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Factors affecting avifauna diversity in selected mangrove areas of Misamis Oriental, Philippines: Basis for conservation and management

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Abstract

Ecological and anthropogenic factors may influence the distribution and diversity of birds. This study assessed the avifauna and mangrove species composition, abundance, and diversity as well as the socio-economic and institutional conditions in three coastal ecosystems of Molugan, El Salvador City; Baybay, Alubijid and Tubajon, Laguindingan, Misamis Oriental. Point count and mist-netting methods were used to survey birds, quadrat method to survey mangroves, household survey to 212 respondents and Geographic Information System (GIS) in mapping birds, mangroves and human activities. Results showed a total of nine (9) Orders, 19 Families, 22 species and 1,168 individuals were documented in three selected areas. Baybay had the highest diversity index (2.46), followed by Molugan (1.96) and Tubajon got the lowest (1.70). As for the mangroves, five (5) species were recorded namely: *Rhizophora mucronata, Sonneratia alba, Avicennia alba, Avicennia rumphiana* and *Rhizophora apiculata*. However, continuing threats such as growing human population, land-use changes and weak management in the coastal ecosystems led to its unsustainability. Thus, the diversity of birds is highly dependent on the mangrove species and zonation and human activities in the coastal areas. Hence, regular monitoring of programs and policies by stakeholders to ensure sustainability and conservation of birds and mangroves species is recommended.

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Introduction

The Philippine archipelago which is composed of 7,100 distinct islands (Ambal *et al.,* 2012) is recognized as one of the 17 mega diverse countries which contain two-thirds of the earth's biodiversity and about 70-80% of the world's flora and fauna species. Avifauna refers to a group of birds that are found almost everywhere on the planet which shows great diversity by their habitat and geographical conditions (Tandan *et al.*, 2015). Birds are valuable indicators of global patterns in biodiversity conservation (Mallari *et al.,* 2011). Avifauna provides several ecological functions such as pest control, pollination, seed dispersal, and plant reproduction in thousands of economically and culturally important plant species through its consumption of several terrestrial, marine, and aerial resources (Whelan *et al.,* 2015). The bird population is a sign of environmental changes as they respond fast to threats and changing environmental conditions (Mallari *et al.,* 2011). However, few are aware of the importance of birds and are greatly affected by human development which leads to the loss of its species. Mangroves belong to a higher group of plants which may exist as trees, shrub, palm, herb, or fern (Primavera *et al.,* 2004). It is a habitat of different avifauna species where they can hatch their eggs (Duke *et al.,* 2007). Mangrove is the one that lessens the impact of tsunamis, hurricanes, cyclonic storms on human lives, properties and helps to prevents flooding and it is the one who catches the waste generated by humans (Danielsen *et al.,* 2005). The mangrove habitat loss caused by deforestation, urbanization, salt production, conversion into paddy fields and aquaculture ponds, over-harvesting of timber and fuel wood, pollution, dumping of domestic sewage and crude oil exploration (Giri, 2011), and degradation has posed major threats to a wide array of fauna bringing them among the ranks of endangered and extinct species (Sandilyan *et al.,* 2010). Thus, there is an urgent demand to examine the avifauna diversity inhabiting mangrove habitats to know the impact of disturbance for future conservation and management.

Materials and methods

Research Setting

This study was conducted at Brgy. Molugan, El Salvador City; Baybay, Alubijid; and Tubajon, Laguindingan, Misamis Oriental as shown in Fig. 1 from June to July 2020. These coastal areas are mixtures of residential and industrial zones dominated by factories engaged in manufacturing and processing, storage, and fuel depots. In addition, the study sites are remnants of previously depleted and disturbed ecosystems and the current existing mangrove vegetation is a product of reforestation efforts.

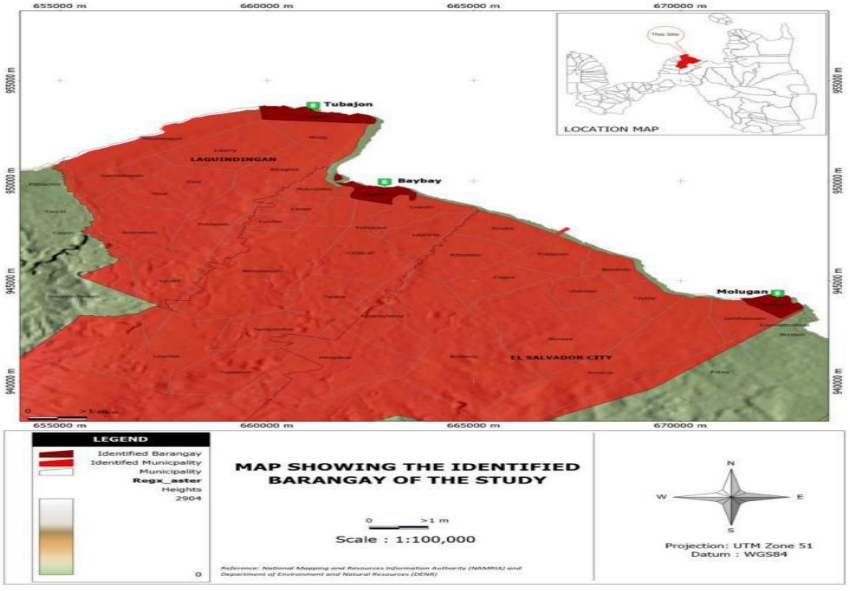

Fig. 1. Map showing the sampling sites in Brgy. Molugan, El Salvador, Baybay, Alubijid and Tubajon, Laguindingan, Misamis Oriental.

Sampling Sites Description

The first Site is located in Barangay Molugan with the coordinates of 8˚32′24.3744″N, 124˚33′59.6808″E, with 17 hectares of mangroves all were planted and monitored by the Local Government Units (LGU's).

The site is characterized as residential and commercial. The second site is in Brgy. Baybay located at 8˚35′16.6344″N, 124˚28′54.9768″E with 15 hectares of mangroves, planted and facilitated by DENR and Bureau of Fisheries and Aquatic Resources (BFAR)-10. The site is characterized as residential, agricultural, and commercial. Lastly, the third site, Brgy. Tubajon lies at 8°37.452" N, 124˚27.947" E, with 24 hectares are known as non-protected areas. The population in the Barangay is increasing due to the existence of Laguindingan Airport. The site is highly dominated by agricultural land such as tobacco and coconut plantations nearby the coast (Fig. 2).

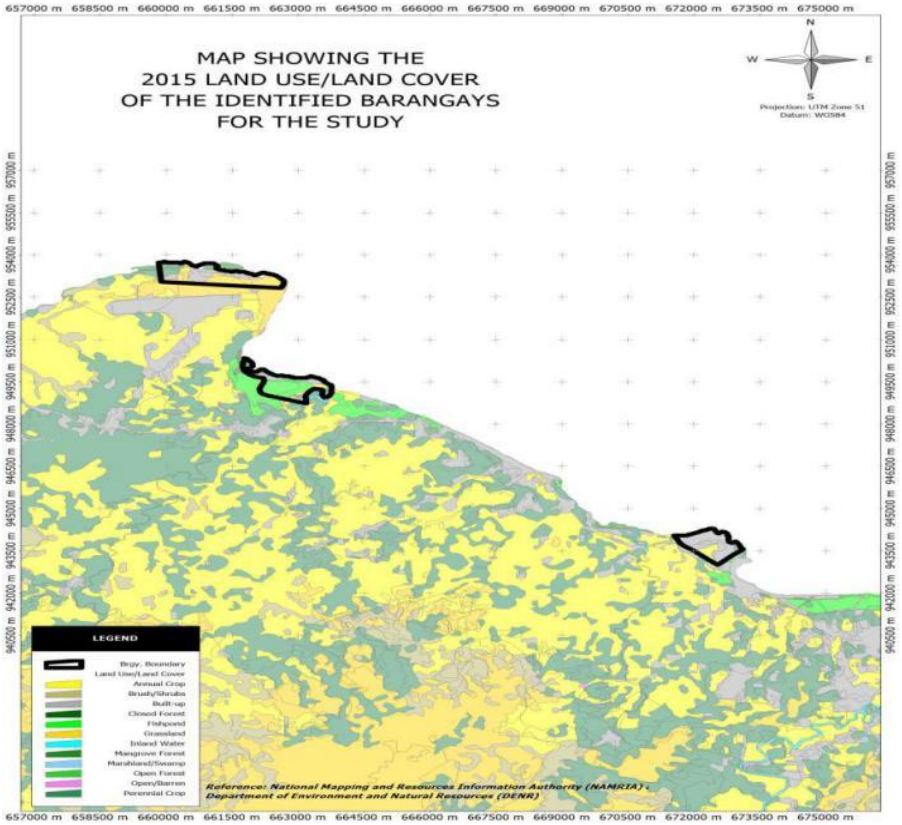

Fig. 2. Map showing the land use/land cover of barangay Molugan, El Salvador City, Baybay, Alubijid; and Tubajon, Laguindingan, Misamis Oriental.

Data Gathering and Analysis

Point count and mist-netting methods were used to identify the avifauna species found in Molugan, Baybay, and Tubajon from June to July 2020. Ten (10) mist nets with measurements of ten (10) meters (m) long were established within the mangrove areas per site from seaward to a landward zone. Mist nets were checked every (30) minutes to one hour (Calimpong and Nuñeza, 2015) if birds were trapped on them. Each species captured was removed from the mist nets and identified (Calimpong and Nuñeza, 2015) based on its morphometric data. The species was identified using the Guide to the Birds of the Philippines (Kennedy *et al.,* 2000). In the point count method, sampling was done along the one-kilometer line transect during foraging, and roosting time of the bird species around 6-7 am and 3-4 pm with an interval of 250 meters for 15-20 minutes (Ascaño II *et al.,* 2016; Relox *et al.,* 2011). A sampling of mangroves was conducted along the transect line perpendicular to the shoreline in each barangay using a Global Positioning System (GPS) to establish the

coordinates of the sampling sites (Calimpong and Nuñeza, 2015). Three stations measuring 150 meters were established per barangay (Mohagan *et al.,* 2015). In each station, five 10m x 10m plots with an interval of 20 meters Abino *et al.* (2014); cited by Pototan *et al.* (2017) and classified taxonomically based on its fruits, leaves, flowers, and other characteristics up to the species level using the Manual to Philippine Mangroves by Primavera *et al.* (2004) cited by Pototan *et al.* (2017). The Species Effort Curve (Fig. 3) illustrates every new species of birds found in the sampling sites during the sampling period. As it reaches its plateau, it means that there are no new species of birds that are found. The total number of individuals was calculated to obtain their abundance (y-axis) and then ranked from the most to the least abundant species (x-axis). The x-axis denotes the number of days and the y-axis as the number of species found (adapted from Relox *et al.,* 2011).

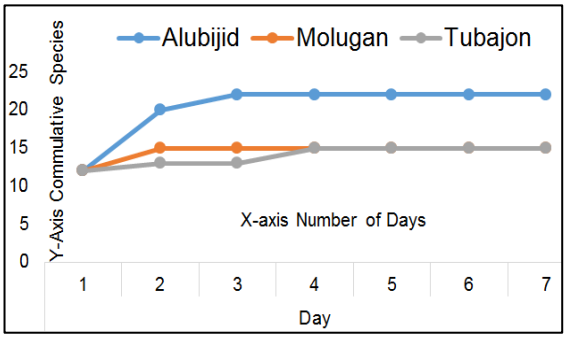

Fig. 3. The species effort curve of birds in Brgy. Molugan, El Salvador City, Baybay, Alubijid and Tubajon, Laguindingan, Misamis Oriental.

Avifauna Analysis

Biodiversity indices such as Relative Abundance (RA) and Shannon-Weiner index (H') were computed to give a quantitative description of the species composition of the bird species in the study areas. A diversity index is a mathematical measure of species diversity in a community and provides more information about species composition.

Mangrove Analysis

To analyze the mangrove structure and vegetation in the three different barangays, Relative Density (RD), Relative Frequency (RF), Relative Dominance (RDom), and Importance Value (IV) were computed (adopted from the study of Pototan *et al.,* 2017).

Socio-Demographic and Economic Factors

The gathered data were tabulated and analyzed per barangay. The survey questionnaire was categorized based on socio-demographic and economic factors affecting birds and mangroves in the area.

Results and discussions

Species Composition, Relative Abundance and Diversity Index of Avifauna.

There were 22 bird species recorded in the three barangays belonging to 19 Families and nine (9) Orders in mangrove ecosystem (Table 1). Brgy. Molugan has 16 avifauna species, 14 families with 1.969 diversity index. *Passer montanus* has the highest (RA) 33.06% while the least abundant was *Corvus macrorhynchos* 0.17%. Brgy. Baybay has 22 species, 19 families with 2.468 diversity index. *Passer montanus* has the highest (RA) 22.17% while the least abundant were *Edolisoma ostentum and Chlidonias hybrida* 0.17%. Brgy. Tubajon has 13 species, 13 families with 1.700 diversity index. *Aerodramus mearnsi* has the highest (RA) 45.78% while the least abundant was *Anas luzonica* 0.49%. The abundance of these species determined by their habitat, characteristics, and diet. According to Mengesha and Bekele (2008), food availability has a positive impacts on species abundance and distribution. It is also the availability of food which makes birds dominate the area (Welsh, 1987). Based on the results, among 22 birds species found in the three areas, 20 of which are classified as Least Concern and two (2) were already Vulnerable namely: *Chloropsis flavipennis* and *Edolisoma ostentum* (Table 2). This result signifies that the number of these two identified vulnerable species are decreasing (IUCN, 2018). Some of the threats that were identified was due to the increasing human population. The decline may be attributed to over exploitation by coastal dwellers, and conversion to agriculture, salt ponds, industry and settlements (Primavera *et al.,* 2004) leading to the conversion of land use for human settlement from forested area to a residential one and commercialization.

Table 1. Taxonomic classification of avifauna species found in mangrove ecosystem in Brgy. Molugan, El Salvador, Baybay, Alubijid, and Tubajon, Laguindingan, Misamis Oriental.

Order	Family	Scientific Name	Common Name	Local Name	Molugan	Baybay	Tubajon
Coraciiformes	Alcedinidae	*Todiramphus chloris*	White-Collared Kingfisher	*Tikarol*	✔	✔	✔
Anseriformes	Anatidae	*Anas luzonica*	Philippine Duck	*Itik*	✔	✔	✔
Apodiformes	Apodidae	*Aerodramus mearnsi*	Philippine Swiftlet	*Sayaw/ Balinsasayaw*	✔	✔	✔
Pelecaniformes	Ardeidae	*Egretta garzetta*	Little Egret	*Tagak*	✔	✔	✔
Columbiformes	Columbidae	*Geopelia striata*	Zebra Dove	*Tukmo/ Kurokutok*	✔	✔	✔
Passeriformes	Corvidae	*Corvus macrorhynchos*	Large-Billed Crow	*Uwak*	✔	✔	✔
Passeriformes	Estrildidae	*Lonchura atricapilla*	Chestnut Munia	*Mayang pula*	✔	✔	✔
Passeriformes	Nectariniidae	*Cinnyris jugularis*	Olive Backed Sunbird	*Tamsi*	✔	✔	✔
Passeriformes	Passeridae	*Passer montanus*	Eurasian Tree Sparrow	*Goryon/ Maya*	✔	✔	✔
Passeriformes	Pycnonotidae	*Pycnonotus goiavier*	Yellow Vented Bulbul	*Kulkul*	✔	✔	✔
Galliformes	Phasianidae	*Gallus gallus*	Red Junglefowl	*Labuyo*	✔	✔	✔
Passeriformes	Rhipiduridae	*Rhipidura nigritorquis*	Philippine Pied Fantail	*Pitsa-Pitsa/ Maria Capra*	✔	✔	✔
Passeriformes	Sturnidae	*Aplonis panayensis*	Asian Glossy Starling	*Tusing*	✔	✔	✔
Passeriformes	Campephagidae	*Lalage nigra*	Pied Triller	*Kachak*	✔	✔	X
Columbiformes	Columbidae	*Columba vitiensis*	Metallic Pigeon	*Punay*	✔	✔	X
Passeriformes	Campephagidae	*Edolisoma ostentum*	White-Winged Cuckooshrike	*None*	✔	✔	X
Passeriformes	Chloropseidae	*Chloropsis flavipennis*	Philippine Leafbird	*None*	X	✔	X
Charadriiformes	Laridae	*Chlidonias hybrida*	Whiskered Tern	*Kanaway*	X	✔	X
Passeriformes	Muscicapidae	*Monticola solitarius*	Blue Rock thrush	*None*	X	✔	X
Passeriformes	Acrocephalidae	*Acrocephalus orientalis*	Oriental Reed-warbler	*None*	X	✔	X
Accipitriformes	Accipitridae	*Haliastur indus*	Brahminy Kite	*Banog*	X	✔	X
Pelecaniformes	Ardeidae	*Ardea cinerea*	Grey Heron	*Tagak*	X	✔	X

Legend: (✔) Presence; (X) Absence

Table 2. Conservation status and endemism of avifauna in Brgy. Molugan, El Salvador, Baybay, Alubijid and Tubajon, Laguindingan, Misamis Oriental.

Scientific Name	Conservation Status	Endemism	Molugan	Baybay	Tubajon
Todiramphus chloris	Least Concern	Resident-Common	✔	✔	✔
Anas luzonica	Least Concern	Endemic-Common	✔	✔	✔
Aerodramus mearnsi	Least Concern	Endemic-Common	✔	✔	✔
Egretta garzetta	Least Concern	Migrant-Common	✔	✔	✔
Geopelia striata	Least Concern	Resident-Common	✔	✔	✔
Corvus macrorhynchos	Least Concern	Resident-Common	✔	✔	✔
Lonchura atricapilla	Least Concern	Resident-Common	✔	✔	✔
Cinnyris jugularis	Least Concern	Resident-Common	✔	✔	✔
Passer montanus	Least Concern	Resident-Common	✔	✔	✔
Pycnonotus goiavier	Least Concern	Resident-Common	✔	✔	✔
Gallus gallus	Least Concern	Resident-Common	✔	✔	✔
Rhipidura nigritorquis	Least Concern	Resident-Common	✔	✔	✔
Aplonis panayensis	Least Concern	Resident-Common	✔	✔	✔
Lalage nigra	Least Concern	Resident-Common	✔	✔	X
Columba vitiensis	Least Concern	Resident-Uncommon	✔	✔	X
Chlidonias hybrida	Least Concern	Migrant-Common	X	✔	X
Monticola solitarius	Least Concern	Migrant-Common	X	✔	X
Acrocephalus orientalis	Least Concern	Migrant-Common	X	✔	X
Haliastur indus	Least Concern	Resident-Common	X	✔	X
Ardea cinerea	Least Concern	Migrant-Uncommon	X	✔	X
Chloropsis flavipennis	Vulnerable	Endemic-Uncommon	X	✔	X
Edolisoma ostentum	Vulnerable	Endemic-Uncommon	✔	✔	X

Mindanao has a record of just about 341 species of birds that consist of 147 resident species, 93 migratory, 94 endemic species and 14 migrant and resident species (Kennedy *et al.,* 2000). Furthermore, there were four (4) migrant-common species and one (1) migrant-uncommon species of birds found in the study areas in Misamis Oriental namely: *Egretta garzetta, Chlidonias hybrida, Monticola solitarius, Acrocephalus orientalis,* and *Ardea cinerea* as identified using the book of Kennedy *et al.* (2000) (Fig. 4).

Fig. 4. Avifauna species captured in the three sampling sites: **A** (*Aplonis panayensis*); **B** (*Todiramphus chloris*); **C** (*Aplonis panayensis*); **D** (*Passer montanus*); **E** (*Todiramphus chloris*); **F** (*Edolisoma ostentum*) in Brgy. Molugan, El Salvador, Baybay, Alubijid and Tubajon, Laguindingan, Misamis Oriental.

Vegetation heterogeneity, the abundance of food resources, and habitat diversity may lead to bird abundance (Malavasi *et al.,* 2009). In Brgy. Molugan, *Passer montanus* has the highest relative abundance of 33.06% (Table 3). It mainly eats grains, seeds, fruits, flowers, and invertebrates which are very common in Asia and Philippines in particular. In Brgy. Baybay, *Passer montanus* has the highest relative abundance with 22.17%.

In Brgy, Tubajon, *Aerodramus mearnsi* has the highest relative abundance of 45.78%. This is probably because *Aerodramus mearnsi* are insectivorous, feeding solely on aerial insects and spiders that it gathers in its mouth as it glides through the air (Harrison, 1976).

According to Kerkhoff (2010), the typical values of a diversity index are generally between 1.5 and 3.5 in most ecological studies, and the index is rarely greater than 4 which means the birds in the area are highly diverse. Species diversity may be affected by the structure of habitat, the type of food item, and the abundance of food, and the time (Alviola, 2010).

Table 3. Relative abundance of avifauna species found in mangrove ecosystem in Brgy. Molugan, El Salvador, Baybay, Alubijid and Tubajon, Laguindingan, Misamis Oriental.

Species	Tubajon		Molugan		Baybay		Total	
	Ni	RA%	Ni	RA%	Ni	RA%	Ni	RA%
Todiramphus chloris	96	5.84	72	5.95	88	7.53	256	6.36
Anas luzonica	8	0.49	5	0.41	6	0.51	19	0.47
Aerodramus mearnsi	753	45.78	306	25.29	139	11.90	1198	29.78
Egretta garzetta	10	0.61	6	0.50	19	1.62	35	0.87
Geopelia striata	113	6.87	74	6.12	91	7.79	278	6.91
Corvus macrorhynchos	22	1.34	2	0.17	10	0.85	34	0.85
Lonchura atricapilla	25	1.52	150	13.40	51	4.36	226	5.62
Cinnyris jugularis	50	3.04	61	5.04	76	6.51	187	4.65
Passer montanus	382	23.22	400	33.06	259	22.17	1041	25.88
Pycnonotus goiavier	24	1.46	9	0.74	33	2.82	66	1.64
Gallus gallus	49	2.98	14	1.16	17	1.46	80	1.99
Rhipidura javanica	104	6.32	40	3.31	28	2.39	172	4.28
Aplonis panayensis	9	0.55	19	1.57	214	18.32	242	6.02
Lalage nigra	X	0	22	1.82	38	3.25	60	1.49
Columba vitiensis	X	0	15	1.24	13	1.11	28	0.70
Edolisoma ostentum	X	0	15	1.24	2	0.17	17	0.42
Chloropsis palawanensis	X	0	X	0	10	0.85	10	0.25
Chlidonias hybrida	X	0	X	0	2	0.17	2	0.05
Monticola solitarius	X	0	X	0	18	1.54	18	0.45
Acrocephalus orientalis	X	0	X	0	7	0.59	7	0.17
Haliastur indus	X	0	X	0	20	1.71	20	0.50
Ardea cinerea	X	0	X	0	27	2.31	27	0.67
TOTAL	1,645	100	1,210	100	1,168	100	4,023	100

Legend: (X) Absence

In Molugan, the bird species found has a highest diversity index of 2.468 followed by Baybay with 1.969 and Tubajon with 1.700. This study is similar to the study of Alviola and Mohagan (2017) however, the results were quite low which gives only a total 0.94 average diversity index. The high species diversity is the result of the abundance of vegetation and the presence of mangroves in the area. Tagupa *et al.* (2017) cited that the numbers and kinds of birds that occur are related to their habitat types and biological attributes.

Table 4. Summary of species diversity of avifauna in mangrove ecosystem in Brgy. Tubajon,Laguindingan; Molugan, El Salvador and Baybay, Alubijid, Misamis Oriental.

Species	Diversity Index (Brgy. Tubajon)	Diversity Index (Brgy. Molugan)	Diversity Index (Brgy. Baybay)
Avifauna	1.700361582	1.969092944	2.468805768

Species Composition, Relative Frequency, Relative Density, Relative Dominance and Importance Value of Mangrove Analysis.

The mangrove species is composed of *R. apiculata Blume, S. alba Sm., A. alba,* and *A. rumphiana* (Table 5). According to (IUCN, 2016), three (3) species were considered Least Concern, and one (1) species found to be Vulnerable (V). In Brgy. Baybay, three (3) mangrove species found with a total of 193 individuals belonging to three (3) Families. According to IUCN (2016), all species were considered (LC).

The mangrove is composed of *S. alba Sm., R. mucronata Lam.* and *A. alba.* In Brgy. Tubajon, three (3) mangrove species found with a total of 162 individuals belonging to three (3) Families. Furthermore, all species were considered to be (LC).

The mangrove is composed of *R. apiculata Blume, S. alba Sm.,* and *R. mucronata Lam.* This study is similar to the study of Cailing *et al.* (2018) where the same species of mangroves were identified except for *S.alba Sm.* which was present in current study. Furthermore, in the study of Mariano *et al.* (2019), seven (7) mangrove species were identified in Pitogo, Zamboanga del Sur under three (3) families but only two are present in the recent study, namely; Avicenniaceae and Rhizophoraceae which has a similar result of this study.

Table 5. Taxonomic classification of mangrove species found in Molugan, Baybay and Tubajon Misamis Oriental.

Family	Scientific Name	Common Name	Local Name	Conservation Status	Molugan	Baybay	Tubajon
Rhizophoraceae	*Rhizophora apiculata Blume*	Tall-stilt Mangrove	Bakhaw Lalaki	Least Concern	✔	X	✔
Sonneratiaceae	*Sonneratia alba Sm.*	Mangrove Apple	Pagatpat	Least Concern	✔	✔	✔
Rhizophoraceae	*Rhizophora mucronata Lam.*	Loop-root Mangrove	Bakhaw Babae	Least Concern	X	✔	✔
Acanthaceae	*Avicennia alba*	Api-api putih	Miapi	Least Concern	✔	✔	X
Acanthaceae	*Avicennia rumphiana*	Api-api bulu	Bungalon	Vulnerable	✔	X	X

Legend: (✔) Presence; (X) Absence

As shown in Table 6, *R. mucronata Lam* has the highest (RF) 63.71 in all three areas. Furthermore, *R. mucronata Lam.* and *R. apiculata Blume* are the most abundant species in Laguindingan, Misamis Oriental. Moreover, *A. rumphiana* got the highest (RD) 100.00 in Molugan, *R. apiculata* has 100.00 in Tubajon, and *A. alba* has 96.30 in Baybay. According to Cailing *et al.* (2018), *R. apiculata* and *R. mucronata* were identified in Tubajon, Laguindingan, Misamis Oriental which has similar result to this recent study, particularly to Brgy. Tubajon, however it differs in other study areas. In addition, *R. mucronata* got the highest (RDom) with 36.82 in Brgy. Molugan, 10.47 in Brgy. Baybay, while *R. apiculata* with 13.66 in Brgy. Tubajon.

In the study of Walters (2004), *R. mucronata* was commonly planted in Banacon Island, Bohol Province. Furthermore, *R. mucronata Lam* got the highest (IV) with 57.42 in Brgy. Molugan, 24.27 in Brgy. Baybay, while *R. apiculata* with 28.29 in Brgy. Tubajon. In the study of Alemayehu *et al.* (2014),

In Manda Island, the importance value index revealed that *R. mucronata* dominated species which makes it similar to the study.

Socio-Demographic and Economic Profile of Coastal Residents.

A total of 212 respondents were interviewed per household in Baybay, Molugan, and Tubajon using a survey questionnaire. The majority of the respondents were males, aged 40-50 years old, mostly are fisher folks and have an estimated income of 10,000 per month in the three (3) barangays. Furthermore, the findings were consistent with the results reported by Branch *et al.* (2002) who noted that productive ages 21-50 are involved in many development activities such as degradation of natural resources. In terms of the respondents' gender, the finding is connected to the study conducted by Mtwana (2012) who noted that some roles of gender in the exploitation of natural resource may undermine ecosystem sustainability.

Table 6. Relative frequency, relative density, relative dominance and importance value of mangrove species found in Molugan, El Salvador, Baybay, Alubijid and Tubajon, Laguindingan, Misamis Oriental.

Study Areas	*Rhizophora mucronata Lam (Bakhaw Babae)*	*Avicennia rumphiana*	*Avicennia alba*	*Sonneratia alba Sm.*	*Rhizophora apiculata (Bakhaw Lalaki)*
Relative Frequency					
Brgy. Molugan	95.00	1.25	0.75	3.00	0.00
Brgy. Baybay	47.79	0.00	34.51	17.70	0.00
Brgy. Tubajon	8.64	0.00	0.00	4.32	87.04
Overall RF	63.71	0.63	10.28	7.49	17.69
Relative Density					
Brgy. Molugan	75.70	100.00	3.70	20.34	0.00
Brgy. Baybay	21.52	0.00	96.30	67.80	0.00
Brgy. Tubajon	2.79	0.00	0.00	11.86	100.00
Overall RD	100.00	100.00	100.00	100.00	100.00
Relative Dominance					
Brgy. Molugan	36.82	0.48	0.29	1.16	0.00
Brgy. Baybay	10.47	0.00	7.55	3.88	0.00
Brgy. Tubajon	1.36	0.00	0.00	0.68	13.66
Overall RDom	48.65	0.48	7.84	5.72	13.66
Importance Value					
Brgy. Molugan	57.42	11.72	11.48	12.57	0.00
Brgy. Baybay	24.27	0.00	20.62	15.99	0.00
Brgy. Tubajon	12.82	0.00	0.00	11.96	28.29
Overall IV	94.51	11.72	32.1	40.52	28.29

The educational attainment and religion are in line with the findings of Shackleton *et al.* (2011) who found out that, the more education one attains helps one, better in the management of natural resources. This study is also in line with the findings of Jin *et al.* (2003), who reported that respondents' beliefs and practices might affect the views and perspectives of an individual. In terms of civil status, increasing population is inevitable, thus affecting also the income due to the number of children in the family. Shackleton *et al.* (2011) reported that married individuals had significant influence on exploitation of natural resources in a given area. In terms of household size, related findings have been confirmed by Nordlund *et al.* (2018), that household size is predominantly involved in any coastal activities.

In terms of monthly income, the increasing standards of living and low level of education of the majority of the coastal communities in the study sites have shown limitations to secure government and private employment opportunities. This situation might led the local coastal community to rely on mangrove resources as an alternative source of income generating through selling of building poles, making charcoal, fuel wood, fish traps, and poles for boat making Nordlund (2018). According to Mtwana (2012); and Shackleton *et al.* (2011) majority of coastal communities are resource dependent as they rely on marine natural resource (seagrass and mangrove) and fishing for their livelihood. However, being resource dependent is risky due to reliance on particular resources for income and employment (Branch *et al.,* 2002).

In terms of no. of years living in Misamis Oriental, similar observations were reported by Giliba *et al.* (2011) which indicated that people who stay longer in a given area with resource availability are more likely to exploit more of those resources than those who stay for a short duration.

Conclusions

Based on the findings, among the three study areas namely: Molugan, El Salvador City; Baybay, Alubijid; and Tubajon, Laguindingan, Misamis Oriental, Barangay Baybay harbored the most abundant bird species compared to Brgy. Molugan and Tubajon. Moreover, due to the ecological and human factors that affects the diversity of birds and mangroves species, the results from this study stress the importance of environmental protection and conservation in the three coastal areas.

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