

# Species Composition and Diversity of Mangroves in the Riverbanks of Barangay Basing, Binmaley, Pangasinan

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**Abstract** - This study investigated the mangrove species composition, density and diversity in the riverbanks of Barangay Basing, Binmaley, Pangasinan. Five (5) stations measuring 5 m x 20 m (100 m<sup>2</sup>) with interval distance of 200 m were established in the area. The coordinates of each station were taken using a portable GPS. Results of the study revealed that there were 8 species of mangroves belonging to 7 families thriving in the riverbanks. The species identified were; *Rhizophora apiculata*, *Rhizophora mucronata*, *Excoecaria agallocha*, *Avicennia officinalis*, *Sonneratia caseolaris*, *Lumnitzera racemosa*, *Nypa fruticans* and *Heritiera littoralis*. Identified families were Rhizophoraceae, Avicenniaceae, Sonneratiaceae, Combretaceae, Euphorbiaceae, Palmae and Sterculiaceae. *N. fruticans* generated the highest mean density 0.608 stems /100m<sup>2</sup> and relative density of 77.35%. In addition, only *N. fruticans* appeared consistently in all stations. The species diversity was very low at  $H' = 0.72$ , including its species richness at  $S_M = 0.63$ , though evenness index registered  $E = 0.57$  indicating moderate distribution of species.

**Key words:** Mangroves, species richness, density, relative density, diversity, evenness index

## INTRODUCTION

Mangroves are one of the most diverse groups in the tropical region particularly in the Indo-Malay Philippines archipelago. Globally, there are about 75 species of mangroves [1] though some claimed that there were 50 to 60 known species of mangroves [2] and 46 of these are found in the Philippines [3]. Mangrove forests are threatened worldwide where they have been decimated at an alarming rate from pollution, land clearance, coastal development, natural disasters and climate change [4]. The mangrove forests in the Philippines covered an area of about 450,000 ha in 1918 [5], but this extent declined by 51.8% in 2010 [6].

Mangroves cover merely 0.1% of the total earth's continental surface [7], and constitute about 0.7% of the world's tropical

forests [8]. Despite its mere size, mangroves are regarded as highly productive ecosystems which contribute to between 10 and 15% (24 Tg C/year) coastal sediment carbon storage [9]. The primary productivity of the coastal areas such as estuary, mangrove, seagrass, and coral reef ecosystems is estimated more than 10,000 gC·m<sup>-2</sup>·yr<sup>-1</sup>, which is about 100-200 times greater than the primary productivity in the open ocean [10]. The total net primary productivity of mangroves was estimated to be at 21.0 Mg·ha<sup>-1</sup>·yr<sup>-1</sup> [11]. Considering the benefits derived from mangroves, they are regarded as ecologically and economically important tropical forests [9].

The province of Pangasinan is home to 25 species of mangroves [12] and these are scattered both along the coastal shorelines and inland waters particularly in the riverbanks. The coastal town of Binmaley, Pangasinan has 33 barangays where most of the tributaries of Agno river pass through. Along the riverbanks thrive

the flourishing mangroves. Unfortunately, few studies have been undertaken on the mangroves particularly on species composition, density and diversity. Hence, this study was conducted.

mangroves found in each station were determined and counted.

## MATERIALS AND METHODS

### Research Design

This study employed a descriptive-survey method of research. The species of

### Location of the Study

The study was conducted in the riverbanks of Barangay Basing, Binmaley, Pangasinan (Figure 1). The river is one of the minor Agno tributaries located at the southern portion of the town.

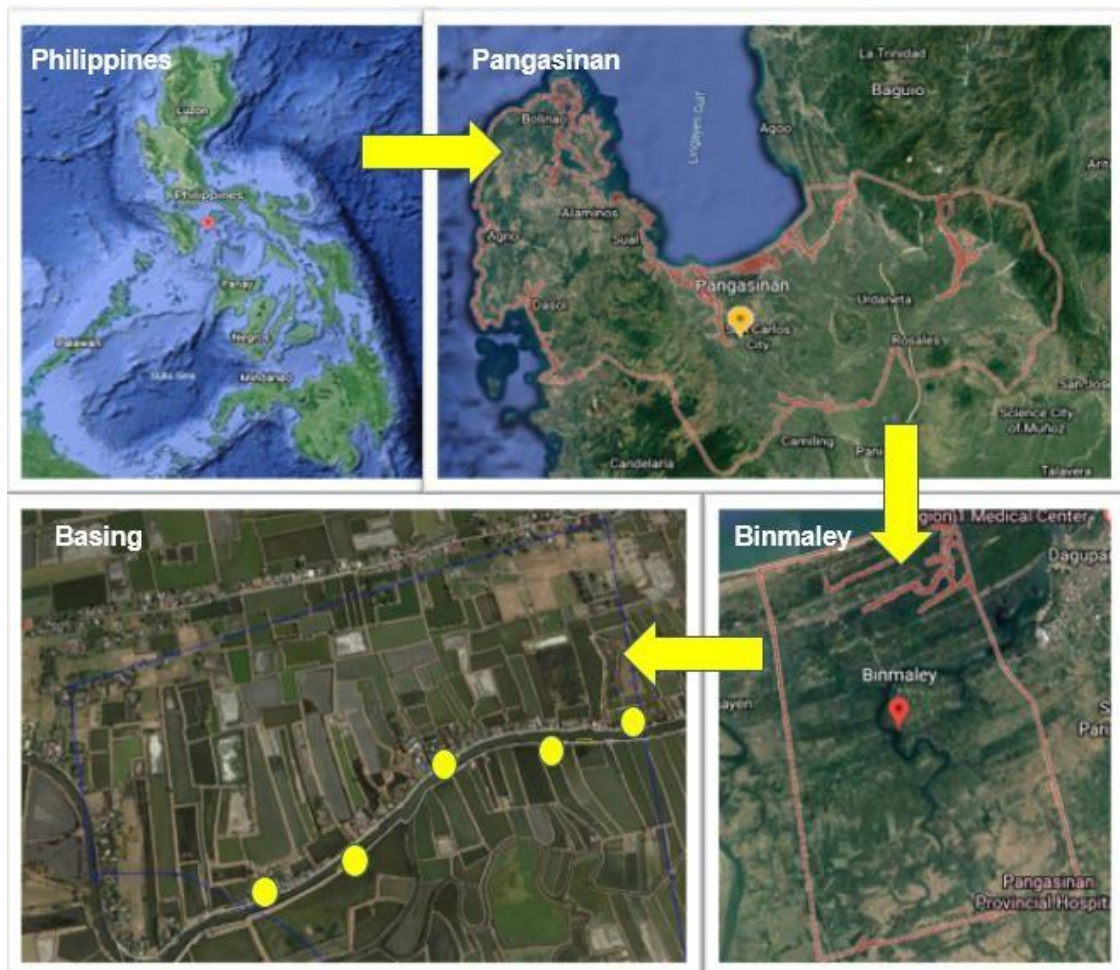


Figure 1. Location map of the sampling stations.

The coordinates of each sampling station were taken using a portable Global Positioning System (GPS) (Table 1).

**Data Gathering Procedure**

There were 5 stations established in the riverbanks of Barangay Basing. Each station has an area of 100 m<sup>2</sup> (5m x 20m), alternately placed by riverbank at 200 m interval. A 500-m transect line was used to measure the area of each station. A rented-motorized boat was used in sampling. Upon reaching each established station, the identification and enumeration of samples were undertaken. Species of mangroves were identified based on available field guide books [13-15]. Important features of mangrove such as leaves, roots, flowers and fruits were photographed. The number of mangrove stands per species was counted. Only matured mangroves were considered in the counting.

The following formula were used in computing for density, relative abundance, species richness, diversity, and evenness indices:

**Density**

The density of mangroves was computed using the formula of English et al. [16]:

$$\text{Density} = \frac{\text{Total Number of Mangroves}}{\text{Total Sampling Area}}$$

where: Number of Mangroves: Total number of counted mangroves per quadrat

Total Sampling Area (100m<sup>2</sup>): 20m length x 5m width

**Relative Density**

The relative density of each species was estimated using the following formula:

$$\text{RD (\%)} = \frac{\text{Density of Individual Species of Mangroves}}{\text{Total Density of Mangroves}}$$

where:

Density of Individual Species of Mangroves:  
Number of individual species per unit area

Total Density of Mangroves: Total Number of Mangroves per unit area

**Species Richness**

The species richness in the area was assessed based on the presence of mangroves in each station. The Margalef index was used to determine the species richness in each river. The Margalef index was determined using the following formula:

$$S_M = (S - 1) / \ln N$$

where:

S<sub>M</sub> = number of species in a sample

N = the total individuals

Table 1. Coordinates of Sampling Stations in Barangay Basing, Binmaley, Pangasinan.

Station	Corner	North	East
1	1	15°59'3.21"N	120°17'0.50"E
	2	15°59'2.95"N	120°16'59.48"E
2	1	15°59'2.25"N	120°16'56.73"E
	2	15°59'2.16"N	120°16'55.51"E
3	1	15°59'0.18"N	120°16'46.12"E
	2	15°58'59.36"N	120°16'45.17"E
4	1	15°58'51.03"N	120°16'38.03"E
	2	15°58'50.23"N	120°16'37.10"E
5	1	15°58'47.77"N	120°16'32.74"E
	2	15°58'47.18"N	120°16'31.66"E

**Species Diversity**

The species diversity of mangroves in each river was determined using the Shannon-Wiener Index formula:

$$H' = -\sum P_i \log P_i$$

where:

- H' = index of species diversity.
- P<sub>i</sub> = proportion of the total sample belonging to the species (n<sub>i</sub>/N)
- N<sub>i</sub> = number of individuals in a species
- N = total number of individuals in all species

Interpretation of diversity values was based on the following:

Table 2. Categories of Species Diversity Index.

Relative Values	H' values
Very high	> 3.5000
High	3.000 - 3.499
Moderate	2.500 – 2.999
Low	2.000 – 2.499
Very low	< 1.999

**Evenness Index**

The even distribution of mangrove species based on the generated diversity index of each river was estimated using Pielou's Evenness index:

$$E = H'/\ln(S)$$

where:

- E = evenness index

- H' = diversity index
- S = species richness or the number of species

Interpretation of Evenness index values was based on the following:

Table 3. Categories of Evenness Index.

Relative Values	H' values
Fair distribution	0.96-1.00
Good distribution	0.76-0.95
Moderate distribution	0.51-0.75
Poor distribution	0.26-0.50
Very poor distribution	0.00-0.25

**RESULTS AND DISCUSSION**

**Species Composition of Mangroves**

A total of 8 species of mangroves belonging to 7 families were identified in the riverbanks of Barangay Basing (Table 4). The species were; *Rhizophora apiculata*, *Rhizophora mucronata*, *Excoecaria agallocha*, *Avicennia officinalis*, *Sonneratia caseolaris*, *Lumnitzera racemosa*, *Nypa fruticans* and *Heritiera littoralis*. Identified families were Rhizophoraceae, Avicenniaceae, Sonneratiaceae, Combretaceae, Euphorbiaceae, Palmae and Sterculiaceae. Family Rhizophoraceae has the highest number of species with 2, while the rest; Sonneratiaceae, Avicenniaceae, Combretaceae, Euphorbiaceae, Palmae and Sterculiaceae have 1 each species.

Table 4. Species composition of mangroves in the riverbanks of Barangay Basing.

Family	Species	Common Name	Local Name
Rhizophoraceae	<i>Rhizophora apiculata</i>	Bakawan-lalaki	Pakar
	<i>Rhizophora mucronata</i>	Bakawan-babae	Pakar
Avicenniaceae	<i>Avicennia officinalis</i>	Api-api	Payar
Sonneratiaceae	<i>Sonneratia caseolaris</i>	Pedada	Palpaltak
Combretaceae	<i>Lumnitzera racemosa</i>	Kulasi	Kulasi
Euphorbiaceae	<i>Excoecaria agallocha</i>	Buta-buta	Makabulag
Palmae	<i>Nypa fruticans</i>	Nipa	Nipa
Sterculiaceae	<i>Heritiera littoralis</i>	Dungon-late	Palpaltak

There are about 75 species of true mangroves in the world [1] while in the Philippines around 46 species [3, 14]. In the province of Pangasinan, there are 25 species identified, namely; *Aegiceras corniculatum*, *Aegiceras floridum*, *Avicennia alba*, *Avicennia lanata*, *Avicennia marina*, *Avicennia officinalis*, *Bruguiera cylindrica*, *Bruguiera gymnorrhiza*, *Bruguiera parviflora*, *Bruguiera sexangula*, *Camptostemon philippinense*, *Ceriops decandra*, *Ceriops tagal*, *Excoecaria agallocha*, *Heritiera littoralis*, *Lumnitzera racemosa*, *Nypa fruticans*, *Rhizophora apiculata*, *Rhizophora mucronata*, *Rhizophora stylosa*, *Sonneratia alba*, *Sonneratia ovata*, *Sonneratia caseolaris*, *Xylocarpus granatum* and *Xylocarpus moluccensis* [12]. All the identified 8 species of mangroves in the riverbanks of Basing were in the above-mentioned list.

Ten species of mangroves were identified in Dinagat islands in Caraga region [17]. Five species of *Rhizophora* were described including *R. apiculata* and *R. mucronata*. In a community-managed forest in Calatagan, Batangas, 7 species of mangroves under 4 families were described [18]. Species of mangroves identified were *R. apiculata*, *R. mucronata*, *B. cylindrica*, *S. alba*, *A. marina*, *Aegiceras corniculatum* and *Ceriops decandra*.

Lately, 12 species of mangroves were described in Butuan Bay, Agusan del Norte [19]. Two species, *Avicennia alba* and *Rhizophora mucronata* dominated in all sampling stations while *N. fruticans* was present in all sampling stations.

The fewer number of species maybe attributed to the location of mangroves found in the riverbanks. Considering the space, the growth and expansion of these species may be limited as compared to their counterparts in the coastlines where space is wider. The mangroves found in the coastlines exhibit zonation as opposed to the mangroves in the riverbanks where zonation is not evident.

### Density of Mangroves

The total density of mangroves in the five sampling stations was 3.930 stands per 500 m<sup>2</sup> with a mean density of 0.786 stands per 500 m<sup>2</sup> (Table 5). Station 5 obtained the highest density of 1.170 stands per 100 m<sup>2</sup>, followed by Station 3 (1.000 per 100 m<sup>2</sup>), Station 2 (0.730 per 100 m<sup>2</sup>), Station 1 (0.720 per 100 m<sup>2</sup>) and Station 4 (0.310 per 100 m<sup>2</sup>). In terms of mean density by species, *N. fruticans* gained the highest mean density with 0.608 stands per 500 m<sup>2</sup> while *H. littoralis* has the least with 0.002 stand per 500 m<sup>2</sup>.

Table 5. Density of mangroves in the riverbanks of Barangay Basing, Binmaley, Pangasinan.

Family	1	2	3	4	5	Total	Mean
<i>Rhizophora apiculata</i>	0.020	-	0.050	-	0.050	0.120	0.024
<i>Rhizophora mucronata</i>	-	0.180	0.200	-	0.120	0.500	0.100
<i>Avicennia officinalis</i>	0.030	-	-	-	-	0.030	0.006
<i>Sonneratia caseolaris</i>	-	-	-	0.020	-	0.020	0.004
<i>Lumnitzera racemosa</i>	0.020	-	-	0.020	-	0.040	0.008
<i>Excocaria agallocha</i>	0.070	-	-	0.100	-	0.170	0.034
<i>Nypa fruticans</i>	0.580	0.540	0.750	0.170	1.000	3.040	0.608
<i>Heritiera littoralis</i>	-	0.010	-	-	-	0.010	0.002
	0.720	0.730	1.000	0.310	1.170	3.930	0.786

**Relative Density**

In terms of relative density, *N. fruticans* dominated the group of mangroves in Basingriver with 77.35%, followed by *R. mucronata* (12.72%), *E. agallocha* (4.33%), *R. apiculata* (3.05%), *L. racemosa* (1.02%), *A. officinalis* (0.76%), *S. caseolaris* (0.51%) and *H. littoralis* (0.25%) (Figure 2).

In the estuarine of Maligaya, Palanan, Isabela, 14 species of mangroves were identified with *N. fruticans* dominating the group with the highest density of 0.099 stems per 500 m<sup>2</sup> while *R. mucronata* and *R. apiculata* registered density of 0.023 and 0.016 stems per 500 m<sup>2</sup>, respectively [20].

Similarly, *N. fruticans* registered the highest density at 61,000 stems/hectare and 45,000 stems/hectare in the unmanaged and managed Nipa, respectively in Bohol [21]. Conversely, the Rhizophorans; *R. apiculata* (24%) and *R. mucronata* (22%) dominated the group from the 15 species identified along the Puerto Princesa Bay in Palawan [22].

The presence and dominance of *N. fruticans* may suggests that the species had adapted to the existing environmental conditions of the rivers. The species composition, growth and structure of the mangrove forest varies as a function of several factors like the geophysical, geographical, geological, hydrographic, biogeographical, climatic, edaphic factors and the other environmental conditions [23]. For a particular species of mangroves, the climatic conditions and the coastal geography play a greater role.

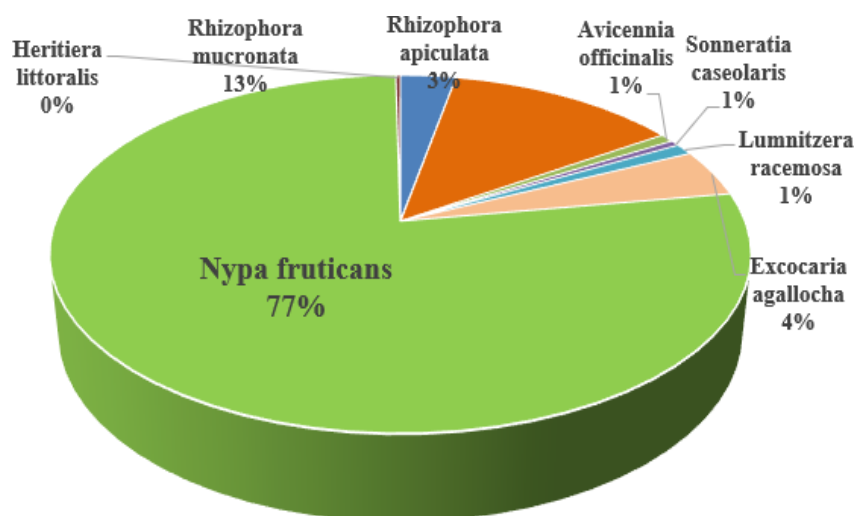


Figure 2. Relative density of mangroves in the riverbanks of Barangay Basing, Binmaley, Pangasinan.

**Species Diversity**

The species richness, diversity and evenness indices are presented in Table 6. The mean species richness obtained was  $S_M = 0.63$  where Station 1 incurred the highest species richness of  $S_M = 0.94$  while Station 5 recorded the lowest with  $S_M = 0.42$ . The mean species diversity was  $H' = 0.72$  indicating very low diversity while mean evenness index was 0.57 suggesting moderate distribution of species.

The very low species diversity of mangroves recorded in the riverbanks of Basing, Binmaley, Pangasinan is comparable to the species diversity ( $H' = 0.64$ ) obtained from Puerto Princesa bay [22]. In the same province, low diversity index ( $H' = 1.700$ ) was recorded in Manamoc islands, Cuyo, Palawan [23]. Similarly, low diversity index ranging from  $H' = 0.8854$  to 1.2268 was observed in the various mangrove areas in Moalboal, Cebu [25]. Likewise, in Dinagat islands ( $H' = 1.86$ ) [17], Panabo mangrove park in Davao del Norte ( $H' = 1.0273$ ) [26], Conservation mangrove park in Calatagan, Batangas, ( $H' = 1.1936$ ) [18]. The species diversity index obtained from the 5 sampling stations is very low indicating a few numbers of species and lower number of individuals per species. The declining number of mangrove species can be attributed to anthropogenic activities like conversion of mangroves into fishponds.

In 1918, the country used to have 500,000 hectares of mangroves [5] but this has declined rapidly to 100,000 hectares in 1994 due to exploitation and other anthropogenic activities [3]. Most of the species identified in the study are categorized as least concern by the International Union for the Conservation of Nature. A least-concern species is a species that has been categorized by the International Union for Conservation of Nature (IUCN) as evaluated as not being a focus of species conservation because the specific species is still plentiful in the wild [27]. While these are of least-concern species, the present trends of these species are declining except for the *N. fruticans* and *E. allogacha*.

The Indo-Malay Philippine archipelago which the Philippines belong has the highest mangrove biodiversity in the world though about 15% of the species are threatened. Very alarming is the rate of decline of mangrove areas about 30% have been loss since 1980 [4]. Contributing factors are pond conversion for aquaculture, logging for timber or lumber use, fuel wood, urbanization and others [3, 28]. These activities may result to harsh environmental conditions that threaten the growth and development of varied mangrove species in coastal habitats [29]. The continued anthropogenic activities in the mangrove areas may result to loss of species, low species diversity and ecosystem loss [30].

Table 6. Species diversity of mangroves in the riverbanks of Basing, Binmaley, Pangasinan.

Index	1	2	3	4	5	Total	Mean
Species Richness	0.94	0.47	0.43	0.87	0.42	3.13	0.63
Species Diversity	0.73	0.62	0.68	1.05	0.50	3.58	0.72
Evenness Index	0.45	0.56	0.62	0.76	0.46	2.85	0.57

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