State of Mangroves in Tiniguiban Cove, Puerto Princesa Bay, Puerto Princesa City, Palawan

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ABSTRACT

The study State of Mangroves in Tiniguiban Cove, Puerto Princesa Bay, Puerto Princesa City was documented and assessed using the following parameters: total area covered, diversity, population structure and diversity and threats to mangrove (cutting).

The study was conducted in May 2003 using plot-quadrat method. Ten plots were non-randomly distributed in the study area.

Fourteen major and one associated mangrove species were found in the study area (H=0.85). The three dominant species were *Rhizophora apiculata* (41%), *Sonneratia alba* (39%) and *R. stylosa* (13%). These species also accordingly, they had the highest importance values at 192, 146, and 80, respectively.

Considering the small size of the mangrove stand, diversity was relatively high compared in other areas of Palawan. However, continuous expansion of residential areas as well as the development of various students poses a threat to the survival of mangroves. Thus, demarcation of the present mangrove area in Tiniguiban Cove is needed.

INTRODUCTION

The Philippines, an archipelago of some 7,100 islands with an area of 300,838 km^2 had approximately 450,000ha of mangroves in 1918 (Brown & Fischer 1920 as cited by PCARRD 1991). In 1980, about 220,242ha of mangrove forests borders 17,360km of Philippine coastline (Gomez 1980). Of these mangrove stands 146,000ha were with closed canopy representing primary and secondary growth conditions dominated by true mangrove species (Gomez 1980). Mangroves of large and contiguous extent can be found in Panay, Biliran, Samar, Leyte, Palawan and Mindanao (Gomez 1980). Ninety-five percent of the remaining mangroves are secondary growth and only 5% are old or primary mangroves. The later are mainly found in Palawan (Melana 1994 as cited by Melana et al. 2000). With an estimated national deforestation rate of 4,432ha/year between 1951 and 1988 (DENR 1990), Palawan and the rest of Region IV had a total mangrove area of 51,000ha representing 43 % of the country's total mangrove areas.

According to the DENR 1995 statistics, conversion to fishponds, prawn farms, salt ponds, reclamation and other forms of industrial development have reduced the mangrove area to 117,700ha (Melana et al. 2000).The steady reduction in mangrove areas during

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the past several decades is attributed to harvesting of mangroves for charcoal or firewood production, and to forest clearing for fishponds establishment. Expansion of coastal communities also played a role in reduction of mangrove areas (PCARRD 1991).

In Tiniguiban Cove, the establishment of a power barge, fish cages and expansion of residential areas in the coastal communities contributed to the reduction of mangrove vegetation. This led to this study on the state of the mangroves in Tiniguiban Cove. This paper reports the status of mangroves in Tiniguiban Cove in terms of: a) total area covered, b) species composition, c) community structure, and d) cutting commencing May 1 to July 4, 2003.

METHODOLOGY

This study was conducted in the eastern part of the Tiniguiban Cove, Puerto Princesa City located at the north-eastern part of Puerto Princesa Bay (Figure 1). The study area is situated east of the Palawan State University and west of Camp H. Mendoza, 4 km from the city proper (ca. 09o46'04" North latitude and 118o43'26" East longitude, Salva et al. 1996). The area is characterized by mangroves, which narrowly (50 - 100m) fringe the coastline. In order to assess the size of the area covered by mangroves and to identify the location of structures that might influence the occurrence of mangroves, the area was assessed and mapped using the global positioning system Garmin II.

All mangrove species encountered were recorded at species level using the following references: Calumpong and Meñez (1997), Tomlinson (1986) and a dichotomous identification key developed by Schoppe (undated). To assess the community structure in terms of density, dominance and frequency of mangroves, a total of ten plots were non-randomly established. The size of the plots was 100m^2 each. This is the usual plot size suggested for mangrove assessment having at least 40 trees (English et al. 1997). In each plot, the species were identified, stems per species were counted and the girth of each tree was measured at breast height (GBH) approximately 1.3 m above the ground using a measuring tape. Seedlings (height 1m or less) and saplings (girth less than 4cm and height more than 1m) were identified. The number of individuals per species was determined by actual counts.

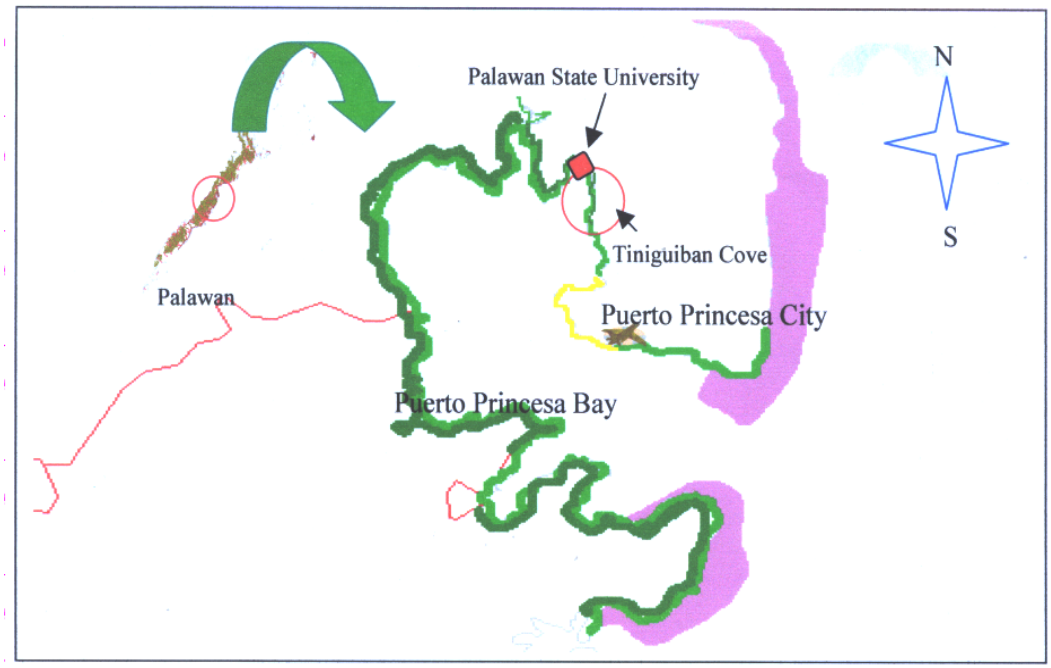

Figure 1. Map of Palawan showing the location of Puerto Princesa Bay and the Tiniguiban Cove in Puerto Princesa City, Palawan, Philippines.

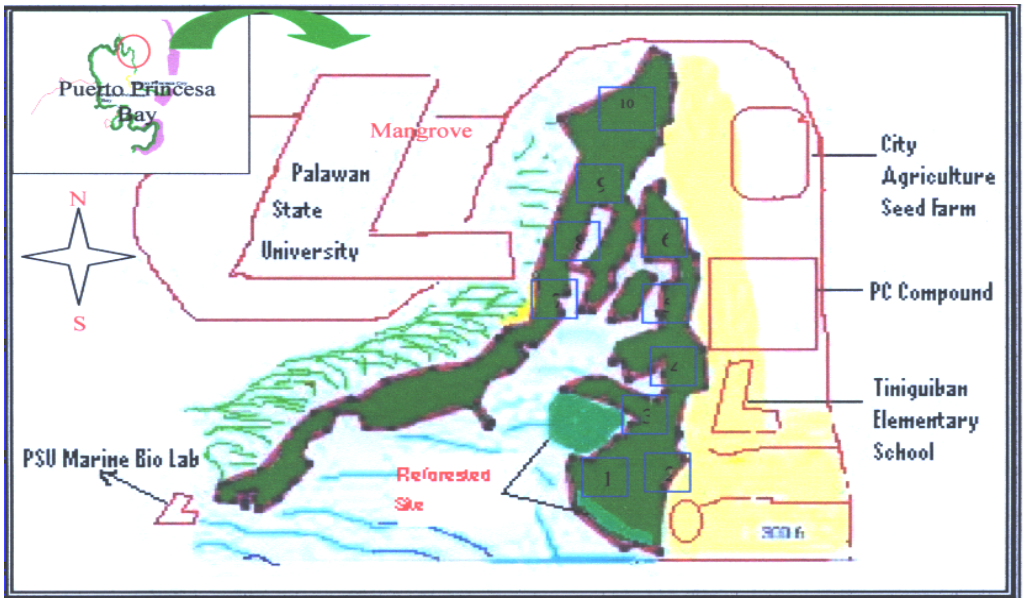

Figure 2. Map of the study area showing the location of sampling plots.

For each mangrove species encountered in any of the plots, notes were taken on the maximum inundation level based on the watermark on the bark. To assess threats to mangroves, cut branches, cutting of whole trees and dead trees were counted per plot.

RESULTS AND DISCUSSION

Site Specifications

The major adjacent and nearby components which the researcher thought to be the major factors influencing the existence of mangrove in the locality were identified. These include the residential area (colored yellow), Tiniguiban Elementary School, PC Compound, City Agricultural Seed Farm and the Palawan State University (Figure 2). Among them, the continuous development of the residential area seems to pose the major threat to the mangrove stand. The total mangrove area (colored dark green) is about five hectares including approximately 0.18ha reforested area (Figure 2).

Species Composition

The area was composed of 14 major mangrove species and one mangrove associate. These includes *Avicennia marina, A. officinalis, Bruguiera cylindrical, B. sexangula, Ceriops tagal, Excoecaria agallocha, Lumnitzera littorea, L. racemosa, Rhizophora apiculata, R. mucronata, R. stylosa, Sonneratia alba, Xylocarpus granatum, Nypa fruticans* and *Pandanus* sp.

The number of major mangrove species found in Tiniguiban Cove is higher (14 species) compared to recorded in Snake Island, Honda Bay (8 species; Schoppe 2003); Benito Marcelo Beach (7 species; Batin et al. 2001) and in Sabang, Puerto Princesa City (10 species; Batin 2003) but comparable in Bancao-Bancao, Puerto Princesa City (SPCP-ASTI 1999) though with different species. The recorded species richness in Tiniguiban Cove is low compared to Bataraza and Balabac (Southern Palawan) where 22 and 21 major mangroves were found (Conservation International 2004), respectively (Table 1). This study showed that even a small area like Tiniguiban Cove can harbor a diverse mangrove flora.

Community Structure

Mangroves in the study area showed a typical zonation based on inundation level (per observation). Species found in the landward zone (0-10m from the shoreline; inundation, 6 cm) were *L. littorea, L. racemosa, B. cylindrica, B. sexangula, E. agallocha* and *X.*

Table 1. Number of mangrove species and approximate area in Puerto Princesa City, southern Palawan, Romblon and Mindoro.

Site	Puerto Princesa City					Southern Palawan		Romblon	Mindoro
	Tiniguiban Cove (This Study)	Sabang (Batin 2003)	Mangingisda (SPCP-ASTI 1999)	Bancao-Bancao (SPCP-ASTI 1999)	Snake Island (Schoppe 2003)	Bataraza (Conservation International 2004)	Balabac (Conservation International 2004)	Romblon (SPCP-ASTI 1999)	Occidental Mindoro (SPCP-ASTI 1999)
Number of species	14	10	15	14	8	9	9	22	21
Area (ha)	5	4	182	51	na	440	60	na	na

na = not available

granatum. In the central part of the forest (inundation: 2.53 - 32.2cm) are *A. marina, A. officinalis* and *C. tagal.* In the seaward zone (inundation: >60cm) were the species of *Rhizophora apiculata, R. mucronata, R. stylosa,* and *S. alba* occurred.

Among mangrove species, *R. apiculata* has the highest basal area (10.47 m^2ha-1) followed by *S. alba* (10.00 m^2ha-1) (Table 2). *Rhizophora apiculata* has the highest stem density (5130 stems/ha) followed by *R. stylosa* (2803 stems/ha). *Sonneratia alba* ranked third based on stems density (1720 stems/ha), despite having equal mean basal area as *R. apiculata.* This shows that *S. alba* had larger trunks and therefore was comparable with *Rhizophora* species when it comes to dominance in the community. The other species of mangrove were rather inconspicuous in terms of basal area and stem number (Table 2).

Rhizophora apiculata occurred in all plots. It was followed by *S. alba* (90%), *R. stylosa* (40%) and *R. mucronata* (30%). Other identified species occurred only once or twice in all sampling plots (Table 2).

R. apiculata and *S. alba* dominated the community in terms of size (Table 2) and may have the highest contribution to energy cycle of the ecosystem (Smith 1992). The relative dominance of the species in the entire study area ranged from 0.06% to 41.11%. *Rhizophora apiculata* dominated all ten plots with a mean relative dominance of 41.11% followed by *S. alba* (39.27%) and *R. stylosa* (13.53%). Others have less than 5% relative dominance.

Relative density of the species ranged from 0.19 to 51.4%. *Rhizophora apiculata* had the highest density followed by *R. stylosa* (26.8%) and *S. alba* (16.6%). Other mangrove species had less than 1% relative density. The domination of *Rhizophora* may be probably due to the muddy substrate in the site which is favorable for its growth (Hogarth 1999).

In Tiniguiban Cove, the most important species was R. apiculata followed by *S. alba* and *R. stylosa. Avicennia marina* is accounted for the lowest importance value (Table 2).

The diversity of mangroves in Tiniguiban Cove using Shannon Index was 0.851. The diversity results signify that the area was dominated by only a few species particularly *R. apiculata, S. alba* and *R. stylosa.* Diversity index in Tiniguiban Cove was however higher compared to Barangay Mangingisda (0.502) and Barangay Bancao-Bancao (0.584) of Puerto Princesa City and in the nearby provinces of Palawan particularly Romblon (0.528) and Mindoro (0.607)

Table 2. Basal area, mean number of individuals per hectare and frequency of the mangrove species in the study area.

Species of Mangrove	Mean basal area (m^2/ha)	Mean number of stems/ha	Frequency	Relative frequency	Relative dominance	Relative density	Importance Value
Avicennia marina	0.02	20	0.1	10.0	0.06	0.19	10.25
A. officinalis	0.06	50	0.2	20.00	0.23	0.47	20.71
Bruguiera cylindrica	0.08	20	0.1	10.00	0.32	0.19	10.50
B. sexangula	0.03	50	0.1	10.00	0.10	0.47	10.57
Ceriops tagal	0.05	60	0.1	10.00	0.20	0.57	10.77
Excoecaria agallocha	0.09	20	0.1	10.00	0.35	0.38	10.73
Lumnitzera littorea	0.62	20	0.1	10.00	2.45	0.47	12.93
L. racemosa	0.3	70	0.2	20.00	1.19	0.76	21.95
Rhizophora apiculata	10.47	5130	1	100.00	41.11	51.37	192.48
R. mucronata	0.03	80	0.3	30.00	0.13	0.76	30.89
R. stylosa	3.45	2830	0.4	40.00	13.53	26.82	80.35
Sonneratia alba	10	1720	0.9	90.00	39.27	16.68	145.95
Xylocarpus granatum	0.27	120	0.2	20.00	1.06	0.85	21.92
Total	**25.48**	**10190**	**NA**	**NA**	**NA**	**NA**	**NA**

(SPCP-ASTI 1999). In comparison with the other sites, Tiniguiban Cove is a good mangrove site but should be managed immediately since disturbances and threats are besetting the site.

Mangrove seedlings and saplings of the three dominant species *(R. apiculata, R. mucronata* and *S. alba)* contributed to the recruitment in Tiniguiban Cove. The number of seedlings and saplings of *R. apiculata* was 320 and 1070, respectively. It was followed by *S. alba* with 150 seedlings and 480 saplings. *R. mucronata* ranked third with a total of 410 seedlings and saplings per hectare. Other species had no or only few recorded seedlings and saplings.

Threats to Mangroves

The fringing mangroves in Tiniguiban Cove are subjected to human disturbances. In fact, part of the area had been already cleared and most houses were made of light and/or concrete materials existing along the seashore. A portion of the mangrove forest has also been converted into a fishpond with two compartments of approximately 0.01 hectare each. Domestic animals are also raised by the communities. Domestic wastes (wastewater, cellophane and the like) are directly discharge into the immediate environment.

Within the forest, cut trees were observed. *Rhizophora apiculata, R. mucronata* and *S. alba* had the highest number of cut trees (1070, 650 and 510 cut trees per hectare, respectively). Being the most common trees in the area it seems that these species are more susceptible to exploitation for as fence enclosure and posts.

CONCLUSION

Based on the study, it was concluded that a possibility of having a diverse mangrove ecosystem may not be limited in large areas though threats to mangrove stand is greater in a small areas. Construction, improper waste disposal and cutting activities especially affect the stands of *R. apiculata, R. mucronata,* and *S. alba.*

RECOMMENDATIONS

For management purposes, demarcation of the present mangrove stand in the Tiniguiban Cove should be

conducted by the proper authority particularly the DENR for monitoring purposes. To increase the level of awareness of the residents of Barangay Tiniguiban on the ecological importance of mangroves, educational and information campaigns should be conducted. Likewise, a follow-up or continuous study on mangroves particularly on economic aspects should also be done.

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