Estimation of fine root production and decomposition rates in tropical and subtropical mangrove forests.

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Mangrove forests generally store a large amount of carbon as peat in their substrata compared with terrestrial forests. Mangroves have the distinctive feature of allocating a large production of biomass belowground as shown by their low top/root biomass ratio (Fujimoto et al. 2000). Furthermore, production of a large volume of belowground fine roots with a short lifespan contributes considerably to the net primary production (NPP) of mangrove forests (Poungparn et al. 2016). Indeed, the concomitant high volume of production and low decomposability of mangrove roots under anaerobic belowground conditions account for the large amount of carbon sored belowground in mangrove forests. Few studies, however, have attempted to comprehensively evaluate the contribution of fine root production to peat accumulation in mangrove. We examined fine root dynamics in several tropical and subtropical mangrove forests in order to understand the role of carbon sequestration in natural mangrove forests. We evaluated the production and decomposition of fine roots using the ingrowth core method and the root litterbag method, respectively.

We studied five mangrove species (*Rhizophora stylosa, R. apiculata, Sonneratia alba, Bruguiera gymnorrhiza, and Xylocarpus granatum*) in four forest stands on Pohnpei Island, Micronesia (6˚53′N, 158˚20′E) and two stands on Iriomote Island (24˚17′N, 123˚51′E). Pohnpei Island is located in the center of the tropical zone and Iriomote Island is at the northern limit of the mangrove habitat range. Fine root production (FRP) in mangrove peat (0-30 cm depth) ranged from 2.3 to 16.9 t/ha/year on Pohnpei Island and from 2.0 to 3.5 t/ha/year on Iriomote Island. These results indicate that FRP in mangrove forests was generally equal and/or relatively high compared with values previously recorded for terrestrial forests (Finér et al. 2011). FRP in the seaward side near forest edge of *S. alba* stand was 16.9 ±2.6 t/ha/year, which was higher than that of the stands on Pohnpei Island but not significantly so. FRP in the *R. stylosa* and *B. gymnorrhiza* stands on Pohnpei Island were 5.9 ±5.3 and 7.0 ±3.0 t/ha/year, 1.5 to 4 times higher than on Iriomote Island, which reflects larger tree size and the tropical climate condition of the former (i.e., high temperature and humidity). Annual mass loss of fine roots ranged from 21 to 73wt%/year on Pohnpei Island and from 38 to 52wt%/year on Iriomote Island. These results indicate that the decomposability of fine roots considerably lower than the values previously reported for leaf litters of mangrove forests (Ono et al. 2006). Although annual mass loss of *B. gymnorrhiza* roots on Pohnpei Island was markedly lower than that of other species' roots, the difference was not significant.

The results of the present study suggest that mangrove forests tended to have high FRP values and low decomposition of fine roots, but that FRP and decomposition did not differ significantly among species. Amount of belowground stored carbon differed among the mangrove community types. Thus the results of the present study indicate that carbon storage in mangrove peat is controlled by elements of fine root dynamics (e.g., FRP and decomposability) in respective mangrove communities.

Keywords: mangrove peat, fine root dynamics, belowground stored carbon, Pohnpei Island, Iriomote Island

