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**Rolando B Cerezo**
College of Fisheries, Pangasinan State University-Binmaley Campus Binmaley, Pangasinan, Philippines

**Shella C Parreno**
College of Fisheries, Pangasinan State University-Binmaley Campus Binmaley, Pangasinan, Philippines

**Jennie B Fernandez**
College of Fisheries, Pangasinan State University-Binmaley Campus Binmaley, Pangasinan, Philippines

**Raul V Dela Peña**
College of Fisheries, Pangasinan State University-Binmaley Campus Binmaley, Pangasinan, Philippines

**Correspondence**
**Jennie B Fernandez**
College of Fisheries, Pangasinan State University-Binmaley Campus Binmaley, Pangasinan, Philippines

# Mangroves and associated macroflora and macrofauna of Buenlag-Sabangan River in Binmaley, Pangasinan

**Rolando B Cerezo, Shella C Parreno, Jennie B Fernandez and Raul V Dela Peña**

## Abstract
To assist the municipal government of Binmaley, Pangasinan in gathering baseline data on their proposed sanctuary in Buenlag-Sabangan River, the status of mangroves and associated flora were assessed as to species composition, frequency of occurrence, density, dominance, and diversity using combination of transect and quadrat method. Five stations were also established in the upstream, midstream and downstream portion of the river specifically for fishes and crustaceans sampling and water quality monitoring. Problems/issues associated with the utilization, management and conservation of the river ecosystem were also determined through ocular observation during transect walk in the mangrove area and through interview to key informants and their severity were measured using hedonic scale.

Results of the study revealed three types of macroflora present in the study area: True mangroves, associated mangroves, and beach forest species. True mangroves species consists of three species from Family Rhizophoraceae: *Rhizophora apiculata*, *Rhizophora mucronata*, *Bruguiera cylindrica*; two species from Family Avicenniaceae: *Avicennia officinales* and *Avicennia marina*: One species each from Family Euphorbiaceae (*Excoecaria agallocha*), Combretaceae (*Lumnitzera racemosa*), Myrsinaceae (*Aegiceras corniculatum*), Sonneratiaceae (*Sonneratia alba*), Palmae (*Nipa fruticans*), Pteridaceae (*Acrostichum aureum*), Acanthaceae (*Acanthus elicifolius*). Associated species include two species from Family Fabaceae (*Derris trifoliate*, *Acacia farnisiana*) and one species from each of the following Families: Combretaceae (*Terminalia cattapa*), Malvaceae (*Hibiscus tiliaceus*) Clusiaceae (*Calophylum inophyllum*), Moraceae (*Artocarpus ovatus*), Aizoaceae (*Sesuvium portuculastrum*), Pandanaceae (*Pandanus tectorious*), and Mimosaceae (*Leuceana leucocephalia*). Among the beach forest type, only coconut (*Cocus nucifera*) and Lambayong (*Ipomea pescaprae*) can be found in the study area.

Most frequently occurring true mangrove species are the *Rhizophora apiculata*, *Excoecaria agalocha*, *Rhizophora mucronata* and *Brugueira cylindrica*. The wildlings outnumbered the saplings and the matured true mangroves with *Rhizophora mucronata* on the top rank considering all stages. For the associated mangrove species, matured outnumbered the wildlings and the saplings. Most frequently occurring associated species is the *Derris trifoliate* and *Actocapus ovatus* which is a shrub.

Among the true mangrove species *Rhizophora apiculata* has the highest density (1.01 stand/$m^2$) and Transect 22 has denser (4.54/m2) vegetation. Highest Dominance Index, as computed using the Simpson Index of Dominance of 1 was computed from Transect 19. Mean species diversity of the area is 0.90 with Transect 21 having the highest (H = 2.1923).

Macrofaunal species in the study area is composed of fishes, crustaceans and mollusks. Fifteen species of fish (*Mugil cephalus*, *Apogon sp*., *Tetraodon fluviatilis*, *Oreochromis mossambicus*, *Glossogobius sp*., *Stolephorus heterolobus*, *Rhynchorhamphus georgii*, *Suggrundus macracanthus*, *Bunaka pinguis*, *Gerres erythrourus*, *Leognathus equulus*, *Anadontostoma chacunda*, *Sillago* sp., *Anguilla sp*., *Pseudotriancanthus strigilifer*) constitute 48.39% of the total macrofaunal species.

Crustaceans constitute 32.26%, 40% of which are crabs and 60% are shrimps. Crab species include two species of the family Portunidae (*Portunus pelagicus*, *Scylla serrata*, and two species of the Family Grapsidae (*Metapograpsus messor* and *Varuna litterata*). The shrimps are composed of three species of the family Penaiedae (*Penaeus sp*. *Penaeus indicus*, *Penaeus monodon* and *Metapenaeus ensis*) and two species of the family Palaemonidae (*Macrobrachium sp.* and one unidentified species (Tampal bae). Six species of mollusks (*Telescopium telescopium*, *Terebralia sp*, *Perna sp*., *Crassostrea sp*., *Isognomon ephippium*, *Nerita communis*) were found in the study area.

The frequency per species of fish and crustaceans is low. The size of most of the species is also small. Computed catch per unit effort (CPUE) is also very low. This indicates overfishing in the river.

**Keywords:** Mangroves, associated macroflora, associated macrofauna

## Introduction
Pangasinan occupies the northern portion of the Central Plains of Luzon. The Province is composed of forty four (44) municipalities and four (4) cities.

Of these, twelve municipalities and two cities are situated along the coast (Dagupan and Alaminos). In 1996, about 11% (246,503) of the total population lived along the 122 coastal barangays.

The major fishery resources in the province are classified as marine and inland. The marine is predominantly located along the Lingayen Gulf. Inland resources on the other hand include brackishwater and freshwater fishponds and communal waters like estuaries, rivers, creeks streams including Small Water Impounding Projects (SWIPs) and Small Farm Reservoirs (SFRs). Of the aforementioned inland resources, the rivers can be considered as the richest resource and highest contribution to the economic well-being of the people and the community.

These rivers when properly tapped and developed, will enhance tourism industry, create livelihood opportunities and increase the income thereby bringing about sustainable economic development of the province. However, as various technologies continue to grow, most of the rivers and the all other natural resources are degraded and others totally destroyed. Several massive fish kills have been reported in the major rivers of Pangasinan in the past. This has resulted to great losses in fish production and income.

One of the important resource components of the river which is greatly disturbed is the mangrove forest. Despite its wide uses: Habitat for migratory birds and variety aquatic organisms, the original mangrove forest of the country continues to degrade as centuries passed. It reached its critical condition due to mangrove swamp conversion into fishponds and the over harvesting of mangrove timber products. Other factors which have contributed are reclamation for residential and industrial purposes, over harvesting of mangroves trees for charcoal or fuel wood production, lack of reforestation and physical expansion of coastal communities (White and Trinidad, 1998) [22]. Currently, 95%of remaining mangroves are secondary growth and only 5% are old or primary mangroves mostly found in Palawan (Melana 1994) [14]. According to DENR 1995 statistics, conversion to fishponds, prawn farms, salt ponds, reclamation and other form of industrial Development has reduced the mangrove area to 117,700 hectares (Melana *et al*, 2000) [16]. To save our mangroves from total degradation and possible extinction, the Philippine government promulgated the New Fisheries Code of 1998 (RA 8550) and the local Government Code (RA 7160). Local Government Units are now mandated to establish MPAs (Marine Protected Areas). Through such laws, steps are being made and results are now visible. Mangrove areas now being protected and degraded areas are undergoing rehabilitation activities.

Assessment of mangroves and its associated flora has already been done in many parts of the country and in some parts of Pangasinan. In Binmaley, the Municipal Agriculture Office (MAO) is already implementing their Comprehensive Coastal Development Plan (CCDP) and Coastal Resource Management Program (CRMP) wherein one of its projects is the assessment of the distribution and abundance of their mangrove resources and associated species.

The assessment of the status of mangroves and associated macroflora and macrofauana hopes to provide the Municipal Agriculture Office baseline data so that long-term changes in abundance and diversity due to natural phenomenon as well as human impact may be determined and management measures may be readily implemented.

## Materials and Methods

The study was conducted in the river of barangay Buenlag, Binmaley, Pangasinan. It is approximately 1.83 km long and 38.78m wide. A total of thirty (30) quadrats (50mx3m) were laid in the whole stretch of the river bank. Total enumeration was employed for mangroves and associated macroflora. In each quadrat, three (3) small quadrats (1m x 1m) were laid, to gather data on the species of mollusks. Samples of fishes and crustaceans, on the other hand, were collected from six fyke nets (skylab) being operated in the downstream, midstream and upstream part of the river. All the catch in each fyke net were bought from the operator in per kilo basis. All the species were then counted, identified and classified to the Family level.

Distribution of macroflora was determined through its frequency of occurrence in every quadrat. The coordinates of each quadrat were taken using a Global Positioning System (GPS) and plotted in a Google map.

All vegetation were characterized as to their age stages whether matured, saplings and wildlings, based on their height and diameter at breast height (DBH). Those whose height is below 1 m were considered as wildlings, those above 1 m in height but have below four centimeters DBH were considered as saplings and those with above four centimeters DBH were considered as matured. The DBH and height were measured using a foot-rule and graduated bamboo stick. Crown diameters were likewise determined using the latter.

The same transect used in the identification of macrofloral species was employed in the assessment of the abundance of mangroves and associated flora and fauna. All mangroves and associated flora in each transect were identified, counted and recorded in a data sheet**.** Counting started from the crown portion of the river bank to the last vegetation at its base (3m wide). Soil substrate type in each transect also were noted.

In every 50m stretch transect, three 1m**²** quadrats were laid, two at both transect end and the other at the middle, all species of macrofauna found in each quadrat were handpicked, identified, counted and recorded in the aforementioned data sheet.

For the abundance of fish and crustaceans, four fishers having fyke net, set in the downstream, midstream and upstream portion of the river were selected. Fish catch of each fisher were bought and pertinent data such as species common name, scientific name, length and weight were recorded in separate data sheet**.** Secondary data from previous researches and Municipal Agriculture Office (MAO) of Binmaley, Pangasinan were taken to support the primary data taken.

Abundance of the mangroves and macroflora and macrofauna were determined using the following indices: frequency of occurrence, density, and diversity. Formula used were derived from Ingles *et al*., 1994. Catch per unit effort was computed based on the total catch per man/hour.

## Results and Discussion

### Species composition of mangroves and associated flora and fauna

The macroflora of Buenlag-Sabangan River consists of true mangroves and associated species as well as beach forest species. Twelve species of true mangroves, ten associated species and two beach forest species abounds the Buenlag-Sabangan River in Binmaley, Pangasinan.

True mangroves have the following characteristics; warm water plant (<24 ºC), exhibit high tolerance to high salt

concentrations, adapted for life in waterlogged, acidic and poor oxygen soil, and some have seeds which germinate while still in the mother tree and are able to survive even when dispersed by waves.

True mangroves in Buenlag-Sabangan River consist of three species from Family Rhizophoraceae: *Rhizophora apiculata, Rhizophora mucronata, Bruguiera cylindrica;* two species from Family Avicenniaceae: *Avicennia officinales and Avicennia marina:* One species each from Family Euphorbiaceae (*Excoecaria agallocha*), Combretaceae (*Lumnitzera racemosa*), Myrsinaceae (*Aegiceras corniculatum*), Sonneratiaceae, (*Sonneratia alba*), Palmae (*Nipa fruticans*), Pteridaceae (*Acrostichum aureum*), Acanthaceae (*Acanthus elicifolius*).

Associated species include two species from Family Fabaceae (*Derris trifoliate, Acacia farnisiana*) and one species from each of the following Families: Combretaceae (*Terminalia cattapa*), Malvaceae (*Hibiscus tiliaceus)* Clusiaceae (*Calophylumi nophyllum*), Moraceae (*Artocarpus ovatus*), Aizoaceae (*Sesuvium portuculastrum*), Pandanaceae (*Pandanus tectorious*), and Mimosaceae (*Leuceana leucocephalia*).

Among the beach forest type, only coconut (*Cocos nucifera*) and Lambayong (*Ipomea pes-caprae*) can be found in the study area. They are thriving along the beach side of the river. All of the coconuts are planted, matured and fruiting.

Mangroves are known as excellent buffers, habitat as well as spawning and nursery ground of many valuable species of both aquatic and terrestrial fauna such as fish, crustaceans, mollusks, birds, reptiles and other species. Aside from all these important uses, some mangroves have other potential uses. The leaves of *Acrosticum aureum*, for instance, can be eaten either raw or can be prepared into salad. The *Excoecaria agallocha* are used by some fishpond operators to treat diseases of fish in ponds. The leaves and twigs of *Artocarpus ovatus* on the other hand are used as traps for crabs, not as attractant but repellant. The crabs would get out of their holes once they smell the bad odor of the plant. They will get trapped in the net set beside their holes. *Nipa fruticans* are very much well known for the nipa shingles and vinegar it provides for the local communities. However, due to its lesser density, it is not well utilized in the study area.

**Distribution of Mangroves and associated Macroflora**

The whole length of the river is covered with vegetation. True mangroves are present in 27 of the 30 transects established and associated species are present in 19 transects. Beach forest was separately classified based on DENRs classification and they are only present in three transects.

Most frequently occurring true mangrove species are the *Rhizophora apiculata* which can be seen in almost all (27) transects followed by *Excoecaria agallocha* and the other two species under Rhizophoraceae family (*Rhizophora mucronata* and *Brugueira cylindrica*). The former has a mean value of 0.70 while the latter have the same mean value of 0.60 or 60% least occurring of the total transect established. The least occurring true mangrove species is the *Acanthus ilicifolius* which occurred only once in 30 transects.

**Age Stage of Mangroves and Associated Macroflora**

The mangroves and associated macroflora in the study area were characterized as to their age stage whether wildlings, saplings or matured. Those with a height below one meter were considered as wildlings (naturally growing seedlings). Those with a diameter at breast height (DBH) of less than 4 cm and with a height greater than one meter were considered as saplings and those with a DBH greater than 4cm were considered as matured. The wildlings and saplings including propagules whose primary leaves have just evolved were characterized by the DENR as regenerants.

Wildlings outnumbered the saplings and the matured true mangroves with a total frequency of 2352,1177, and 786, respectively, with *Rhizophora mucronata* on the top *r*ank considering all stages. For the associated mangrove species, matured outnumbered the wildlings and the saplings. Most abundant in terms of frequency among the associated species is the *Derris trifoliata* which is a vine. It is followed by *Actocapusovatus* which is a shrub. The climbing habit of a vine and the numerous small woody branches of shrubs allow them to establish easily and firmly in the soil unlike in the trees like the *Acacia farnisiana, Terminalia cattapa* and *Canophylum inophylum* which are much affected by frequent flooding, especially when they are on their younger stage (seeds to seedlings).

Data for true mangroves indicate that the area could be a good source of planting materials for reforestation in the area. It could also be a good site for mangrove nursery establishment considering also the number of species found in the area.

**Abundance of macrofauna and macroflora**

The abundance of the different species of mangroves and associated macroflora were determined using the following indices: density (d), dominance (c) and diversity (H).

Among the true mangrove species *Rhizophora apiculata* or Bakawan lalaki has most number of individuals per square meter (density) with a mean value of 1.01 stand/$m^2$. *Avicennia marina* followed extremely behind with a mean density of 0.11stand/$m^2$. All other species, including the associated and beach forest species, have very low density.

Transect wise, Transect 22 has denser vegetation followed by transect 11, and 13 with mean values of 4.54/$m^2$, 3.09/$m^2$ and 3.0/$m^2$, respectively. This is attributed to the higher frequency of wildlings of *R. apiculata* recorded in the said transects.

Most of the mangroves in the area are naturally growing but there are areas which are planted especially in the new dikes. Since the area under study is a river, mostly it is submerged in water during high tide, the propagules were driven out of site by the current before they are planted in the soil. The natural stands have to be supported by transplantation in low density areas to increase the density and fully support the river bank.

Highest Dominance Index, as computed using the Simpson Index of Dominance, is 1 in Transect 19. The highest value was attributed to the fact that there is only one species (*Rhizophora mucronata)* found in the said transect. Transect 27 has the second highest Dominance Index of 0.9414. Its high rank was also attributed to low number of species (3) and lowest total number of individuals (100). Transect 15 ranked third, though it has higher number of species and total number of individuals per species, than Transect 4 ($4^{th}$), the uneven distribution of the number of individuals per species placed the transect on the third rank.

Species diversity is also a function not only of the number of species but also the number of individuals per species. It is evidenced by the diversity index values in this study. Transect 21 has the highest value of 2.1923 followed by Transects 25, 12 and 11 with mean values of 1.4628, 1.4386, 1.4246,

respectively. The number of species in the same order are as follows: 16, 7, 6 and 8. In Transect 21, aside from it has the highest number of species, the distribution of individuals per species do not vary greatly. The same is true with Transect 25, although it has only 6 species, the deviation on the number of individuals per species is small. Comparing Transect 11 and 12, the former has 8 species but wider range with respect to the number of individuals per species; the latter has only 6 but very slight variation on the number of individuals per species.

Mean diversity of the of the area is 0.90. This is higher compared to the diversity index of Balinagsay River in Bolinao, Pangasinan despite the much bigger size (7 km.) and more number of species (30 both true mangroves and associated species. That of Canaolan River in Binmaley, Pangasinan is also lower (H=0.4463), but only mangroves species are considered in the latter.

**Conclusions**

Based on the results following conclusions were drawn:

1. Buenlag-Sabangan River has diverse macrofloral species.
2. The area is a good source of seedling for mangrove plantation and rehabilitation.
3. Cutting of mangroves caused dike erosion and poor water quality.

**Recommendations**

Based on the results of the study, the following are recommended:

1. A year-round monitoring of the water quality of the river should be done to avoid further fishery losses.
2. A mangrove nursery should be established in the area to support any reforestation plan in the less dense area and other mangrove areas in Binmaley.
3. The fisherfolks and other residents of the community who are directly using the river should informed of the comprehensive resource management plan of the municipality to enable them to participate in the protection and management of the resource.

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