem cross-section area ratio. Although *R. apiculata* was the most common in the established number of trees, the ratio of the stem cross-sectional areas of *R. apiculata* and *B. gymnorhiza* was just over 10%. Looking at the trend over the 14 years from 2002 to 2016, although the standing density.

The total amount of above-ground biomass per 1 ha of PS fixed plot was 536.9 t/ha. For the different species, *S. alba* accounted for 478.4 t/ha (89.1%), *R. apiculata* accounted for 31.9 t/ha (5.9%), and *B. gymnorhiza* accounted for 26.6 t/ha (5.0%). All three above-ground biomass increased every survey year: that of *S. alba* increased by 72.6 t/ha (2002, 443.6 t/ha; 2016, 516.2 t/ha), that of *R. apiculata* increased by 6.6 t/ha (2002, 25.3 t/ha; 2016, 31.9 t/ha), and that of *B. gymnorhiza* increased by 7.5 t/ha (2002, 19.1 t/ha; 2016, 26.6 t/ha). Furthermore, the annual average ground biomass increase rate increased to 3.7 t·ha⁻¹·yr⁻¹ (2002-2004), 5.2 t·ha⁻¹·yr⁻¹ (2004-2012), 8.1 t·ha⁻¹·yr⁻¹ (2012-2016) At the *S. alba* site, the trunk biomass increased greatly. The respiratory root biomass of *S. alba* decreased from 33.1 t/ha in 2002 to 22.8 t/ha in 2012, but then increased greatly to 38.0 t/ha in 2016.

Keywords: above-ground biomass, Mangrove (*Sonneratia alba* forest), Biomass dynamics, Stem area growth rate, sea level rise, Federated States of Micronesia Pohnpei