Regional Studies in Marine Science 25 (2019) 100475

Contents lists available at ScienceDirect

Regional Studies in Marine Science

journal homepage: www.elsevier.com/locate/rsma

Comparison of biomass and net primary productivity among three species in a subtropical mangrove forest at Manko Wetland, Okinawa, Japan

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HIGHLIGHTS

- Species composition and stand structure of the mangrove communities was investigated.
- AGB, BGB, litterfall, and net primary productivity were analyzed and compared.
- *Rhizophora stylosa* at Manko wetland is a faster growing as well as more productive mangrove species compared to other species.

ARTICLE INFO

Article history:
Received 23 September 2018
Received in revised form 7 December 2018
Accepted 9 December 2018
Available online 13 December 2018

Keywords:
Primary productivity
Mangrove ecosystems
Long term litterfall
Stand structure
Biomass

ABSTRACT

This study was conducted to quantify and compare the above- and belowground biomass, litterfall and net primary productivity of three mangrove species in the family Rhizophoraceae: *Bruguiera gymnorrhiza*, *Kandelia obovata*, and *Rhizophora stylosa*, in Manko Wetland, Okinawa Island, Japan. A total of thirty five plots were monitored over five years. The studied mangrove stands of all three species were mostly dominated by a large number of small sized trees. Total above-ground biomass of *B. gymnorrhiza*, *K. obovata*, and *R. stylosa* was 64.9,111.6, and 208.290.6 Mg ha^{-1}, respectively. There was no significant difference in AGB between *B. gymnorrhiza* and *K. obovata*, but AGB of both of these species differed significantly from that of *R. stylosa*. Similarly, there was no significant difference in total BGB between *B. gymnorrhiza* and *R. stylosa*, but BGB of both of these species differed significantly from that of *K. obovata* AGB and BGB of *K. obovata* increased with increasing basal area of this species. On the other hand, in case of AGB and BGB of *B. gymnorrhiza* and *R. stylosa*, it did not show any relationship with basal area of the respective species. The average annual rate of above-ground biomass increment was 15.7 Mg ha^{-1} yr^{-1} in the *R. stylosa* stands. Hence, *R. stylosa* stands recored a higher AGNPP (43.8 Mg ha^{-1} yr^{-1}) than *B. gymnorrhiza* (17.7 Mg ha^{-1} yr^{-1}) and *K. obovata* (22.3 Mg ha^{-1} yr^{-1}). Annual total litterfall rates for *B. gymnorrhiza*, *K. obovata*, and *R. stylosa* during the five-year period was 10.1, 9.9, and 12.3 Mg ha^{-1} yr^{-1}, respectively. The annual rate of NPP in the *R. stylosa* stands was greater than that of two other species. *R. stylosa* was the most productive tree in the mangroves of Manko Wetland area in terms of dry matter production.

1. Introduction

According to the current issue of global warming, studies on carbon dynamics and in relation to the role of forest ecosystems as carbon sink have been in progress. There are also growing efforts of mapping carbon stock and flux more accurately at a global scale (Baccini et al., 2012). However, mangroves have largely been ignored in these syntheses due to their relatively small spatial extent and challenges in their mapping (Hutchison et al., 2014). Despite this small spatial extent, field studies have shown that mangroves have high above-ground biomass, productivity (Putz and Chan, 1986), and low AGB/BGB ratio (Komiyama et al., 2008). In a very recent time, the global warming phenomenon has generated interest in understanding the carbon storage ability of mangrove species (Mitra et al., 2011). Carbon storage and its sequestration are linked with the biomass and productivity of the mangrove communities. However, biomass production depends on the interaction between edaphic and climatic factors of the specific area. There are also some methodological differences in calculation of net primary productivity.

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https://doi.org/10.1016/j.rsma.2018.100475
2352-4855/