ASSESSMENT OF THE MANGROVE AND BIODIVERSITY FOR THE ESTABLISHMENT OF GINABLAN MANGROVE AND BIRD SANCTUARY AS CRITICAL HABITAT

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Ecosystems Research and Development Bureau
INNOVATING FOR SUSTAINABLE ECOSYSTEMS

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EXECUTIVE SUMMARY

Mangroves provide enormous ecosystem goods and services to society, including sources of fuelwood, crabs and shellfishes; habitat of wildlife, nursery for important marine organisms, protection against strong winds and storm surges during typhoons and storage and reservoir of sequestered atmospheric carbon. However, they are being threatened by various human activities, and climate change is exacerbating these anthropogenic pressures.

The mangrove of Ginablan in Romblon is one of the remaining intact mangroves in the country and serves as a habitat of the endemic and threatened Philippine mangroves and wildlife fauna. In order to protect this important mangrove stand from deforestation, forest degradation and other human disturbances, this mangrove area is being proposed as a critical habitat in order to be placed under strict protection. However, before a meaningful evaluation can be done as to the fitness of Ginablan mangrove as a critical habitat, a characterisation and assessment of its mangrove biodiversity, both the flora and faunal components, and their conditions, should be done first.

Therefore, this study aims to assess the Ginablan mangroves, including its flora and faunal composition, structure and condition. Standard field methods were used to characterise the mangrove flora and faunal composition, diversity and structure, and assess their present condition. The field survey was done in July 2022.

The Ginablan mangrove ecosystem is a mixed forest ecosystem and composed of true mangroves and mangrove associates/beach species. A total of 28 species belonging to 17 families were recorded, with Rhizophoraceae family being the most represented. The mean DBH and height of trees range from 7 to 20 cm and 5 to 6 m, respectively. *Lumnitzera racemosa* is the most dominant species, followed by *Rhizophora stylosa* and *Avicennia marina*. *Excoecaria agallocha* and *Barringtonia asiatica* had the lowest importance value.

There are a total of 314 individuals in the 12 plots established (26.16/plot or 1,699 trees/ha). The result revealed a low diversity index due to the dominance of fewer species. The biomass Carbon stock of Ginablan mangrove ranged from 49.2 to 153.8 Mg C^{-1} ha or a mean of 96.4 Mg C^{-1} ha. Four of the recorded species in Ginablan mangrove are threatened species. *Xylocarpus rumphii, Vitex parviflora, Pemphis acidula,* and *Pterocarpus indicus*

are listed either as vulnerable or endangered species under the IUCN Red List and DENR DAO 2017-11.

Moreover, a total of 26 avifaunal species were recorded within and in adjacent areas of the study site, including the *Anas luzonica* and *Streptopelia* cf. *dusumieri,* both are listed as Endangered and Vulnerable species, respectively. A sighting of a small flock of Ardea intermedia or Intermediate Egret was found to be hovering over Ginablan. Remarkably, no observed avifauna is listed in any of the CITES Appendices.

For mammalian species, *Cynopterus brachyotis* or the Lesser Dog-faced Fruit Bat was recorded, along with *Pteropus hypomelanus* or the Island Flying Fox. The species, referred to as one of the Old World fruit bats or flying fox, also belongs to the Pteropodidae family. According to the IUCN, its conservation status is categorized as Near Threatened

For herpetofauna, a total of six (6) reptiles and one (1) amphibian were observed, including the Philippine flying dragon, Island wolf snake, House Gecko, Monitor Lizard and Cane toad. Two species were listed as Threatened species, Tokay Gecko and Wet Visayan Monitor Lizard.

For macrobenthos, 15 species of macrobenthos were recorded. *Geloina expansa* as well as *Terebralia palustris* are the edible and abundant species found in the area. Other species are also seagrass-associated macrobenthos because the presence of seagrass was observed near the other plots laid for the assessment. The class gastropoda dominates the species found in the area. No threatened species was observed.

This assessment has demonstrated that the Ginablan mangrove area is an important habitat for ecologically and economically important flora, fauna, and other associated living organisms. This mangrove area also supports the growth and development of a number of species that are considered globally and nationally threatened by extinction due to anthropogenic causes, among many other causes. It also stores a considerable stock of carbon from the biomass of its mangrove trees. Therefore, protection of this sanctuary is of utmost importance.

The following recommendations are forwarded:

- Name tagging should be done on tree species present in the area.
- It is also necessary to explore opportunities to have a replanting program for *Xylocarpus rumphii* as this is categorized as

Vulnerable. This should be done along with other threatened mangrove species as mentioned in the report.

- For the conservation of fauna, it is important to formulate mitigation strategies for invasive alien species such as the *R. marina* while too much infestation is not yet observed in the area.
- Comprehensive management plans may be implemented to further protect threatened species that inhabit within and in adjacent areas of the sanctuary such as the Romblon Boobook, Philippine Duck, Philippine Collared Dove, Tokay Gecko, West Visayan Monitor Lizard, and Island Flying Fox.
- The potential of the area to become an established eco-tourism spot may give way to the conservation of these species. Moreover, formally declaring this wildlife as flagship species of the locality could heighten awareness of locals and tourists alike.
- Preservation of macrobenthos should also be a priority as these are food sources of other organisms such as birds. The area pegged to be protected should be expanded, and must include the seagrass beds in the coastal area adjacent to the sanctuary.
- Promotion of the protection of the area may be done by strengthening information, education, and communication (IEC) campaigns in order to involve the locals in the preservation of the natural resources of Ginablan.
- It is also important to capacitate or train the *Bantay Bakawan* on the importance of different flora species that may be used in the education and awareness component of ecotourism programs.
- Monitoring this area, particularly the recorded flora and fauna species, should be done in order to obtain the necessary data for developing strategies to ensure their protection and survival.

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INTRODUCTION

A healthy marine ecology is dependent on healthy mangrove forests. Mangroves are an important forest ecosystem that dominates coastlines in tropical and subtropical regions around the world. True mangroves, which are found only in the intertidal zones of the coasts and are taxonomically distinct from their terrestrial counterparts, number 54-75 species (Deguit et al 2004). Mangroves thrive in highly saline waters and soils because they are highly adapted to their environment and are capable of excluding or expelling salt. However, salinity, as well as other environmental factors such as climate, tidal fluctuation, and sediment and wave energy, can still limit the distribution of mangroves (Caizares & Seronay, 2016).

Many threatened and endangered species are found in mangrove forests, which serve as critical habitat for a wide range of marine and terrestrial flora and fauna. They also serve as a haven for juvenile fish, crabs, shrimp, mollusks, and other invertebrates. They are also ideal nesting, migratory resting, and feeding grounds for hundreds of bird species.

Despite their importance, mangrove forests are still threatened by deforestation and the rapid expansion of aquaculture development (Caizares & Seronay, 2016). Pollution, siltation, and sea level rise are among the other threats (Melana et al., 2000).

The mangrove of Ginablan in Romblon Island is one of the remaining intact mangroves in the country and serves as a habitat of the endemic and threatened Philippine mangroves and wildlife fauna. In order to protect this important mangrove stand from deforestation, forest degradation and other human disturbances, this mangrove area is being proposed as a critical habitat in order to be placed under strict protection. However, before a meaningful evaluation can be done as to the fitness of Ginablan mangrove as a critical habitat, a characterization and assessment of its mangrove biodiversity, both the flora and faunal components, and their conditions, should be done first. There is a need to assess the area's coastal resources that rely on mangrove forests.

To address the above concerns, this study aims to assess the Ginablan mangroves' biodiversity and their present condition. Specifically, the study aims to achieve the following:

1) To characterize and assess the existing vegetation and its component flora of Ginablan mangrove ecosystem; and

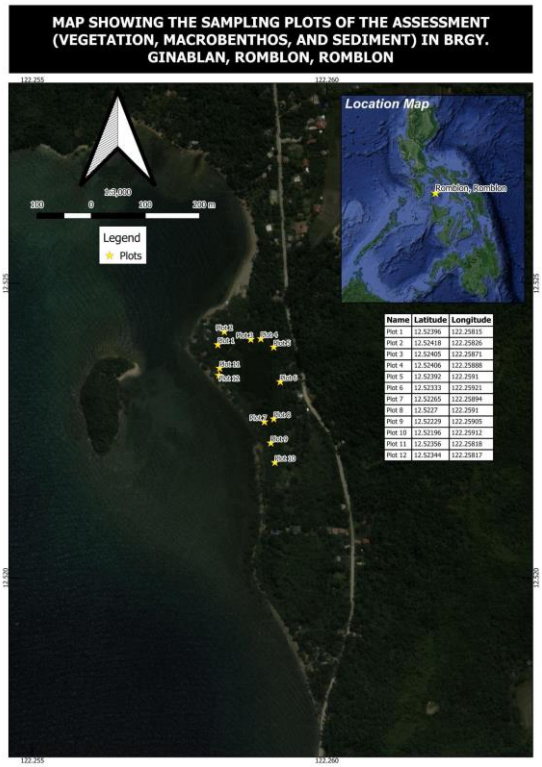
2) To characterize and assess the existing faunal component of Ginablan mangrove ecosystem, including birds, mammals, herpetofauna and macrobenthos

This report is prepared by DENR-ERDB for DENR-PENRO Romblon for their Ginablan mangrove area. It is based on a rapid site assessment conducted on July 12 to 15, 2022. The information generated from the study will hopefully serve as scientific basis for formulating plans and programs, as well as for assessing the fitness of Ginablan mangroves to support its declaration as Critical Habitat and Ecotourism Area. The assessment of mangroves is critical in ensuring the proper management and rehabilitation efforts of the various concerned entities in order to sustain the area's biodiversity conservation information.

METHODS

Study site

The Ginablan mangrove is approximately ___hectares and located in Barangay Ginablan in the municipality of Romblon, in the island province of Romblon (Fig.1). The site is some x km from Manila and is geographically located at approximately 12.5323, 122.2576. At these coordinates, the elevation is estimated to be 30.0 meters (98.4 feet) above mean sea level. Romblon gets about 124.94 millimeters (4.92 inches) of rain per year and has 218.02 rainy days (59.73 percent of the time) (Lamotan, 2022).



Plot No.	Latitude	Longitude
Plot 1	12.52396	122.25815
Plot 2	12.52418	122.25826
Plot 3	12.52405	122.25871
Plot 4	12.52406	122.25888
Plot 5	12.52392	122.2591
Plot 6	12.52333	122.25921
Plot 7	12.52265	122.25894
Plot 8	12.5227	122.2591
Plot 9	12.52229	122.25905
Plot 10	12.52196	122.25912
Plot 11	12.52356	122.25818
Plot 12	12.52344	122.25817

Figure 1. Map showing the relative location of Ginablan mangrove and the survey plots for the study.

Field Method

Vegetation

A total of twelve (12) circular plots of 7-m radius (154 m^2) were established at an interval of 10–20m. These plots were used for trees with a diameter at breast height (dbh) of > 5 cm. The geographic coordinates of each plot were determined using a handheld GPS receiver. For each circular plot with a 7-m radius, all vegetation within each duly designated plot was measured, identified, and counted. Height and dbh were measured for species with at least a 5 mm diameter. The count and DBH collected in the field will be used to calculate tree density and basal area. Tree saplings were also recorded for analysis. Other species seen were documented.

A total of 12 circular plots were laid on the study site. The Ginablan Mangrove and Bird Sanctuary is a protected mangrove wetland that provides habitat for a variety of local and migrating species, including the endemic and endangered Philippine Duck.

Fauna and Macrobenthos

Fauna

Various methods, applying opportunistic sampling, for the faunal assessment were performed in order to identify and observe terrestrial vertebrates in the area as well as in locations adjacent to the sanctuary.

Figure 2. Map showing the adjacent areas where faunal assessment was conducted

The data gathering was only limited to 4 taxa: aves, mammalia (volant), reptilia, and amphibia. It should be noted that the assessment was just limited to daytime surveys – from sunrise to sunset. Witnessed nocturnal species were not intentionally observed at night as these were just casual encounters. Furthermore, no population count was conducted in most species except to the sanctuary's flagship species – the Philippine Duck or *Anas luzonica*. Significant areas where data gathering was conducted were also geotagged with the use of a global positioning system device.

Figure 3. Geotagging of the lagoon in the Ginablan Bird and Mangrove Sanctuary (Photo: AVelasquez)

Auditory and visual encounter survey (AVES)

Mobile (Figure 2) and 15-minute stationary (Figure 4) AVES were conducted. For proper identification, most species observed were photo-documented.

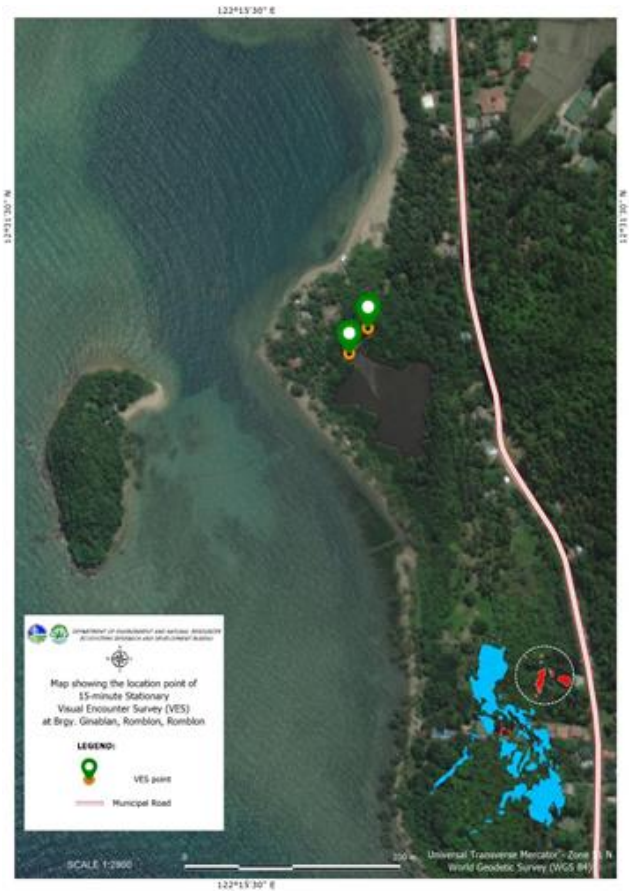


Figure 4. Location of 15-minute AVES

Familiarity of the researcher to bird calls also supplemented in the identification. For mammals, pre-identified roosting sites of flying foxes were visited to validate existing populations, identify species, and verify roosting/foraging areas. As for herpetological survey, identified species were from casual encounters only.

Figure 5. (A) Photo-documentation in the lagoon; (B) Photo-documentation at the coastal area adjacent to the sanctuary (Photo: MMBernales & RTanaelJr)

Mist netting

Two (2) separate mist nets, with dimensions of 3 x 4 meters, were set-up. This method was just for trial-and-error as the only objective of establishing mist nets is to determine the probable flyways of birds and volant mammals. All mist nets were set-up on the first day of faunal assessment in the afternoon.

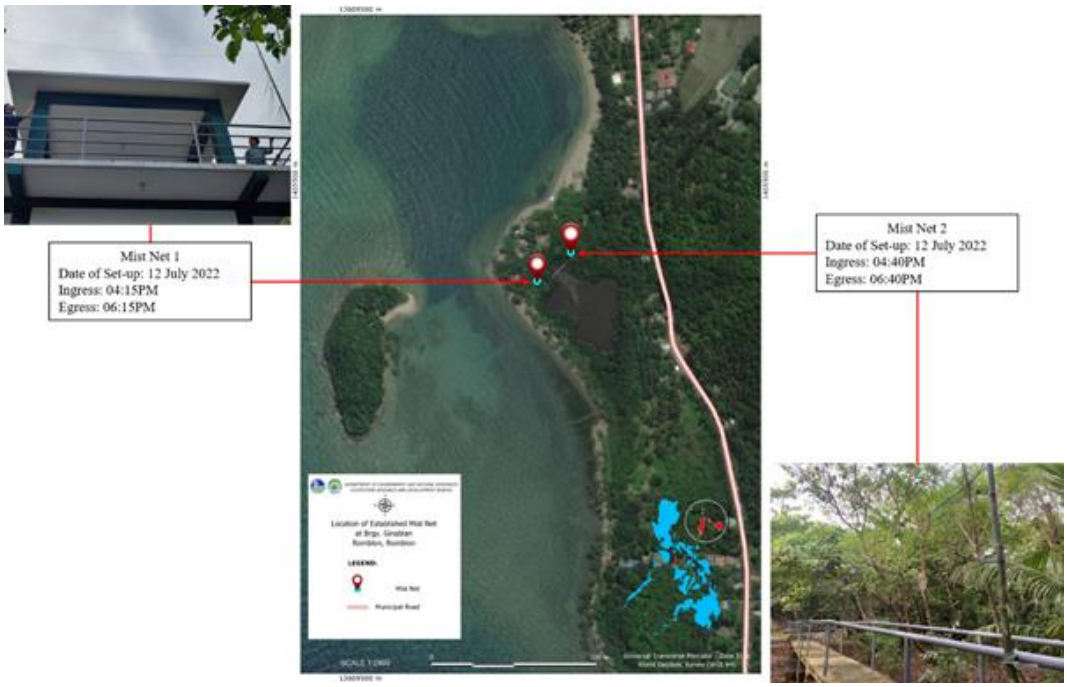


Figure 6. Map of established mist nets
(Photo: MMBernales & AVelasquez)

Bird and bat count

To give prime to the flagship species of the sanctuary, bird count was only conducted for the Philippine-endemic *Anas luzonica* to initially determine its population. For an acceptable estimate, three (3) observers were provided a counter to simultaneously count observable individuals of the species that are present in the lagoon at five (5) different times (Table 1). After gathering all counts from the observers, the average estimated population was computed.

Table 1. Schedule of A. luzonica count in the sanctuary's lagoon

Day	Time
1st	05:30AM
	10:00AM
	01:00PM
	05:00PM
2nd	05:30AM

For bats, counting was only conducted once per roosting and/or foraging site, either in the morning while they roost and afternoon while they are about to forage. Using a counter, two (2) observers simultaneously count all observable bat individuals per site. After which, the average number of flying fox individuals was computed.

Identification and data processing

With the use of a baseline field guide – that is *A Guide to the Birds of the Philippines* (Kennedy *et. al.*, 2000) – birds were initially identified. Furthermore, in processing and validating the data, *All the Birds of the World* (del Hoyo, 2021) and The Cornell Lab of Ornithology: Birds of the World website (https://birdsoftheworld.org/bow/home) served as references as these contain the most updated information about birds. For the herpetological data, the references used were that of Siler *et. al.* (2012) and Leviton *et. al.* (2018). On the other hand, volant mammals (bats) were identified based on Ingle and Heaney (1992). In addition, the International Union for the Conservation of Nature (IUCN) Red List website (https://www.iucnredlist.org/) was also used to supplement the processing of data.

After identifying all species observed, information about their conservation status was gathered from the IUCN Red List website, DENR Department Administrative Order (DAO) 2019-09, and Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES) Appendices. In addition, distribution and worldwide population trends of the species were identified as well.

Macrobenthos

Within the established vegetation plot, plots for epifauna and infauna were established. For epifauna, a 1m x 1m quadrat was used for the demarcations of sample collection. For infauna, a soil corer (10 cm in depth) was used for the collection. Only day surveys were conducted in all plots. All species encountered within the quadrat were identified and counted to the lowest possible taxonomic rank based from Springsteen and Leobrera (1986), Poppe (2016), idscaro.net, and online references. The currently accepted names of the listed species were validated from the World Register of Marine Species (WoRMS) and International Union for Conservation of Nature (IUCN) website. Reference or representative samples of macrobenthos were photo-documented.

Figure 7. Assessment of macrobenthos (Photo: MMBernales)

Data Processing and Analyses

Vegetation

The collected data were analyzed for abundance, dominance, diversity, among other vegetation variables, as discussed in Kent and Coker (1992); Mueller-Dombois and Ellenberg (1971).

a. Community Structure

The dominant species for each site was determined based on the importance value (IV). The IV is the sum of the relative density, relative frequency, and relative dominance. These were computed using the following formula:

$$\text{Density} = \frac{Total\ number\ of\ individuals\ of\ species\ i}{Total\ area\ sampled\ (m2)}$$

$$\text{Relative Density} = \left(\frac{Density\ of\ species\ i}{Total\ density\ of\ all\ species}\right) x\ 100$$

Basal Area (m2)/Dominance = 0.7854 * DBH^2 of species i / area sampled (m^2)

$$\text{Relative Dominance} = \left(\frac{Basal\ area\ of\ \ species\ i}{Basal\ area\ of\ all\ species}\right) x\ 100$$

$$\text{Frequency} = \left(\frac{No.of\ plots\ where\ species\ i\ occur}{Total\ number\ of\ plots}\right) x\ 100$$

$$\text{Relative Frequency} = \left(\frac{Frequency\ of\ a\ species}{Frequency\ of\ all\ species}\right) x\ 100$$

Importance Value **=** $Relative\ Density + Relative\ Dominance + Relative\ Frequency$

b. Species Diversity and Abundance

Species diversity indices was computed using the Shannon-Weiner diversity index:

Shannon-Weiner diversity index (H'); H' = $-\Sigma p_i \ln p_i$, where p_i, the proportional abundance of the *i*th species = (n_i/N)

The Abundance of each species was computed as the mean number of individuals per species across the total plots established. The mean value was scaled to a hectare basis.

c. Aboveground and Belowground Biomass

Published allometric equations for aboveground and belowground biomass of mangroves from Southeast Asian countries were used to calculate the tree biomass (table x). The tree biomass data were converted to its C equivalent using C fraction value (47% for AGB and 39% for BGB) based on Kauffman and Donato (2012).

Table 2. Biomass allometric equations and wood density value used in the study

Species	Aboveground	Belowground[+]	References for aboveground biomass equations	Wood Density (g cm^{-3})
Aegiceras floridum	Biomass (kg) = $0.251*\square*D^{2.46}$	Biomass (kg) = $0.199*\square^{0.899}D^{2.22}$	Komiyama *et al.* (2005)	0.71[a]
Bruguiera gymnorrhiza	Biomass (kg) = 0.186 $D^{2.31}$	Biomass (kg) = $0.199*\square^{0.899}D^{2.22}$	Clough and Scott (1989)	0.85[b]
B. parviflora	Biomass (kg) = $0.168D^{2.42}$	Biomass (kg) = $0.199*\square^{0.899}D^{2.22}$	Clough and Scott (1989)	0.89[b]
B. sexangula	Biomass (kg) = $0.168D^{2.42}$	Biomass (kg) = $0.199*\square^{0.899}D^{2.22}$	Clough and Scott (1989)	0.87[b]
Camptostemon philippinense	Biomass (kg) = $0.251*\square*D^{2.46}$	Biomass (kg) = $0.199*\square^{0.899}D^{2.22}$	Komiyama *et al.* (2005)	0.71[a]
Ceriops tagal	Biomass (kg) = $0.251*\square*D^{2.46}$	Biomass (kg) = $0.199*\square^{0.899}D^{2.22}$	Komiyama *et al.* (2005)	0.89[b]
Cocos nucifera	Biomass (kg) = $0.7854*D^2*H*\square*1.6$	Biomass (kg) $=0.7845*D^2*H*\square*1.6*0.04$ (Zamora 1999)	Brown (1997); Zamora (1999)	0.25[c]
Heritiera littoralis	Biomass (kg) = $0.251*\square*D^{2.46}$	Biomass (kg) = $0.199*\square^{0.899}D^{2.22}$	Komiyama *et al.* (2005)	0..84[a]
Lumnitzera racemosa	Biomass (kg) = $0.251*\square*D^{2.46}$	Biomass (kg) = $0.199*\square^{0.899}D^{2.22}$	Komiyama *et al.* (2005)	0.71[a]
Rhizophora apiculata	Biomass (kg) = $0.235D^{2.42}$ + $Biomass_{stilt}$ (kg) = $0.0209D^{2.55}$	Biomass (kg) = $0.199*\square^{0.899}D^{2.22}$	Ong et al. (2004)	1.04[b]
R. mucronata	Biomass (kg) = $0.235D^{2.42}$ + $Biomass_{stilt}$ (kg) = $0.0209D^{2.55}$	Biomass (kg) = $0.199*\square^{0.899}D^{2.22}$	Ong et al. (2004)	0.98[b]
R. stylosa	Biomass (kg) = $0.235D^{2.42}$ + $Biomass_{stilt}$ (kg) = $0.0209D^{2.55}$	Biomass (kg) = $0.199*\square^{0.899}D^{2.22}$	Ong et al. (2004)	0.98[b]
Sonneratia alba	Biomass (kg) = $0.251*\square*D^{2.46}$	Biomass (kg) = $0.199*\square^{0.899}D^{2.22}$	Komiyama *et al.* (2005)	0.83[b]
Xylocarpus moluccensis	Biomass (kg) = $0.251*\square*D^{2.46}$	Biomass (kg) = $0.199*\square^{0.899}D^{2.22}$	Komiyama *et al.* (2005)	0.66[b]
X. granatum	Biomass (kg) = $0.251*\square*D^{2.46}$	Biomass (kg) = $0.199*\square^{0.899}D^{2.22}$	Komiyama *et al.* (2005)	0.66[b]

[a]Howard *et al.*, 2014 [b]Brown and Fisher, 1920 [c]Brown 1997; Zamora, 1999 [+]Equations from Komiyama et al. (2005) unless stated otherwise

Fauna and macrobenthos

Species Richness, Species Density, Shannon-Wiener diversity (H') index, and Pielou evenness (J') index were determined using the program Paleontological Statistics/ PAST Volume 4.03 (Hammer et al., 2001).

RESULTS AND DISCUSSION

Vegetation

The Ginablan mangrove ecosystem photos are shown in Figure 8.

Figure 8. Plots for the mangrove assessment (Photo: MMBernales)

Vegetation Type and Composition

The area is covered with beach and mangrove strand vegetation. It is a mixed stand as a result of the efforts of LGU that planted more *Rhizophora spp.* around the lagoon located in the middle of the Sanctuary. The common plants recorded are Lumnitzera racemosa and Rhizophora stylosa. A total of 28 species belonging to 17 families were recorded in the area (Table 3).

The analysis of the tree flora of the study showed that the families of Rhizophoraceae are the most represented, followed by Lamiaceae and Fabaceae, which recorded the highest number of species. Indeed, the presence of the Rhizophoraceae, Lamiaceae, and Fabaceae generally represented by species of tree is a characteristic common to all mangrove forests (Feller, 2018).

Table 3. Species observed in the study site

Family	Common Name	Scientific name
Lamiaceae	Alagau Dagat	*Premna serratifolia Linn.*
Acanthaceae	Bungalon	*Avicennia marina (Forssk.) Vierh.*
Fabaceae	Bani	*Milletia pinnata (L.) Panigrahi*
Phyllanthaceae	Bayag usa	*Antidesma globosa Linn.*
Rhizophoraceae	Pototan lalaki	*Bruguiera cylindrica (L.) Bl.*
Lecythidaceae	Botong	*Barringtonia asiatica (L.) Kurz.*
Euphorbiaceae	Buta-buta	*Excoecaria agallocha (L.)*
Combretaceae	Culasi	*Lumnitzera racemosa Willd.*
Aizoaceae	Dampalit	*Sesuvium portulacastrum (L.) L.*
Convolvulaceae	Kamote kamotehan	*Ipomea pes-caprae (L.) R.Br.*
Pteridaceae	Lagolo	*Acrostichum aureum L.*
Lamiaceae	Lagunding dagat	*Vitex trifolia L.*
Boraginaceae	Malabanalo	*Cordia subcordata Lam.*
Malvaceae	Malubago	*Talipariti tiliaceum (L.) Fryxell*
Lythraceae	Pagatpat	*Sonneratia alba Sm.*
Pandanaceae	Pandan dagat	*Pandanus tectorius P.*
Rhizophoraceae	Bakauan lalaki	*Rhizophora apiculata Blume*
Rhizophoraceae	Bakauan bato	*Rhizophora stylosa (Griff.) Schimp.*
Rubiacea	Santan dagat	*Ixora philippinensis Merr.*
Combretaceae	Talisai	*Terminalia catappa L.*
Rhizophoraceae	Tangal	*Ceriops tagal (Perr.) C. B. Robinson*
Rubiaceae	Bangkoro	*Morinda citrifolia L.*
Fabaceae	Aroma	*Prosopis juliflora (Sw.) DC.*
Euphorbiaceae	Bignai	*Antidesma bunius L.*
Meliaceae	Malapiagao	*Xylocarpus rumphii (Kostel.) Mabb.*
Lamiaceae	Molave	*Vitex parviflora Juss.*
Lythraceae	Bantigi	*Pemphis acidula J.R. Forst. & G. Forst.*
Fabaceae	Narra	*Pterocarpus indicus Willd.*

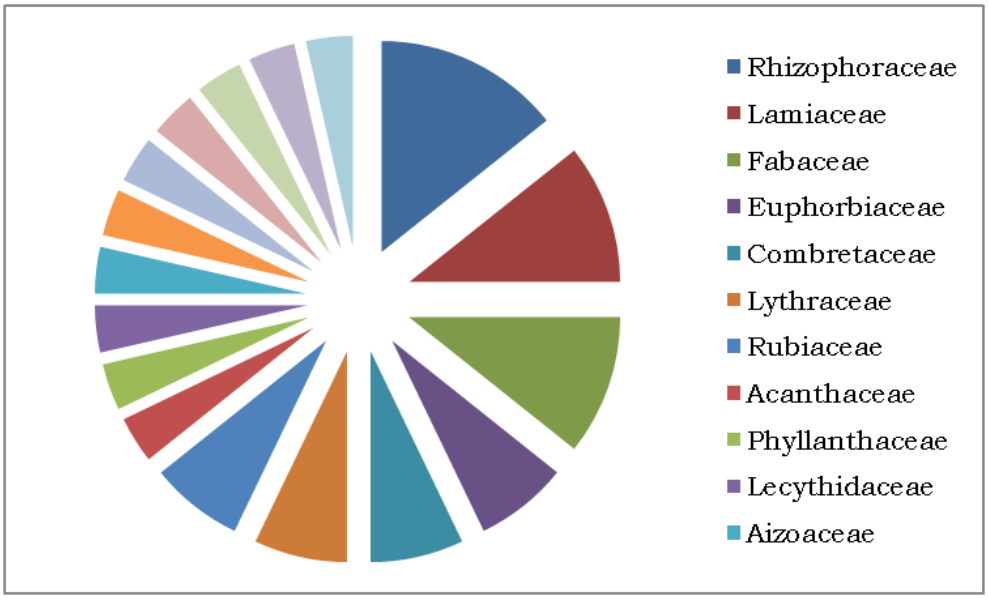


Figure 9. Family of species present in the area

Diameter-at-breast-Height (DBH), Height and Basal Area

The mean DBH and height of trees in Ginablan mangrove range from 7 to 20 cm and 5 to 6 m, respectively (Table 4). It has been observed that *Milletia pinnata* and *Cordia subcordata* resulted in the species with the highest average DBH among others. In terms of the average height, *Cordia subcordata, Excoecaria agallocha,* and *Rhizophora apiculata* bore the highest among other species that can be found at the study site. *Lumnitzera racemosa* bore the highest average basal area.

Table 4. Mean Basal Area, DBH and Height of species present in the area

Species	Mean Basal Area	Mean DBH (cm)	Mean Height (m)
Milletia pinnata	0.06	20.00	6.00
Cordia subcordata	0.05	17.70	7.00
Barringtonia asiatica	0.02	14.00	6.00
Excoecaria agallocha	0.02	14.00	7.00
Sonneratia alba	0.27	11.55	6.20
Rhizophora apiculata	0.20	11.47	6.19
Avicennia marina	0.44	11.31	5.97
Xylocarpus rumphii	0.30	11.29	5.96
Rhizophora stylosa	0.96	11.27	5.96
Lumnitzera racemosa	1.07	11.16	5.93
Talipariti tiliaceum	0.06	10.86	6.00
Terminalia catappa	0.06	10.82	5.55
Bruguiera cylindrica	0.01	7.00	5.00

Species Abundance and Diversity

In terms of species abundance, *Lumnitzera racemosa; Rhizophora stylosa; and Avicennia marina* bore the highest among other species. A total of 124 tree individuals of *Lumnitzera racemosa*, 90 tree individuals of *Rhizophora stylosa*, and 42 individuals of *Avicennia marina were measured* within the 12 plots. *Lumnitzera racemosa* is the most abundant mangrove species due to the presence of numerous mother trees, favorable environmental conditions, and a constant supply of freshwater from the lagoon, which facilitates its growth and survival.

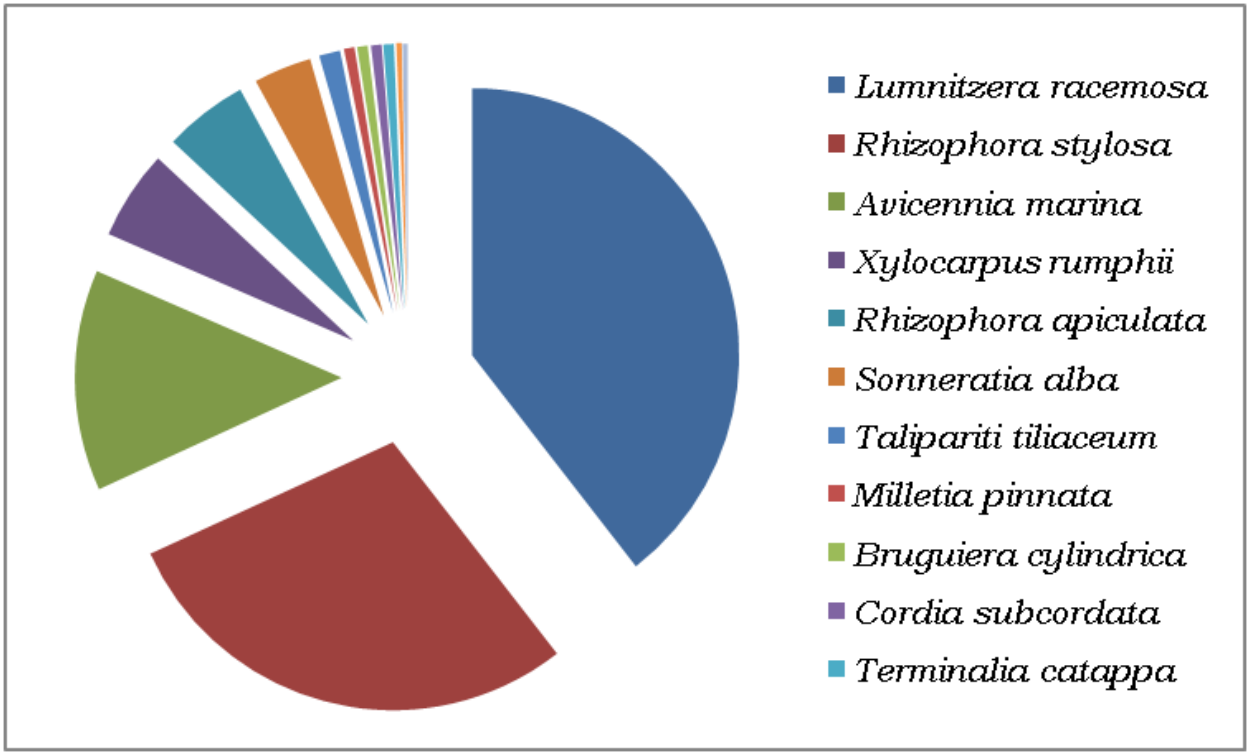


Figure 10. Species abundance at the study site

Lumnitzera racemosa was the most dominant species with an importance value of 153.28, followed by *Rhizophora stylosa* and *Avicennia marina* with IVs of 147.69 and 125.83, respectively. Excoecaria agallocha and Barringtonia asiatica had the lowest importance value.

Table 5. Relative values and dominance of the species in the study site

Species	Relative Frequency	Relative Density	Relative Dominance	IV
Lumnitzera racemosa	83.33	39.49	30.46	153.28
Rhizophora stylosa	91.67	28.66	27.36	147.69
Avicennia marina	100.00	13.38	12.46	125.83
Rhizophora apiculata	41.67	5.10	5.81	52.58
Sonneratia alba	33.33	3.50	7.60	44.43
Xylocarpus rumphii	25.00	5.41	8.59	39.01
Milletia pinnata	16.67	0.64	1.80	19.10
Taliparíti tiliaceum	8.33	1.27	1.58	11.19
Terminalia catappa	8.33	0.64	1.84	10.81
Cordia subcordata	8.33	0.64	1.39	10.36
Bruguiera cylindrica	8.33	0.64	0.22	9.19
Barringtonia asiatica	8.33	0.32	0.44	9.09
Excoecaria agallocha	8.33	0.32	0.44	9.09
Grand Total	100.00	100.00	100.00	300.00

The Shannon diversity index value obtained from all of the plots is 1.88. The evenness index resulted in 0.83 while species richness was 13. There are a total of 314 individuals in the plots, with an average population size of 3.49. The result revealed a low diversity index due to the dominance of fewer species. Only 3 species mostly dominate the area: *Lumnitzera racemosa, Rhizophora stylosa* and *Avicennia marina.*

Biomass Carbon Stock

The biomass Carbon stock of Ginablan mangrove ranged from 49.2 to 153.8 MgC^{-1} ha or a mean of 96.4 MgC^{-1} ha. Plot 9 had the highest biomass C stock with a total of 153.8 MgC ha^{-1} probably because of higher mean DBH and stem density of 11.7cm and 3.3 respectively, as compared to the other sampling plots, resulting in a bigger biomass. On the other hand, Plot 3 had the lowest biomass C stock, with only 49.2 MgC ha^{-1} due to its lowest DBH of only 3.3cm.

Table 6. Total Biomass C stock (MgC^{-} ha^{1}) of the study site

Plot	AGB	BGB	Total
1	70.7	26.2	96.9
2	94.9	31	125.9
3	35.7	13.5	49.2
4	47.8	17.4	65.2
5	68.8	23.3	92.1
6	57.6	20	77.6
7	69.5	26	95.5
8	41.2	14.4	55.6
9	113.6	40.3	153.8
10	47	16.3	63.3
11	89.2	33	122.1
12	90	30.5	120.5
Mean	**71.3**	**25.1**	**96.4**

Conservation Status

Four of the recorded species in Ginablan mangrove are threatened species. *Xylocarpus rumphii, Vitex parviflora, Pemphis acidula,* and *Pterocarpus indicus* are listed to be vulnerable and/or endangered species under the IUCN Red List and DENR DAO 2017-11. Some of these species have been suggested for the Philippines as a tall tree in shelterbelts (WAO, 2021). Some plantations

have been established in reforestation schemes in the country. The population of these species is dwindling. Hence, there is an urgent need to conserve them.

Table 7. Threatened species in the study site and their Conservation status

Family	Common Name	Scientific name	Conservation Status		Observation	Habits
			IUCN/Nparks	DAO 2017-11		
Meliaceae	Malapiagao	*Xylocarpus rumphii*	Vulnerable		True mangrove	Tree
Lamiaceae	Molave	*Vitex parviflora*	Vulnerable	Endangered	Beach forest species	Tree
Lythraceae	Bantigi	*Pemphis acidula*	Vulnerable	Endangered	True mangrove	Shrub
Fabaceae	Narra	*Pterocarpus indicus*	Endangered	Vulnerable	Beach forest species	Tree

Figure 11. Some of the images of the species identified as vulnerable or endangered in the study area

Fauna

Avifauna

A total of 26 bird species (Table 8) were observed within and in adjacent areas of the sanctuary. Since the conduct of the assessment is beyond the migration season of birds, not much of those species were identified. According to the Biodiversity Management Bureau (2021), the annual bird migration season in the Philippines happens between the months of September and March. However, a sighting of a small flock of Ardea intermedia or Intermediate Egret were found to be hovering over Ginablan. These types of species that are sighted in the country beyond the migration season are referred to as overwintering. This means that such species are escaping the cool conditions of winter,thus, spending their time in warmer regions where food is readily available.

Figure 12. A. intermedia sightings (Photo: AVelasquez)

In the established mist nets, not much significant captures were recorded. However, it is noted that the two locations where the mist nets were set-up are flight paths of birds. The images below (Figure 14) show some of the bird species captured, followed by the summary of catch (Table 8). A total of 5 individuals belonging to three (3) different bird species were mist netted.

Figure 13. (A) Geopelia striata or Zebra Dove and (B) Aplonis payanensis or Asian Glossy Starling (Photo: AVelasquez and MMBernales)

Table 8. Summary of mist net capture

Label	**Coordinates**	**Species**		
		Common Name	**Scientific Name**	**Quantity**
M1	12°31'25.6" N; 122°15'29.3" E	Asian Glossy Starling	*Aplonis payanensis*	2
		Zebra Dove	*Geopelia striata*	1
M2	12°31'26.7" N; 122°15'30.7" E	Philippine Pied Fantail	*Rhipidura nigritorquis*	2
TOTAL NUMBER OF HEADS				5

Table 9. List of observed avifauna within and in adjacent areas of Ginablan Bird and Mangrove Sanctuary

Family	Scientific Name	Common Name	IUCN Status	DAO 2019-19	IUCN Global Population Trend
Acanthizidae	*Gerygone sulphurea*	Golden-bellied Gerygone	Least Concern	-	Decreasing
Accipitridae	*Haliastur indus*	Brahminy Kite	Least Concern	-	Decreasing
Alcedinidae	*Todiramphus chloris*	Collared Kingfisher	Least Concern	-	Decreasing
Anatidae	*Anas luzonica*	Philippine Duck	Vulnerable	Vulnerable	Decreasing
Ardeidae	*Nycticorax nycticorax*	Black-crowned Night Heron	Least Concern	-	Decreasing
Ardeidae	*Ardea intermedia*	Intermediate Egret	Least Concern	-	Decreasing
Artamidae	*Artamus leucorynchus*	White-breasted Woodswallow	Least Concern	-	Stable
Campephagidae	*Lalage nigra*	Pied Triller	Least Concern	-	Decreasing
Columbidae	*Geopelia striata*	Zebra Dove	Least Concern	-	Stable
Columbidae	*Treron vernans*	Pink-necked Green Pigeon	Least Concern	-	Stable
Columbidae	*Streptopelia* cf. *dusumieri*	Philippine Collared-Dove	Vulnerable	-	Decreasing
Corvidae	*Corvus macrorhynchos*	Large-billed Crow	Least Concern	-	Stable
Estrildidae	*Lonchura atricapilla*	Chestnut Munia	Least Concern	-	Stable
Hirundinidae	*Hirundo tahitica*	Pacific Swallow	Least Concern	-	Unknown
Meropidae	*Merops* sp. [1]	Bee-eater	Least Concern	-	Stable
Nectariniidae	*Cinnyris jugularis*	Olive-backed Sunbird	Least Concern	-	Stable
Oriolidae	*Oriolus chinensis*	Black-naped Oriole	Least Concern	-	Decreasing
Passeridae	*Passer montanus*	Eurasian Tree Sparrow	Least Concern	-	Decreasing
Pycnonotidae	*Pycnonotus goiavier*	Yellow-vented Bulbul	Least Concern	-	Increasing
Rallidae	*Amaurornis phoenicurus*	White Breasted Waterhen	Least Concern	-	Unknown
Rallidae	*Hypotaenidia torquata*	Barred Rail	Least Concern	-	Unknown
Rallidae	*Amaurornis olivacea*	Philippine Bush-hen	Least Concern	-	Unknown
Rhipidurudae	*Rhipidura nigritorquis*	Philippine Pied Fantail	Least Concern	-	Stable
Strigidae	*Ninox spilonotus*[2]	Romblon Boobook	Endangered	Endangered	Decreasing
Sturnidae	*Aplonis panayensis*	Asian Glossy Starling	Least Concern	-	Unknown
Zosteropidae	*Zosterops meyeni*	Lowland White-eye	Least Concern	-	Stable

[1]Needs further validation as it is possible to be either *M. americanus* or *M. philippinus*
[2]Listed as *Ninox spilonota* or Romblon hawk-owl in DENR DAO 2019-09

In the IUCN Red List of Threatened Species, most of the avifauna (23) that was observed in the area is categorized as Least Concern (LC). This means that, on a worldwide scale, these species are still abundant and widespread in the wild. Moreover, it was followed by 2 Vulnerable (V) species, *Anas luzonica* and *Streptopelia* cf. *dusumieri*, and 1 Endangered (EN) which is the *Ninox spilonotus*. In addition, among the observed bird species, only two (2) are listed in the DENR DAO 2019-19 – that is *N. spilonotus* and *A. luzonica* that are categorized as EN and V, respectively. Remarkably, no observed avifauna is listed in any of the CITES Appendices.

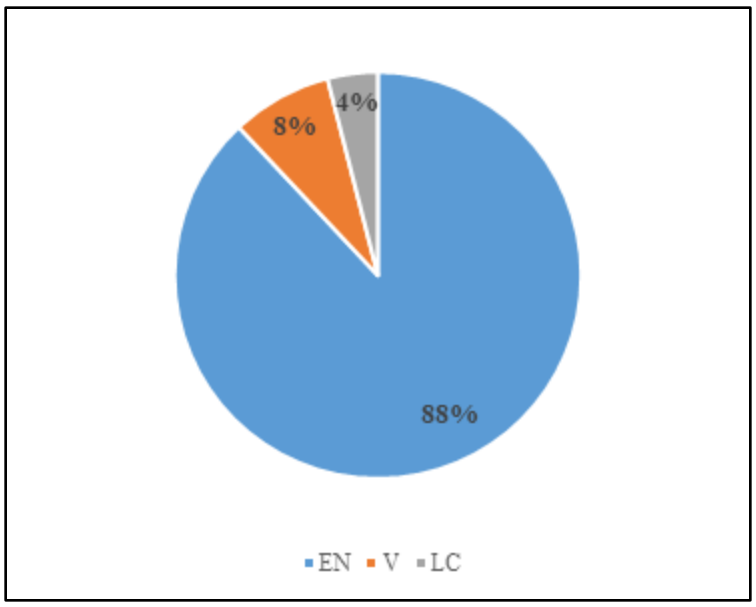


Figure 14. Percent distribution of IUCN conservation status categories of observed avifauna in Ginablan Bird and Mangrove Sanctuary

Although most are categorized as LC, 42% (11) of the total observed species has a decreasing trend in terms of their worldwide estimated population. Thirty-five percent (35%) or 9 species have stable populations, 19% (5) are unknown, and 4% or only one (1) species listed has a population that is continuously increasing – the *Pycnonotus goiavier* or Yellow-vented Bulbul.

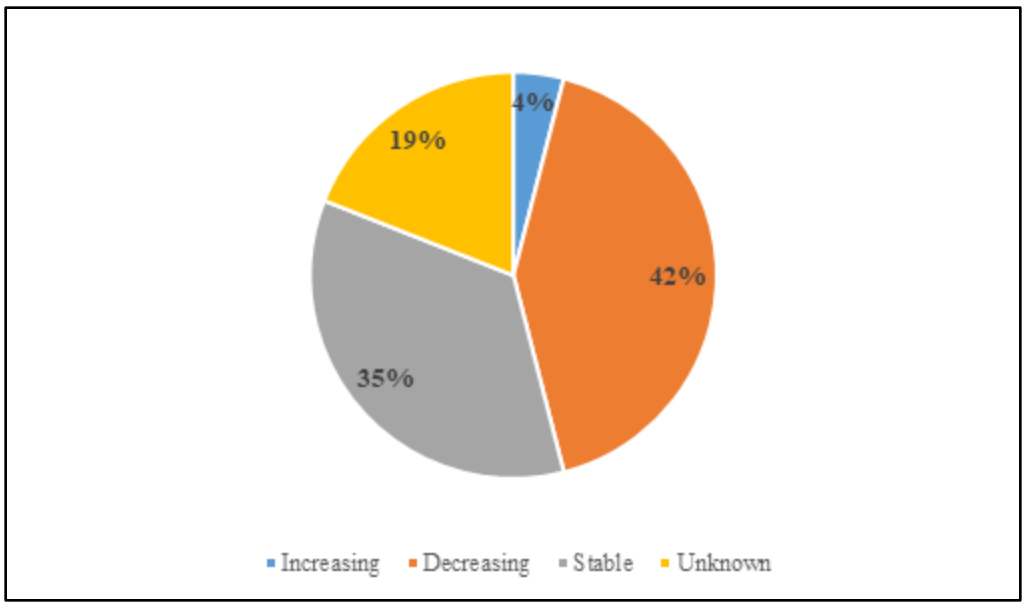


Figure 15.Percent distribution of the worldwide population trend of observed avifauna in the Ginablan Bird and Mangrove Sanctuary

As for the flagship species of the sanctuary, the *Anas luzonica* or Philippine Duck, their presence in the lagoon varies depending on the time of the day. According to BirdLife International (2016), this species is frequently sighted in freshwater and saltwater habitats, including mangroves. Their diet includes crustaceans, mollusks, and sometimes fish and frogs (Marshall, 2005; Rabor, 1977).

Table 10. Summary of observed individuals of A. luzonica

Day	Time	Estimated Number of Observed Individuals			
		Observer 1	Observer 2	Observer 3	Average
1st	05:30AM	38	41	45	41
	10:00AM	23	22	29	25
	01:00PM	0	0	0	0
	05:00PM	26	25	21	24
2nd	05:30AM	46	46	54	49

According to Gonzales (1983), *A. luzonica* are more active early in the morning (Marshall, 2005). This could explain why these species are more visible as early as sunrise based on the manual counting that was conducted. Also, observed behavior varies from foraging, flying, preening, and swimming.

Figure 16. On-site photos: (A) flock of A. luzonica; and (B) a leucistic A. luzonica (Photo: AVelasquez)

Aside from the Philippine Duck, although no manual counting done, it is evident that there are other species that visibly have big flocks such as the Asian Glossy Starling, Black-naped Oriole, Golden-bellied Gerygone, Large-billed Crow, Lowland White-eye, Olive-backed Sunbird, Philippine Pied Fantail, Yellow-vented Bulbul, and Zebra Dove.

Mammals

The mist nets that were set-up were also used to validate the presence of bats in the area. However, among the two set-ups, only one (1) has a successful capture (12°31'26.7" N; 122°15'30.7" E). Although its presence in the country is uncertain according to the IUCN, some literatures has already proven that the *Cynopterus brachyotis* or the Lesser Dog-faced Fruit Bat is found in the Philippines (Flores and Tanalgo, 2018; Marler *et. al.*, 2018; Campbell *et. al.*, 2004). This species of fruit bat comes from the Pteropodidae family. Its conservation status is categorized as Least Concern, but its population trend is still unknown.

Figure 17. Captured C. brachyotis in Ginablan Bird and Mangrove Sanctuary (Photo: RInocencio)

One notable species of mammal that was observed and verified was the presence of *Pteropus hypomelanus* or the Island Flying Fox. This species, referred to as one of the Old World fruit bats or flying fox, also belongs to the Pteropodidae family. According to the IUCN, its conservation status is categorized as Near Threatened, and has a decreasing population trend. Over the last 24.3 years, its global population has declined by 25% that is why it is listed under the said conservation status.

Moreover, this *Pteropus* species is listed in the CITES Appendix II alongside some species belonging to the same genus. It means that the species does not necessarily face the threat of extinction, but may possibly face so if trade will not be closely controlled.

Figure 18. On-site photos of P. vampyurus: (A) Roosting site 1; (B) Roosting site 2; (C) Foraging site 1 (Photo: AVelasquez)

Based on the visual encounter survey, two (2) roosting areas and one (1) foraging site were observed in areas adjacent to the sanctuary. Table 10 shows a summary of information of the areas where the species was observed.

Table 11. Observed roosting and foraging sites of the *P. hypomelanus*

Location	Coordinates	Roost Tree Species	Estimated Number of Individuals Observed		
			1st Observer	2nd Observer	Average
Roosting Site 1	12°31'27.2" N; 122°15'34.0" E	*Pterocarpus indicus* *Terminalia catappa* *Vitex parviflora*	10	10	10
Roosting Site 2	12°31'09.1" N; 122°15'36.0" E	*Artocarpus altilis* *Terminalia catappa*	13	11	12
Foraging Site 1	12°31'32.1" N; 122°15'34.5" E	*Artocarpus altilis*	30	31	31
TOTAL NUMBER OF HEADS			**53**	**52**	**53**

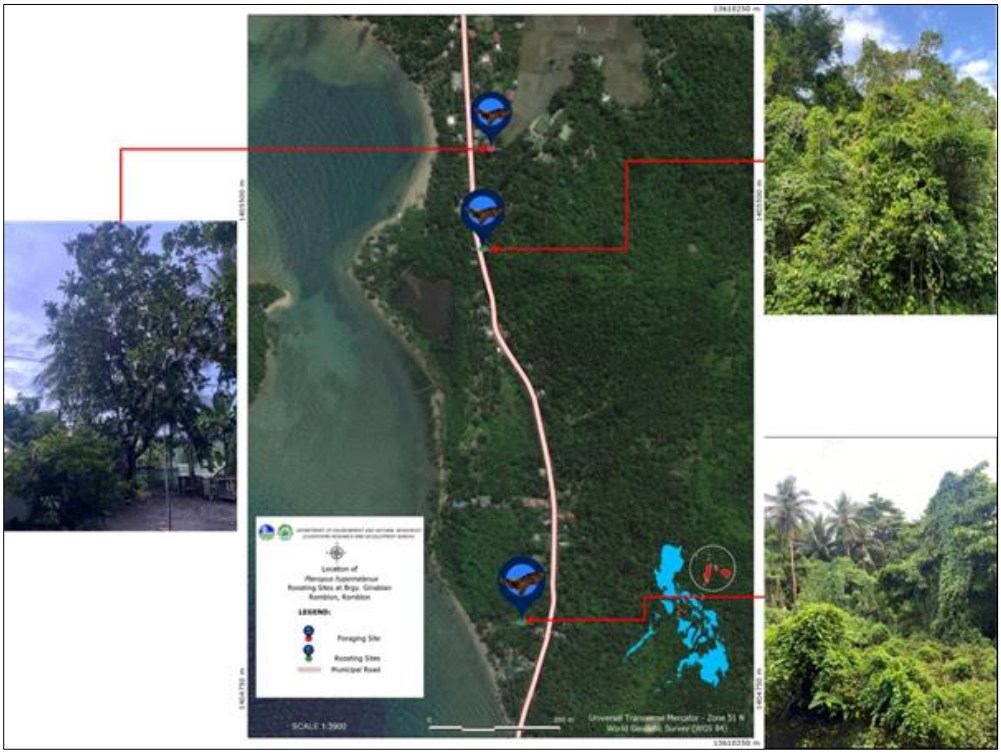


Figure 19. Map showing the different areas where colonies of *P. hypomelanus* are present. Photo: AVelasquez

Herpetofauna

A total of six (6) reptiles and one (1) amphibian were observed in the herpetofauna assessment. All species were sighted during casual encounters.

Table 12. Observed herpetofauna in the Ginablan Bird and Mangrove Sanctuary

Taxa	Family	Scientific Name	Common Name	IUCN Status	DAO 2019-19	CITES	IUCN Global Population Trend
Reptilia	Agamidae	*Draco* cf. *spilopterus*	Philippine Flying Dragon	LC	-	-	Unknown
	Colubridae	*Lycodon capucinus*	Island Wolf Snake	LC	-	-	Stable
	Gekkonidae	*Hemidactylus frenatus*	Common House Gecko	LC	-	-	Stable
	Gekkonidae	*Gekko gecko*	Tokay Gecko	LC	OTS	II	Unknown
	Typhlopidae	*Indotyphops braminus*	Brahminy Blindsnake	LC	-	-	Increasing
	Varanidae	*Varanus nuchalis*	West Visayan Monitor Lizard	NT	OTS	II	Decreasing
Amphibia	Bufonidae	*Rhinella marina*	Cane Toad	LC	-	-	Increasing

Legend: LC = Least Concern; NT = Near Threatened; OTS = Other Threatened Species; II = CITES Appendix II

According to the IUCN, it shows that most of the species observed are categorized as LC, and only one is NT – that is *Varanus nuchalis* or the West Visayan Monitor Lizard. Together with the *Gekko gecko* or the Tokay Gecko, it is also categorized as OTS in the DENR DAO 2019-09, and is listed under CITES Appendix II. This species of monitor lizard is endemic to the Philippines. However, it is only found in the islands of Bantayan, Cebu, Guimaras, Negros, Panay, Romblon, Sibuyan, Siquijor, Tablas, and Ticao (Diesmos and Gaulke, 2009). Another species of lizard was observed, the *Draco* cf. *spilopterus* or the Philippine Flying Dragon. The recorded geographical distribution of this species ranges from the central to the northern Philippine island (Siler *et. al.*, 2012).

In addition, it is also found in other Romblon Islands, such as in Tablas and Carabao islands. Furthermore, the Common House Gecko or *Hemidactylus frenatus* which is widely distributed in the Philippines is also found in the area. Snakes were also observed such as the *Lycodon capucinus* and *Indotyphlops braminus*. Sightings of the invasive *Rhinella marina* or Cane Toad were also documented in the assessment. About three (3) individuals were observed within the sanctuary.

Figure 20. Some photo-documented herpetofauna: (A) *I. braminus*; (B) *D. cf. spilopterus*; and (C) *R. marina* (Photo: AVelasquez & RInocencio)

Macrobenthos

Ginablan mangrove area is home to 15 species of macrobenthos. *Geloina expansa* as well as *Terebralia palustris* are the edible and abundant species found in the area. Other species are also seagrass-associated macrobenthos because the presence of seagrass was observed near the other plots laid for the assessment. The class gastropoda dominates the species found in the area.

Although no threatened species were observed, the sanctuary should be preserved due to the presence of the noticed edible species.

Table 13. Macrobenthic species observed in the study site

Phylum	Class	Family	Species	Common Name
Mollusca	Gastropoda	Nassariidae	*Nassarius livescens* Philippi, 1849	Nassa mud shell
			Nassarius bicallosus E. A. Smith, 1876	
			Nassarius coronatus Bruguière, 1789	Coronate nassa
		Cypraeidae	*Cypraea moneta* Linnaeus, 1758	Money cowry
			Naria erosa Linnaeus, 1758	Gnawed or Eroded cowry
		Neritidae	*Nerita albicilla* Linnaeus, 1758	Ox-palate nerite
			Nerita undata Linnaeus, 1758	
		Littorinidae	*Littoraria pallescens* Philippi, 1846	
			Littoraria scabra Linnaeus, 1758	mangrove winkle
		Potamididae	*Terebralia palustris* Linnaeus, 1767	Mud creeper
		Strombidae	*Strombus* Linnaeus, 1758	True conches
		Naticidae	Polinices mammilla Linnaeus, 1758	Moon snail
		Chilodontaidae	*Euchelus atratus* Gmelin, 1791	Blackish margarite
		Cypraeidae	*Monetaria annulus* Linnaeus, 1758	Gold ring cowrie
		Conidae	*Conus quercinus* Lightfoot, 1786	Oak cone or Yellow cone
		Columbellidae	*Euplica scripta* Lamarck, 1822	dotted dove shell
	Bivalvia	Veneridae	*Gafrarium pectinatum* Linnaeus, 1758	Ribbed venus
		Cyrenidae	*Geloina expansa* Mousson, 1849	Yellowish mangrove clam
		Arcidae	*Anadara inaequivalvis* Bruguière, 1789	Arc clams
Arthropoda	Malacostraca	Portunidae	*Thranita crenata* Rüppell, 1830	

Figure 21. Images of the common macrobenthic specie in the study site (Photo: MMBernales)

CONCLUSION AND RECOMMENDATION

The mangrove ecosystem of Ginablan, Romblon harbors a relatively diverse set of flora and fauna, some of which are threatened and included in the Red List of plants and wildlife. It also stores a considerable stock of carbon from the biomass of its mangrove trees. Therefore, protection of this sanctuary is of utmost importance.

This assessment has demonstrated that the Ginablan Bird and Mangrove Sanctuary is an important habitat for flora, fauna, and other associated living organisms as they support the growth and development of the sanctuary as well as a number of species that are considered globally and nationally threatened by extinction due to anthropogenic causes, among many others.

Name tagging should be done on tree species present in the area. It is also necessary to explore opportunities to have replanting programs for the *Xylocarpus rumphii* as this is categorized as Vulnerable, along with other threatened species in the area.

For the conservation of fauna, it is important to formulate mitigation strategies for invasive alien species such as the *R. marina* while too much infestation is not yet observed in the area. At the same time, comprehensive management plans may be implemented to further protect threatened species that inhabit within and in adjacent areas of the sanctuary such as the Romblon Boobook, Philippine Duck, Philippine Collared Dove, Tokay Gecko, West Visayan Monitor Lizard, and Island Flying Fox.

The potential of the area to become an established eco-tourism spot may give way to the conservation of these species. Moreover, formally declaring this wildlife as flagship species of the locality could heighten awareness of locals and tourists alike.

Preservation of macrobenthos should also be a priority as these are food sources of other organisms such as birds. The area pegged to be protected should be expanded, and must include the seagrass beds in the coastal area adjacent to the sanctuary.

Furthermore, promotion of the protection of the area may be done by strengthening information, education, and communication (IEC) campaigns in order to involve the locals in the preservation of the natural resources of Ginablan. It is also important to capacitate or train the *Bantay Bakawan* on

the importance of different flora species that may be used in the education and awareness component of ecotourism programs.

Furthermore, with threats from a variety of sources, including climate change and human disturbance, monitoring of habitat formation in this area, particularly the recorded flora and fauna species, should be done in order to obtain the necessary data for developing strategies to ensure their protection and survival.

REFERENCES

BirdLife International. 2016. *Anas luzonica*. *The IUCN Red List of Threatened Species* 2016: e.T22680214A92849560. https://dx.doi.org/10.2305/IUCN.UK.2016-3.RLTS.T22680214A92849560.en. Accessed on 27 July 2022.

Campbell, P., Schneider, C. J., Adnan, A. M., Zubaid, A., & Kunz, T. H. (2004). Phylogeny and phylogeography of Old World fruit bats in the Cynopterus brachyotis complex. Molecular Phylogenetics and Evolution, 33(3), 764-781.

De Guzman, E.D., R.M. Umali and E.D. Sotalbo. 1986. Guide to Flora and Fauna: Dipterocarps and Non-Dipterocarps. Volume III. Quezon City: Natural Resources Management Center, Ministry of Natural Resources and University of the Philippines.

del Hoyo, J. 2021. All the Birds of the World.

DENR Biodiversity Management Bureau. 2021. *World Migratory Bird Day 2021*. https://bmb.gov.ph/index.php/resources/news-and-events/199-world-migratory-bird-day-2021

Department of Environment and Natural Resources Administrative Order 2019-09. Updated National List of Threatened Philippine Fauna and their Categories.

Department of Environment and Natural Resources Administrative Order 2017-11. Updated National List of Threatened Philippine Plants and their Categories.

Diesmos, A. & Gaulke, M. 2009. *Varanus nuchalis*. *The IUCN Red List of Threatened Species* 2009: e.T169767A6671267. https://dx.doi.org/10.2305/IUCN.UK.2009-2.RLTS.T169767A6671267.en. Accessed on 29 July 2022.

Fernando, E.S. and M.L. Castillo. 1996. Field Checklist of Species in FBS 21 (Taxonomy of Forest Plants). Third Edition. Department of Forest Biological Sciences, University of the Philippines. Los Baños, Laguna, Philippines. 18 pp.

Flores, A. B., & Tanalgo, K. 2020. Observation of Lesser Dog-Faced Fruit Bat (Cynopterus brachyotis) Feeding on Piper Aduncum in Makilala, North Cotabato, Philippines. *Southeast Asia Vertebr. Rec*, *2020*, 32-33.

Gonzales, P. C. 1983. *Birds of Catanduanes* (No. 2). National Museum.

Ingle, N., & Heaney, H. 1992. A key to the bats of the Philippines. Fieldiana.

Kennedy, R., Gonzales, P. C., Dickinson, E., Miranda Jr, H. C., & Fisher, T. H. 2000. *A guide to the birds of the Philippines*. Oxford University Press.

Kent, M & Coker, P. 1992. Vegetation Description and Analysis: A Practical Approach. CRC Press, Boca Raton, Ann Arbor & Belhaven Press, London. 333 pp.

Komiyama, A., Poungparn, S., & Kato S. 2005. Common Allometric Equations for Estimating the Tree Weight of Mangroves. Volume 21, no 04, pp. 471-7

Leviton, A. E., Siler, C. D., Weinell, J. L., & Brown, R. M. 2018. Synopsis of the Snakes of the Philippines. *Proc. Cal. Acad. Sci*, *64*(14), 399-568.

Lohani, B., J.W. Evans, H. Ludwig, R.R. Everitt, Richard A. Carpenter, and S.L.Tu. 1997. Environmental Impact Assessment for Developing Countries in Asia. Volume 1 - Overview. 356 pp. Asian Development Bank. Manila, Philippines.

Madulid D.A. 2000. A Pictorial Cyclopedia of Philippine Ornamental Plants. 2nd edition. Bookmark, Makati City. 389 pp.

Madulid D.A. 2001. A Dictionary of Philippine plant names. Volume II. Bookmark, Makati City. 329 pp.

Marler, P. N., Jose, E. D., Castro, L. S. G., & Gonzalez, J. B. 2018. Mammals of Cleopatra's Needle Critical habitat: outcomes of a rapid assessment. *Palawan Scienfist*, *10*, 84-103.

Marshall, A. P. 2005. Philippine Duck Anas luzonica. *Ducks, Geese and Swans: Species accounts (Cairina to Mergus)*, *2*, 531.

Mueller-Dombois and Ellenberg. 1971. Aims and Methods of Vegetation Ecology. John Wiley & Sons. New York. 547 p.

Moody, K., C.E. Munroe, R.T. Lubigan and E.C. Paller, Jr. 1984. Major Weeds of the Philippines. College, Laguna: Weed Science Society of the Philippines and University of the Philippines Los Baños.

Odum, E. 1971. Fundamentals of Ecology. 3rd edition, W. Saunders Company, Philadelphia, U.S.A., 574 p.

Palis, HG, 2013. A Handbook of Beach Plants in the Philippines. Ecosystems Research and Development Bureau, Department of Environment and Natural Resources. College, Laguna.

Primavera, J, RB Sabadda, MJ Lebata-Ramos and J. Altamirano, 2016. Mangroves & Beach Forest Species in the Philippines. Ecosystems Research and Development Bureau, Department of Environment and Natural Resources. College, Laguna.

Rabor, D. S. (1977). *Philippine Birds & Mammals*. UP Science Education Center.

Rojo, J.P. 1999. Revised Lexicon of Philippine Trees. Forest Products Research and Development Institute. College, Laguna. 484 pp.

Siler, C., Welton, L., Diesmos, A., Siler, J., Bucol, A., Brown, J., & Brown, R. 2012. Amphibians and reptiles, Romblon Island Group, central Philippines: comprehensive herpetofaunal inventory. *Check List*, *8*(3), 443-462.

Salvosa, F.M. 1963. Lexicon of Philippine Trees. Forest Products Research Institute. College, Laguna, Philippines.

UP Science Education Center. 1971. Plants of the Philippines. University of the Philippines Press, Quezon City.

Vermudo, J.E. 1993. Vegetation Analysis of the Tree Layer of the Dipterocarp Forest Zone in Quezon National Park, Luzon Island, Philippines. M.S. Thesis, University of the Philippines Los Baños, 115 pp.

APPENDIX

Tree species observed in the area


Cordia subcordata

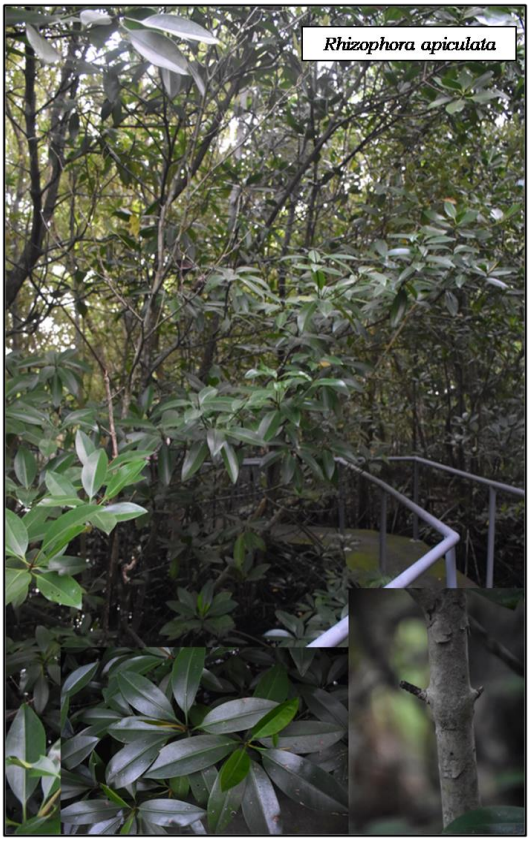

Lumnitzera racemosa


Milletia pinnata


Avicennia marina


Rhizophora stylosa

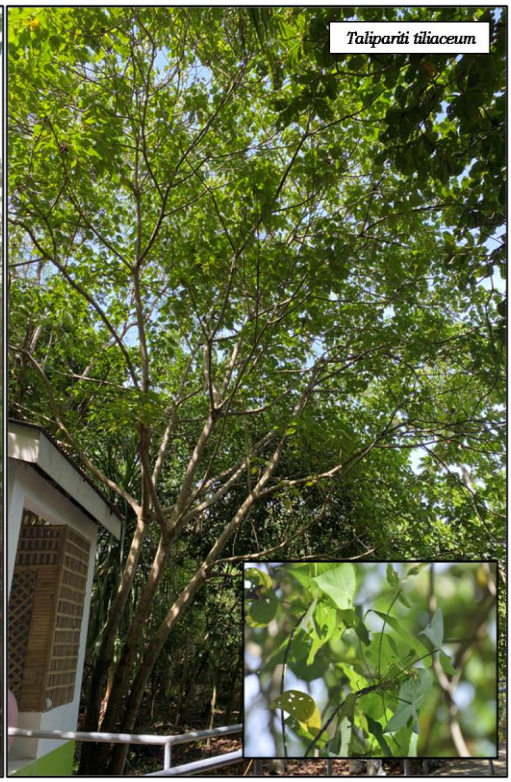

Xylocarpus rumphii


Rhizophora apiculata


Excoecaria agallocha


Premna serratifolia


Terminalia catappa


Taliparíti tiliaceum


Pemphis acidula

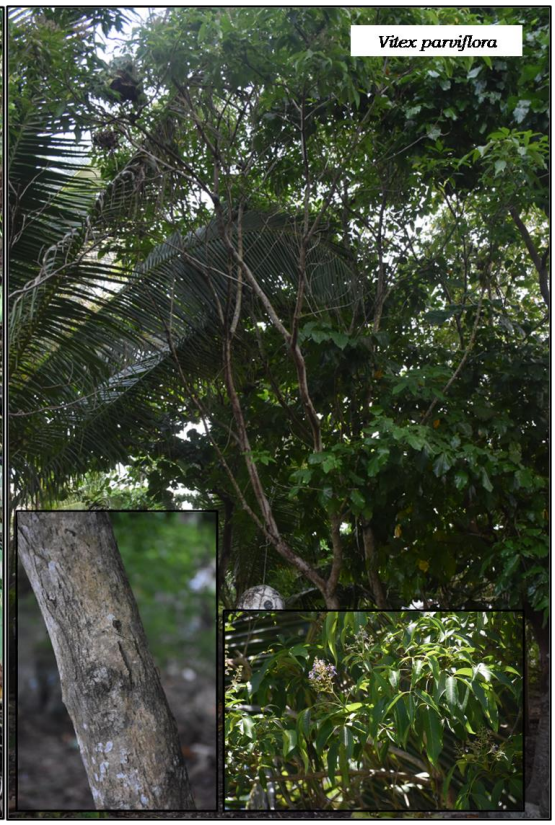

Prosopis juliflora


Sesuvium portulacastrum


Pandanus tectorius


Ipomoea pes-caprae


Acrostichum aureum


Vitex parviflora