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Diversity and structural complexity of mangrove forest along Puerto Princesa Bay, Palawan Island, Philippines

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Abstract The paper describes the diversity and structural complexity of mangrove forest along Puerto Princesa Bay, Palawan Island, Philippines. Occurrence of 28 mangrove species and 11 floral associates were found, which identifies the entire bay as one of the most diverse mangrove forests in the country. Of the six coastal barangays surveyed, San Pedro had the highest diversity index, $H' = 0.912$ while Sta Monica had the lowest, $H' = 0.349$. Mangrove stands are structurally simple with two types of vegetation, fringe and riverine that further constitute five distinct mangrove zones named according to dominating species, *Rhizophora-Sonneratia*; *Rhizophora-Sonneratia-Lumnitzera*; *Rhizophora-Lumnitzera-Xylocarpus*; *Rhizophora-Xylocarpus*; and *Rhizophora-Avicennia*. Commonality among these zones is obvious as revealed in Bray-Curtis cluster analysis. Structural features differed across zones. Trees of larger dbh, 104.5 cm and higher species richness, a total of 15 species, were found in zone 1 while those that comprised the highest basal area, $438 \text{ m}^{-2} \text{ ha}^{-1}$ and density, 8100 ha^{-1} from zones 2 and 4, respectively. Zones 1 and 4 are fringing mangrove forests. Degrees of perturbations greatly depend on human access to mangrove areas. Garbage dumping, occasional cutting of trees, soil erosion, and encroachment of human settlers were identified as potential threats to mangrove forest along the bay.

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Introduction

Mangrove forest is one of the vital ecosystems in tropical countries. The Philippines alone is a home to at least 39 man-

grove species (Sinfuego and Bout, 2014; Primavera et al., 2004) and similar to other regions, the various natural products and ecological services (Rönnbäck, 1999; Clough, 2013) of this resource are well recognized in the country, including its role in climate change mitigation (Donato et al., 2011; Sheeran, 2006).

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Palawan has an extensive mangrove forest at 51,346 ha in 1998, representing 3.63% of the total land area of the province (PCSDS, 2004). Presidential proclamation 2152 of 1981 declared the entire island province as “Mangrove Swamp Forest Reserve” (<http://www.puertoprincesa.ph>, 2012). To date, nearly 31, 507 ha of mangrove forest in the island-province are highly protected under the International Union for Conservation of Nature (IUCN), and three species, *Ceriops decandra*, *Aegiceras floridum* and *Lumnitzera littorea* with threatened conservation status (Long and Giri, 2011) are widely distributed in some of its localities.

Mangrove ecosystems in nearly all municipalities of Palawan are well documented. Accordingly, Palawan has 23 “true mangrove” species. Species richness ranged from 8 to 17 per municipality of which Dumarang and Roxas in northern part of the island have the maximum number of species. *Rhizophora apiculata*, *Sonneratia alba*, and *Bruqueira gymnorrhiza* dominate the mangrove flora of the island (PCSDS, 2004, 1999).

Mangroves of Puerto Princesa constitute 11.7% (5995 ha) of Palawan’s mangrove cover. Major mangrove forests in the city have low volume stands due to deforestation rate of 10 has per year, which may be related to increasing number of fishponds, 530 units in 1998 from only 103 units in 1992 (PCSDS, 2004). In Puerto Princesa Bay alone, 150 ha mangrove area is covered by Fishpond Lease Agreement (FLA) (<http://www.puertoprincesa.ph>, 2012).

Available information on mangrove composition and structure along Puerto Princesa Bay are scarce. The latest available reference reported 18 true mangrove species from nine coastal barangays along the bay (PCSDS, 2006). Earlier attempts made to assess the status of mangroves in the area gave insufficient record on species composition, only 5–14 species, due to

limited number of areas surveyed (Becira, 2005; Aliño et al., 2001). Nonetheless, mangrove species composition, community structure, growth, and recruitment in some portions of the bay were initially investigated.

This study was conducted as part of the Commission on Higher Education’s Research and Development Program for Marine Biodiversity along Bohol and Sulu Seas. After more than a decade, additional accounts on mangrove’s diversity and structural complexity from Puerto Princesa Bay are wanting.

Materials and methods

The study site

Puerto Princesa Bay, 9°40’N to 9°47’N and 118°40’E to 118°47’E, is a relatively shallow bay located in the mid-eastern coast of mainland Palawan, south of Puerto Princesa City. It covers 20 coastal barangays with a land area of 25,688 ha (www.puertoprincesacity.gov.ph, 2012). Mangrove survey was conducted in six coastal barangays along the bay namely; San Pedro, Tiniguiban, Sicsican, Irawan, Iwahig and Sta. Lucia (Fig. 1).

Sampling techniques

Mangrove vegetation assessment followed the standard protocol described by English et al. (1997) with slight modification. In each sampling station, at least two transects, 50–100 m, depending on the extent of mangrove cover, were laid perpendicular to the shore and/or riverbank. A 10 m × 10 m plot was

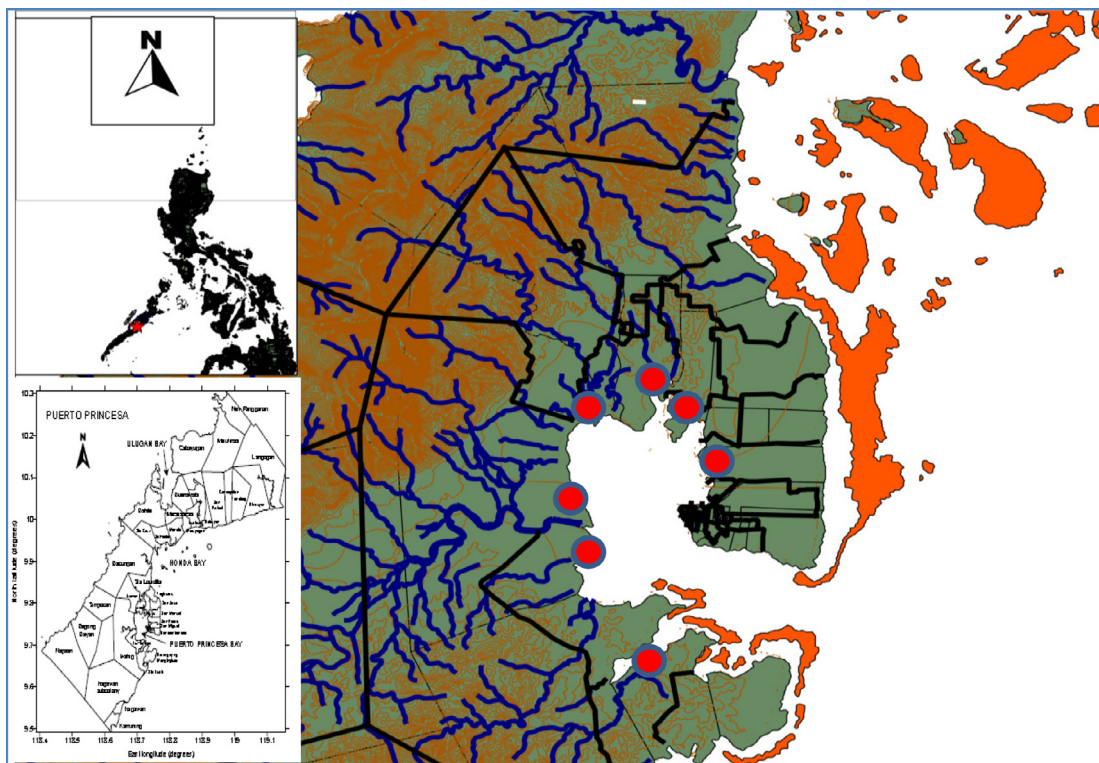


Figure 1 Map of the Philippines (inset) showing the location of Puerto Princesa Bay and the seven sampling stations (red-filled circles).

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