

Symposium Proceedings

Assessment of mangroves in Malabungot Protected Landscape and Seascape in Garchitorena, Camarines Sur

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Abstract

In pursuant to National Integrated Protected Area System Act (NIPAS), the Malabungot Protected Landscape and Seascape (MPLS) was established in on April 23, 2000 under Proclamation No. 288, which was later on formally legislated under the senate bill no. 2895. The protected area is located at Malabungot Island of the Municipality of Garchitorena and encompasses 120.62 hectares. However, there was no baseline records that were used in establishing the area as NIPAS protected nor any recent technical information showing motoring. The study conceptualized to determine the status, species composition and anthropogenic activities of the mangrove forest in Malabungot MPLS. Results revealed that there were 13 species of belonging to seven 7 families of true mangrove species that contributed to more than 33% of the identified “true mangroves” known to the country. The species *R. apiculata* and *R. mucronata* are consistently present in the 4 stations dominating in terms of relative density. Stations 1 and 4 demonstrated high probability of natural regeneration and are more likely to sustain their existence, while Stations 2 and 3 manifested low regenerative capacities. Based on the anthropogenic activities observed, there were only two common threats that had been identified: in MPLS these are: a) cutting of mangrove forest for firewood and b) domestic wastes although to a minimal extent. Overall, the mangrove communities covered by the study areas in MPLS was generally rated as in good condition.

Key words: assessment, mangroves, species composition, Malabungot Island Garchitorena

INTRODUCTION

The protected area system has long been practiced in the Philippines primarily as part of the multitude of interventions to preserve natural endowments and to put in check degradations due to natural and anthropogenic activities. The Philippine Commission Act No. 648 (passed by the US congress in 1903) marked the pioneering foundation of the national parks and protected area initiatives in the country. The scope of these protected areas was expanded by Act No. 1148, also known as Forest Act in 1904. This later on gave birth to establishment of national parks by virtue of the enactment of the National Parks Act (Act No. 3195) in 1932. This was followed by the revised Forestry Code in 1975 and the National Integrated Protected Area System Act (NIPAS) as stated in R.A. 7586 of 1992. The later provides the legal framework for the establishment and management of protected

areas in the Philippines. The NIPAS Act is part of the actualization of the commitment of the Philippine government in various international conventions and agreements it entered into. Under the NIPAS, protected areas in the country are classified and managed in varied ways; and one of them are natural parks. NIPAS describe protected landscape/seascapes as areas of national significance which is characterized by the harmonious interaction of man and land (and the seas) while providing opportunities for public enjoyment through recreation and tourism within the normal lifestyle and economic activity of the area. Pursuant to NIPAS, the Malabungot Protected Landscape and Seascape (MPLS) was established in on April 23, 2000 under Proclamation No. 288, which was later on formally legislated under the senate bill no. 2895. The protected area is located at Malabungot Island of the municipality of Garchitorena and encompasses an area of and formally 120.62 hectares. However, there is no baseline

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records that were used in establishing the area as NIPAS protected nor any recent technical information showing motoring.

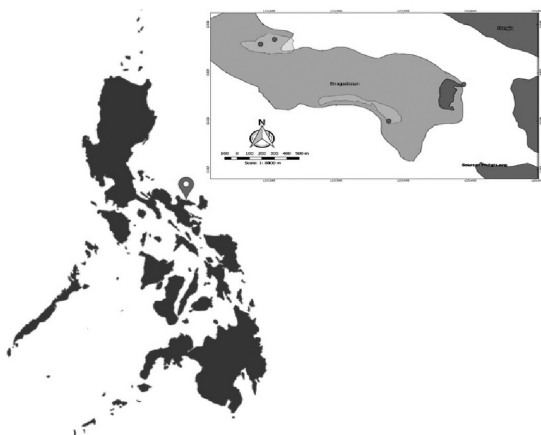
The sustainable utilization of critical ecosystems and habitats which provide the reason d'etre of seascape and landscape conservation enabling acts is commonly challenged by keeping a balance with its resource and social components. To achieve sustainability, the management of these triad components as systems becomes imperative. Deeper understanding of the status of these systems and their dynamic interactions are key requirements for their rational management in the context of protected seascapes and landscapes.

For instance, mangroves are considered as one life support systems in the coastal zones. Mangroves are known to thrive in intertidal zones, river banks and lagoons in the tropics and subtropics. The term 'mangrove' describes both the ecosystem and the plant families that have developed specialized adaptations to live in this tidal environment (Tomlinson, 1986). Mangrove supports a variety of wildlife and this aquatic habitat are production of fishery resources. However, anthropogenic activities and natural disturbances create a synergy of impacts that cast a cloud of uncertainty to their long-term existence and the provision of benefits from these habitats. Considering the scarcity of technical baseline information for MPLS, it was assessed comprehensively and generated data supported with scientific information.

MATERIALS AND METHODS

Study site

The Malabugot Protected Landscape and Seascape (MPLS) is situated on the northeastern part of the Fourth Congressional District of Camarines Sur, Philippines that was established in 1992 thru Proclamation No. 288. The island is separated from from Caramoan Peninsula in the south by the Quinasalag passage connecting to Lamit bay.



The Landscape alone is roughly 120.62 hectares and the seascape area cover 54 hectares of coral reefs, 16 hectares of seagrass beds and 24 hectares of mangrove forest. The assessed area covered 16.74 hectares with the coordinates of no in station 1, 13.923778, 123.599528 in station 2, 13.928477, 123.585397 in station 3 and 13.927982, 123.584359 respectively.

Data gathering

The Line Plot Method adapted from English et al. (1994) was employed in assessing the MPLS mangrove communities. This method provides quantitative descriptions of the species composition, community structure and plant biomass of mangrove forest. The latter provides the rank and order of mangroves thriving in a certain community and it is known to be a better index for the importance or function of species in its habitat rather than density alone (Rotaquio, *et al.*, 2007; Odum and Barrett, 2005; Kent and Coker, 1992; Krebs, 1985; Mueller-Dombois and Ellenberg, 1974).

A reconnaissance survey prior to sampling was the primary step in assessing the areas covered. In each sampling site, a 100-meter transect was laid perpendicular to the shoreline and segmented at 5-meter distance with established sample plots measuring 5 m x 5 m. At least four stations in the MPLS area were assessed using this method. A 1 m x 1 m sub-plot was established inside each plot for the identification and counting of sapling and seedling required for the regenerative capacity characterization. Each mangrove species along each transect was identified, counted and the height and diameter of each tree were measured. Tree girth measurements were taken at breast height i.e. approximately 1.3 m above the ground above the highest prop root or 30 cm above the ground for those species without prop roots. The girth measurements can be converted into diameter at breast height (DBH) measurements and computed by girth/p (3.14).

The field guide from Primavera (2009) and Lebata-Ramos (2013), handbook of Aragonés et al. (1999) were used in determining mangroves for species ID. Photo documentation were also taken for the purpose further identification and laboratory analysis. Human impacts such as trashes, plastics trapped in the roots of mangroves were also documented for mangrove habitat criteria rating

Mangrove habitat criteria rating

The mangrove habitat condition was evaluated using the Habitat Criteria Rating Chart (see Table 1) for Mangroves by Deguit *et al.*, (2004). Participatory Coastal Resource Assessment (PCRA).

Table 1. Habitat criteria rating chart.

Condition	Criteria
Excellent	Undisturbed, no cutting, clean, etc.
Good	Some cuttings for firewood, etc.
Fair	Heavy cuttings, fishpond conversions, etc.
Poor	Nearly destroyed, reclaimed or filled, pollution, etc.

Data analysis

The computation for data analysis used was obtained from the studies of White et al. (2004); Odum and Barrett (2005); Cox (1996); Kent and Coker (1992); Krebs (1985); and Mueller-Dombois and Ellenberg (1974).

From the collected data, the following parameters were computed using the following equations:

$$\text{Frequency} = \frac{\text{Total number of segments in which a species occurs}}{\text{Total number of segments sampled}}$$

$$\text{Relative Frequency} = \frac{\text{Frequency of a species}}{\text{Total frequency of all species}} \times 100$$

$$\text{Density} = \frac{\text{Number of individual of a species}}{\text{Total area samples}}$$

$$\text{Relative Density} = \frac{\text{Density of species}}{\text{Total density of all species}} \times 100$$

$$\text{Relative Basal Area} = \frac{\text{Total basal area of a species}}{\text{Total basal area of all species}} \times 100$$

$$\text{Importance Value} = RF + RD = \text{Relative Basal Area}$$

"Basal area" is described as the average amount of an area occupied by tree stems. It is defined as the total cross-sectional area of all stems in a stand measured at breast height and expressed as per unit of land area. To standardize measurements for basal area, tree diameter is also taken and computed as follows:

$$\text{Basal Area} = 0.005454 \times (\text{DBH})^2$$

"Crown cover" is the percentage of the sample site within the vertical projection of the periphery of the crowns with the crown considered to be opaque (Walker and Hopkins, 1990). This is also the generic definition of canopy cover or plant cover. It is the percent of the ground that has tree crown growing over it.

$$\text{Percentage Crown Cover} = \frac{\sum \text{Crown cover of individual tree}}{\text{Area sampled}} \times 100$$

Ecological diversity indices

"Ecological diversity" relates to the different species of a particular genus which are present in an ecological community. The measures or indices of ecological diversity are statistical summaries of the abundance vector, that is, the frequencies or proportions of each species in the community. These indices include the following:

- "Shannon-Weiner Diversity Index (H)" is a measure of the amount of information needed to describe every member of the community. It is calculated using the following equation:

$$H' = - \sum_{i=1}^S p_i \ln p_i$$

Where P_i is the proportion of each species in the sample

- "Simpson's Index (D)" is a measure of diversity, which takes into account both species richness, and an evenness of abundance among the species present. The formula for calculating D is presented as:

$$D = \frac{\sum n_i (n_i - 1)}{N(N - 1)}$$

Where n_i = the total number of organisms of each individual species

N = the total number of organisms of all species

- "Evenness (E)" is the ratio of the actual H' value to the maximum value (and thus it ranges from 0 to 1). It is expressed as follows:

$$E = \frac{H'}{H_{\max}}$$

RESULTS AND DISCUSSION

Species composition (MPLS area)

The Malabugot Protected Landscape and Seascape MPLS exhibits a selection of mangroves which includes trees and shrubs. Majority of the sites assessed is dominated by *Rhizophora* species and noted to be as an old growth stand.

A total of thirteen (13) species were encountered belonging to seven (7) families of true mangrove species. There were species of *Bruguiera gymnorhiza*, *Bruguiera sexangula*, *Rhizophora apiculata*, *Rhizophora mucronata*, *Rhizophora stylosa* and *Ceriops tagal* belonging from the family *Rhizophoraceae*. Two were recorded from family *Avicenniaceae* (*Avicennia marina*, *Avicennia rumphiana*) and

one each from the families *Sonneratiaceae*, *Myrsinaceae*, *Euphorbiaceae*, *Meliaceae* and *Areaceae*.

Table 2. Mangrove taxonomic description / station.

Taxonomic Description	Station			
	1	2	3	4
Avicenniaceae				
<i>Avicennia marina</i>			x	x
<i>Avicennia rumphiana</i>	x		x	x
Euphorbiaceae				
<i>Excoecaria agallocha</i>		x	x	
Meliaceae				
<i>Xylocarpus granatum</i>	x	x	x	
Myrsinaceae				
<i>Aegiceras floridum</i>		x	x	x
Rhizophoraceae				
<i>Bruguiera gymnorhiza</i>			x	x
<i>Bruguiera sexangula</i>	x	x	x	x
<i>Ceriops tagal</i>		x	x	x
<i>Rhizophora apiculata</i>	x	x	x	x
<i>Rhizophora mucronata</i>	x	x	x	x
<i>Rhizophora stylosa</i>			x	
Sonneratiaceae				
<i>Sonneratia alba</i>		x	x	x

¹ Based on Tomlinson (1986).

² Sources: Brown and Fischer, 1920; Arroyo, 1979; Fernando and Pancho, 1980;

³Tomlinson, 1986; Anon., 1996; Spalding et al., 1997; Yao, 1999.

Area profile and composition

STATION 1

The mangrove forest in Station 1 at 13.920056°N, 123.593889°E. The site is classified as fringe type of mangrove forest. The mangroves inhabiting the area are exposed to tides and waves being unprotected to the storms and hurricanes. The site has sandy to muddy mudflats which are dominated by *R. apiculata*, *R. mucronata* and *R. stylosa*, and was prominent in all plots extending inland. An old growth of *A. rumphiana* was observed reaching more or less 14 feet in terms of height. Conversely, *B. sexangula*, *X. granatum* and *A. rumphiana* were the least occurring species recording merely two individual stands throughout the transect.

STATION 2

In Station 2, the mangrove forest in Station 1 at 13.928477°N, 123.585397°E. The site is classified as fringe type of mangrove forest. The station is geographically similar to Station 1 except for the occurring frontline species such as *X. granatum*, *S. alba*, *E. agallocha* and was dominated by the *A. floridum*, while *R. mucronata* and *R. apiculata* occupies the intermediate zone extending landwards. The soil characteristics of Station 2 is similar to that of Station 1 from the shoreline going innermost part of the sampling station.

STATION 3

Positioned at 13.927982°N, 123.584359°E, Station 3 have the highest species (13 species) recorded belonging to six (6) genera. These families include *Sonneratiaceae*, *Avicenniaceae*, *Rhizophoraceae*, *Myrsinaceae*, *Euphorbiaceae*, and *Meliaceae*. Most of the *Rhizophoraceae* namely: *R. apiculata*, *R. mucronata*, *B. gymnorhiza*, *B. sexangula* and *C. tagal* were found near the surrounding marginal area. While, the mid portion of the forest is dominated by *R. apiculata* along with *E. agallocha*, *X. granatum*, *B. sexangula*, *R. mucronata*, *R. stylosa* and *A. floridum*. Similar observations were noticed as the transects progress inwards.

STATION 4

A riverine-basin type of mangrove forest was observed in station 4 with the coordinates of 13.927982°N, 123.584359°E located near Station 3. Substrate was a mixture of muddy-silt and constantly inundated by tides. There were several species found similar to that of in Station 3; subsequently occurring as the transect progress these species were: *A. marina*, *A. rumphiana*, *S. alba*, *B. gymnorhiza*, *B. sexangula*, *R. apiculata*, *R. mucronata*, *C. tagal* and *A. floridum*. While other species such as *R. stylosa*, *E. agallocha* and *X. granatum* were not found or could possibly not include in the sampling.

Relative density, frequency and dominance

Generally, the Philippines harbour has 39 species of true mangroves belonging to the following genera: *Acanthus*, *Camptostemon*, *Lumnitzera*, *Excoecaria*, *Pemphis*, *Xylocarpus*, *Aegiceras*, *Osbornia*, *Nypa*, *Aegialitis*, *Bruguiera*, *Ceriops*, *Kandelia*, *Rhizophora*, *Scyphiphora*, and *Sonneratia*. The fauna is equally diverse Primavera (2009). Tomlinson (1986) reported that the major mangrove species is recognized because of their distinct features like complete fidelity to the mangrove environment, that they have ability to form pure stand, does a major role in the community, have the morphological specialization that keeps them to be adaptive in their environment, has the ability excrete saltwater, and are taxonomically isolated from terrestrial mangroves.

The mangrove species in Malabugot Marine Protected Landscape and Seascape MPLS represented 33% out of 39 “true mangrove species” known in the country and 55 mangrove species worldwide with the centre of diversity in Southeast Asia. Of the 13 mangrove species identified it is interesting to note that *R. apiculata* and *R. mucronata* are consistently present in the 4 stations dominating in terms of relative density. In Station 1 alone, the population of mangrove species was almost entirely composed of *R. apiculata* posting

more than 60%. In Station 2, *R. mucronata* in similar trend posted 73% recording the highest relative density amongst stations. This is followed by Station 4 with 40% relative density mainly composed of *R. apiculata*. Station 3 has the least percentage of relative density posting 30% mainly composed of *R. apiculata*. Moreover, the species that has the highest occurrence was observed in Station 1 mainly *R. apiculata* registering 45%; and *R. mucronata* posting 36% are the species consistently appeared in each plot laid. The species that are rarely seen in the plots laid were *A. floridum*, *B. sexangula* and *C. tagal*. These species have low occurrence merely posting 2.4%. (see Table 3)

In other studies, the occurrence of a dominant species may be due to the presence of specific substrate type which is favourable for its growth Hogarth (1999).

All stations, except for Station 2, the stands of *R. mucronata* manifested the highest total importance values as a combination of relative density relative dominance and relative frequency thus prevailing among mangrove species. While the rest of the mangroves species manifested lesser representation. This explains that majority of the mangrove species in the area is composed of *R. apiculata* and *R.*

mucronata and commonly encountered species. Kasawani *et al.* (2007) averred that mangrove species showing higher importance value implies an abundance and as pioneer species.

The dominance of such species is explained by its effective adaptation against tidal inundation, light intensity and substrate type which negatively influence the composition of mangroves community structure along the MPLS area. Station 3 recorded the highest diversity value and inversely lowest index of dominance among the stations. This can be attributed to the number of identified species along the area with the highest number of individuals counted. It is worthy to note that Species Evenness is directly related to diversity, considering these values, it could be projected that mangrove species are evenly distributed in the area as compared with the other stations. Although *R. apiculata* recorded the highest in terms of individual count, other species were equally noted within the area.

Commonality of the species identified is noticeable in four stations. These were *B. sexangula*, *R. apiculata* and *R. mucronata* all belonging to family *Rhizophoraceae*. However, the species with the highest accumulated basal area recorded

Table 3. Relative Density, Frequency and Dominance (stations sampled).

Species	Density				RD				Frequency			
	1	2	3	4	1	2	3	4	1	2	3	4
<i>A. marina</i>			109.09	290.91			2.26	6.64			0.09	0.09
<i>A. rumphiana</i>	36.36		690.91	854.55	0.93		14.29	19.50	0.05		0.36	0.41
<i>S. alba</i>		18.182	290.91	563.64		0.433	6.02	12.86		0.05	0.18	0.41
<i>B. gymnorrhiza</i>			327.27	218.18			6.77	4.98			0.18	0.23
<i>B. sexangula</i>	36.36	36.364	309.09	36.36	0.93	0.866	6.39	0.83	0.09	0.09	0.27	0.05
<i>R. apiculata</i>	2363.64	109.091	1490.91	2127.27	60.47	2.597	30.83	48.55	0.45	0.09	0.41	0.45
<i>R. mucronata</i>	1436.36	3090.909	345.45	163.64	36.74	73.593	7.14	3.73	0.36	0.41	0.23	0.14
<i>R. stylosa</i>			109.09				2.26				0.09	
<i>C. tagal</i>		36.364	309.09	54.55		0.866	6.39	1.24		0.05	0.18	0.05
<i>A. floridum</i>		800.000	127.27	72.73		19.048	2.63	1.66		0.23	0.09	0.05
<i>E. agallocha</i>		72.727	509.09			1.732	10.53			0.14	0.18	
<i>X. granatum</i>	36.36	36.364	218.18		0.93	0.866	4.51		0.05	0.09	0.14	
Total	3909.09	4200.00	4836.36	4381.82	100	100	100	100	1.00	1.14	2.41	1.86

Species	RF				RELBA				IV			
	1	2	3	4	1	2	3	4	1	2	3	4
<i>A. marina</i>			3.77	4.88			0.21	3.62			7.23	16.70
<i>A. rumphiana</i>	4.55		15.09	21.95	1.14		5.49	14.19	13.33		60.93	61.77
<i>S. alba</i>		4.00	7.55	21.95		0.11	0.80	8.11		5.31	18.16	46.43
<i>B. gymnorrhiza</i>			7.55	12.20			1.49	2.59			22.85	20.88
<i>B. sexangula</i>	9.09	8.00	11.32	2.44	0.24	0.07	1.15	2.61	11.68	9.45	24.33	7.00
<i>R. apiculata</i>	45.45	8.00	16.98	24.39	8.21	0.30	4.70	33.65	162.57	12.92	74.80	121.12
<i>R. mucronata</i>	36.36	36.00	9.43	7.32	4.75	9.63	1.01	3.30	105.88	185.24	22.37	15.78
<i>R. stylosa</i>			3.77				0.32				7.89	
<i>C. tagal</i>		4.00	7.55	2.44		0.11	0.75	1.28		5.71	18.22	5.51
<i>A. floridum</i>		20.00	3.77	2.44		1.55	0.21	0.50		51.24	7.59	4.81
<i>E. agallocha</i>		12.00	7.55			0.63	0.78			18.65	22.57	
<i>X. granatum</i>	4.55	8.00	5.66		0.15	0.33	0.50		6.54	11.49	13.05	
Total	100	100	100	100	14.50	12.73	17.41	69.84	300	300	300	300

was *R. apiculata* with 10.25 m² found throughout the sampling area; this was followed by *A. rumphiana* posting 4.32 m². ft. which is only absent in Station 2.

The presence of saplings and seedlings in each station only indicated the occurrence of natural regeneration. Among the sampled areas, Stations 1 and 4 are more likely to sustain their existence with observed number of seedling and saplings exceeding 50% of their number of matured trees Deguit ET, et al 2004. (PCRA). These two areas demonstrated the highest probability of mangrove forest regeneration as evinced by the total number of seedlings and saplings observed in these areas. However, seed dispersal of these mangrove species could be influenced by the type of soil appropriate for the growth of specific species, existing reforestation effort within the area, the presence of perturbations and disturbances that apply stress to effective recovery, and other observable parameters affecting regenerative capacity. These could be considered in implementing can mitigation efforts to achieve the sustainability of mangrove ecosystems within the MPLS area. Among the sampled areas, Station 2 registered the highest percentage crown cover of 75% that is attributed to the presence of dominant species of *R. mucronata*. This species does not produce larger stands but contributed massively to the percentage crown cover due to their abundance and branching growth attributes. High percentage crown cover aids in the sequestration of carbon dioxide in the atmosphere. On the other hand, Station 4 had the lowest crown cover occupying 49.46% of the total sampled area and this can be attributed to its sparse distribution in the sampled areas along with their lesser size.

Based on the observed perturbations and disturbances, there were only two common anthropogenic threats that had been identified: in MPLS these are, a) cutting of mangrove forest for firewood and b) domestic wastes although to a minimal extent. Using the Habitat Criteria Rating Chart for Mangroves by Participatory Coastal Resource Assessment (PCRA) (Deguit *et al.*, 2004) the mangrove communities covered by the study areas in MPLS is generally rated to be in category of “Good” condition.

CONCLUSION AND RECOMMENDATIONS

The mangrove forest is one of the valuable resources in the MPLS which provide several environmental services and economic benefits. A total of thirteen (13) species were identified in the area belonging to seven (7) families of true mangrove species. These contributed to more than 33% of the identified “true mangroves” known to the country.

The mangrove communities in MPLS is characterized by differential attributes in diversity, cover and generative capacity. Some areas (e.g. Station 3) harbour the most diverse

assemblage (diversity index = 2.206); while some areas demonstrate reduced diversity (e.g. Station 1 diversity index = 0.804). There are areas that demonstrate high probability of natural regeneration that are more likely to sustain their existence (e.g. Station 1 and 4); while some areas manifested low regenerative capacity. There are also areas with high crown cover due to the abundance and branching growth attributes of dominant mangrove species (e. g. Station 2 percent crown cover = 75%) indicating higher capacity for carbon sequestration. Other areas however, have low crown cover due to the sparse distribution of the mangrove trees (e.g. Station 4, crown cover = 49.46%). These differences in general both reflect the promise of sustaining MPLS as one of the last frontiers of coastal biodiversity in Bicol, and the challenge among stakeholders, resources users and management bodies to develop strong resolve to implement decisive and timely actions that will address the observed weaknesses and threats confronting these fragile communities in order to continue nurture its potential and richness as a coastal and marine biodiversity spot in the country.

Based on these findings, the following recommendations are put forward:

1. Generating alternative land-based livelihood opportunities to reduce the stress on mangrove forests promoting mangroves as recreational, educational and ecotourism sites.
2. Increasing environmental consciousness and awareness of the communities on the benefits of the mangrove ecosystem.
3. Establishing collaboration and open communication among LGU' s, academe, local communities in mangrove areas, and development-oriented organizations.
4. LGU' s to establish Bantay Dagat for patrolling, monitoring and law enforcement in mangrove areas.
5. Allocating funds for the operational costs and personnel services and incentives for the maintenance of mangrove forests.

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APPENDIX TABLES

Table 4. Community structure of mangroves in Station 1.

Species	No. stand	Density	RD	Frequency	RF	RelBA	IV
<i>A.rumphiana</i>	2	36.36	0.93	0.05	4.55	1.14	13.33
<i>B. sexangula</i>	2	36.36	0.93	0.09	9.09	0.24	11.68
<i>R. apiculata</i>	130	2363.64	60.47	0.45	45.5	8.21	162.6
<i>R. mucronata</i>	79	1436.36	36.74	0.36	36.4	4.75	105.9
<i>X. granatum</i>	2	36.36	0.93	0.05	4.55	0.15	6.54
Total	215	3909.09	100	1	100	14.5	300

Table 5. Community structure of mangroves in Station 2.

Species	No. stand	Density	RD	Frequency	RF	Rel. BA	IV
<i>A. floridum</i>	44	800	19.1	0.23	20	1.55	51.24
<i>B.sexangula</i>	2	36.36	0.87	0.09	8	0.07	9.45
<i>C. tagal</i>	2	36.36	0.87	0.05	4	0.11	5.71
<i>E. agallocha</i>	4	72.73	1.73	0.14	12	0.63	18.65
<i>R. apiculata</i>	6	109.09	2.59	0.091	8	0.29	12.92
<i>R. mucronata</i>	170	3090.9	73.6	0.41	36	9.63	185.2
<i>S. alba</i>	1	18.18	0.43	0.05	4	0.11	5.31
<i>X. granatum</i>	2	36.36	0.87	0.09	8	0.33	11.49
Total	231	4200	100	1.14	100	12.7	300

Table 6. Community structure of mangroves in Station 3.

Species	No. stand	Density	RD	Frequency	RF	Rel. BA	IV
<i>A. floridum</i>	7	127.27	2.63	0.09	3.77	0.21	7.59
<i>A. marina</i>	6	109.09	2.26	0.09	3.77	0.21	7.23
<i>A. rumphiana</i>	38	690.91	14.29	0.36	15.09	5.49	60.93
<i>B. gymnorrhiza</i>	18	327.27	6.77	0.18	7.55	1.49	22.85
<i>B. sexangula</i>	17	309.09	6.39	0.27	11.32	1.15	24.33
<i>C. tagal</i>	17	309.09	6.39	0.18	7.55	0.75	18.22
<i>E. agallocha</i>	28	509.09	10.53	0.18	7.55	0.78	22.57
<i>R. apiculata</i>	82	1490.91	30.83	0.41	16.98	4.70	74.80
<i>R. mucronata</i>	19	345.45	7.14	0.23	9.43	1.01	22.37
<i>R. stylosa</i>	6	109.09	2.26	0.09	3.77	0.32	7.89
<i>S. alba</i>	16	290.91	6.02	0.18	7.55	0.80	18.16
<i>X. granatum</i>	12	218.18	4.51	0.14	5.66	0.50	13.05
Total	266	4836.36	100.00	2.41	100.00	17.41	300.00

Table 7. Community structure of mangroves in Station 4.

Species	No. stand	Density	RD	Frequency	RF	Rel. BA	IV
<i>A. floridum</i>	4	72.727	1.66	0.045	2.439	0.499	4.813
<i>A. marina</i>	16	290.909	6.639	0.091	4.878	3.618	16.697
<i>A. rumphiana</i>	47	854.545	19.502	0.409	21.951	14.188	61.768
<i>B. gymnorrhiza</i>	12	218.182	4.979	0.227	12.195	2.589	20.881
<i>B. sexangula</i>	2	36.364	0.83	0.045	2.439	2.608	7.003
<i>C. tagal</i>	3	54.545	1.245	0.045	2.439	1.277	5.513
<i>R. apiculata</i>	117	2127.273	48.548	0.455	24.39	33.649	121.12
<i>R. stylosa</i>	9	163.636	3.734	0.136	7.317	3.304	15.782
<i>S. alba</i>	31	563.636	12.863	0.409	21.951	8.109	46.425
Total	241	4381.82	100	1.864	100	69.839	300

APPENDIX PHOTOS

A. List of True Mangroves identified in *Malabungot* Protected Landscape and Seascape

Avicenniaceae



Scientific name: *Avicennia marina*
Local name: Bungalon



Scientific name: *Avicennia rumphiana*
Local name: Miapi; Piapi

Euphorbiaceae



Scientific name: *Excoecaria agallocha*
Local name: Buta-buta; Lipata

Meliaceae



Scientific name: *Xylocarpus granatum*
Local name: Tabigi

Myrsinaceae



Scientific name: *Aegiceras floridum*
Local name: Saging-saging; Tinduk-tindukan

Rhizophoraceae



Scientific name: *Bruguiera gymnorrhiza*
Local name: Busain, Pototan



Scientific name: *Bruguiera sexangula*
Local name: Busain, Pototan



Scientific name: *Rhizophora apiculata*
Local name: Bakawan lalake



Scientific name: *Rhizophora mucronata*
Local name: Bakawan babae

Sonneratiaceae



Scientific name: *Sonneratia alba*
Local name: Pagatpat

B. Anthropogenic Activities



Trapped plastics



Wood extractions



Scattered plastics in the forest



Nypa cuttings/ extractions for shingles