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Avifaunal Diversity of Lake Mainit Watershed, Caraga Region, Philippines

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A B S T R A C T

This study presents the results of the bird assessments in the Lake Mainit Watershed from August to September 2013, March to May 2014, and September to November 2017. The study was part of the Protected Area Suitability Assessment (PASA) of the proposed Lake Mainit Protected Area establishment. A total of 138 species from 56 families were recorded from the ten sampling sites. About 45% were endemic and 13% within the threatened classification of the International Union for Conservation of Nature (IUCN). Specifically, 8% of the birds were categorized near-threatened, and 4% were vulnerable. The recorded bird species constituted about 20% of the birds in the Philippines and were higher than those recorded in Eastern Mindanao Biodiversity Corridor (EMBC) and Mt. Hilong-hilong. However, the existence of this avifauna is continuously threatened by anthropogenic factors. Resource extraction was apparent, which includes timber and other forest product harvesting. In some sampling sites, small scale mining was evident supporting the livelihood of the people. Several sectors and groups also pose a conflict in resource use like the Mineral Production Sharing Agreement (MPSA) and Certificate of Ancestral Domain Tenure (CADT). Nonetheless, the presence of unique and threatened species of birds supports the importance of establishing the site as a Protected Area (PA). Hence, proper planning and management measures are imperative to address the conflict between conservation and the people's livelihood.

Keywords: *Avifauna, diversity, endemic, protected area, threatened*

1 Introduction

The taxonomic knowledge about the birds in the Philippines has improved brought by interests of amateurs and known researchers worldwide. From the 572 species (Kennedy et al. 2000) in almost 20 years ago, accounts in 2019 is already 700 with 241 endemic and around 182 species in the conservation priority list (Jensen et al. 2019). Birds are highly diverse in countries like the Philippines (Relox et al. 2011) and contributor to various ecosystem services from plant production to regulating functions like the cycling of nutrients (Whelan et al. 2008, 2015). Despite the importance, these organisms are continuously faced by the alteration of its habitat such as the forest and the coastal and freshwater wetlands (Chan et al. 2004).

The establishment of protected area networks have long been recognized as an effective mechanism in safeguarding biodiversity and abating species extinctions (Chan et al. 2004). Recently, the enactment of RA 11038 or the Expanded National Integrated Protected Area System (ENIPAS act of 2018), had ensured 94 protected areas into National

Parks covering 3,084,898.73 hectares as initial components. Other sites potential for conservation and protection are considered remaining initial components and shall undergo processes to be considered a protected area. In the Philippines, Lake Mainit watershed of the Caraga region has the potential.

Lake Mainit watershed is situated adjacent to Mt. Hilong-hilong. It lies within the political boundaries of the provinces Agusan del Norte (ADN), Surigao del Norte (SDN), and Surigao del Sur (SDS). It contains fragments of the remaining blocks of forests within the Eastern Mindanao Biodiversity Corridor (EMBC) of the Philippines, making it a priority conservation area known as the Lake Mainit Key Biodiversity Area or LMKBA (Caraga DENR 2015). Previous studies around the watershed revealed unique flora (Demetillo et al. 2015) and fauna diversity (Lake Mainit Development Alliance 2015) noteworthy for conservation and protection. However, any proposed protected area shall be proven suitable for inclusion in the system such that several studies are needed part of the protected area suitability assessment (PASA).

The study on the diversity of avifauna in the Lake Mainit watershed is significant since the information about the fauna diversity is needed in the protected area resource profile. Also, the information about endemic and threatened species, including birds, could be the basis for designating a protected area's strict protection zone. Thus, the study was conducted and specifically aimed at determining the species composition, distribution, richness, ecological, the conservation status of birds, and threats to biodiversity.

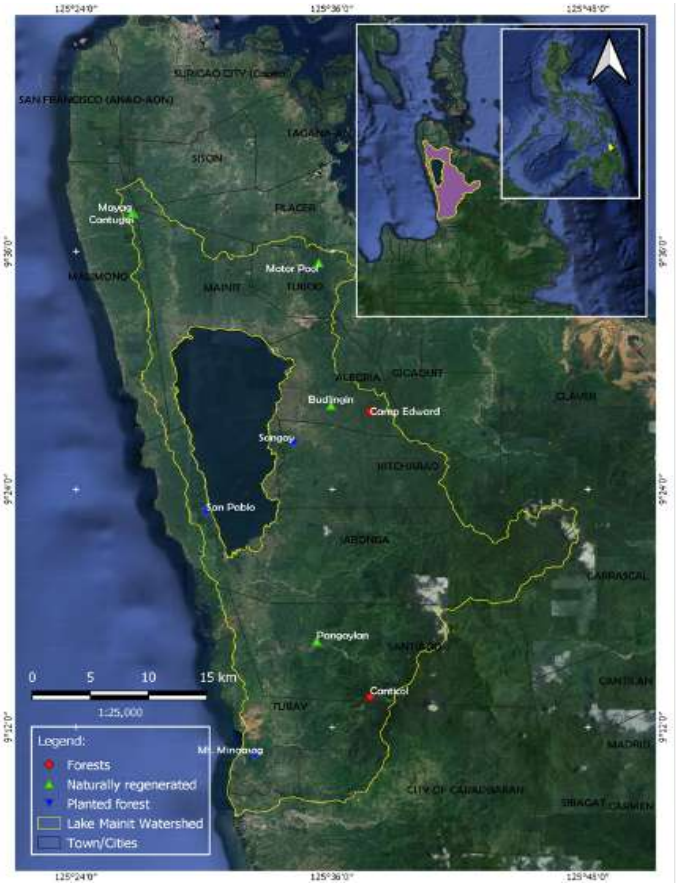

Figure 1. Map showing the terrestrial vertebrate sampling points within the Lake Mainit Watershed in the Caraga Region, Philippines

2 Materials and Methods

Sampling site and selection

Before conducting the study, prior consent from the target local government units (LGUs) in Agusan del Norte (ADN) and Surigao del Norte (SDN) has been made. This consent was a requirement in obtaining the Wildlife Gratuitous Permit (WGP) number R13-2017-0049. Ten sampling sites were established within the eight municipalities covered by ADN and SDN provinces around Lake Mainit watershed (Figure 1). Exact locations were obtained using handheld Global Positioning System (GPS) receiver or by geotagging (DENR-FMB 2013) and were transformed into a digital map using the software Quantum Geographic Information System (QGIS) software v2.14. Sampling was done in August to September 2013, March to May 2014 and in September to November 2017. Although all sites were forested and almost has similarities in canopy cover, it has differences in tree stocks probably due to several land use after logging (Figure 2). These were categorized into: a) Forests (Sites 7 and 10) determined by the presence of trees able to reach 5 meters and canopy cover more than 10 percent with no predominant land use like urban and agriculture, b) Naturally Regenerated Forests of Introduced Species (Sites 1, 2, 3, 8, and 9) predominantly of introduced species, c) Planted Forest of Introduced Species (Sites 4, 5, and 6) where 50% of the growing stock are planted or seeded trees. All categories by Food and Agriculture Organization (2015) were followed.

Site 1: Barangay, Budlingin, Alegria, Surigao del Norte (Figure 2A)

The sampling area between (09°28'14.28"N and 125°35'56.82"E) is situated from the lowland area to a higher altitude of the ridge vegetated with second growth forests. Logging and slash-and-burn were evident in the site. Patches of cultivated and abandoned agricultural land mixed with second growth forests were also observed in the area. Coconut, thickets of bamboo, banana plantation, wild saplings, and few stands of industrial and fruiting trees were undergrown with grasses and vines. Also, a cave and Lumundo falls were sighted in the higher altitude of the area. Abandoned farms and clear water running along creeks may indicate a limited anthropogenic disturbance in the area. Few farmers occasionally traverse the area to visit some active farmlands planted with *Sechium edule, Cucurbita maxima, Ipomea batatas, Musa*, and other marketable crops with lesser inputs and farm maintenance. Distance to the main population center might have contributed to the recede of farm activities on site. This observation was also reported by Gotame (2010), in which humans have less altered mountain areas because of the logistical difficulties it inherent therein.

Site 2: Barangay Mayag, Sison, Mainit, Surigao del Norte (Figure 2B)

This site (09°37'55.81"N and 125°26'36.08"E) is within rolling hills and plains of secondary forest, dominated by small to medium size of *Calophylum blancoi, Parashorea plicata, Shorea contorta*, and *Shorea negrosensis*. The abundance of ferns like *Asplenium nidus* and *Nephrolepis bisserata* in forest floors exposed to sunlight are observed. Understory plants include several species of fruiting ficus. Notable numbers of streams, brooks, and mountain springs with clear water flowing were noticed. The community is about 2.5 kilometers from the sampling site. However, the presence of trails and several stands of coconut and banana in the lower and upper elevations indicates anthropogenic disturbance.

Site 3: Barangay Motorpool, Tubod, Surigao del Norte (Figure 2C)

It is located at 09°35'26.05"N and 125°35'22.31"E with elevations ranging from 132 to 230 masl. The site is characterized as a secondary limestone forest mixed with agricultural land. Few individuals of large trees with buttresses were observed, including several cave formations and creeks. Plant community includes notable species such as *Agathis philippinensis, Cinamomum mercadoi, Canangga odorata, Dipterocarpus grandiflorus, Parashorea plicata, Shorea astylosa, Vatica mangachapoi,* and *Vitex parviflora*. Abundant understory and ground cover plants include several species of *Ficus, Schismatoglottis* sp., *Chromolaena odorata*, *Drynaria quercifolia*, and species of Asplenium and Nephrolepsis. Canopy epiphytes and vines were also present. On-site disturbance includes a cleared area for agricultural conversion, and the open areas with abandoned farms and coconut plantations at forest edges.

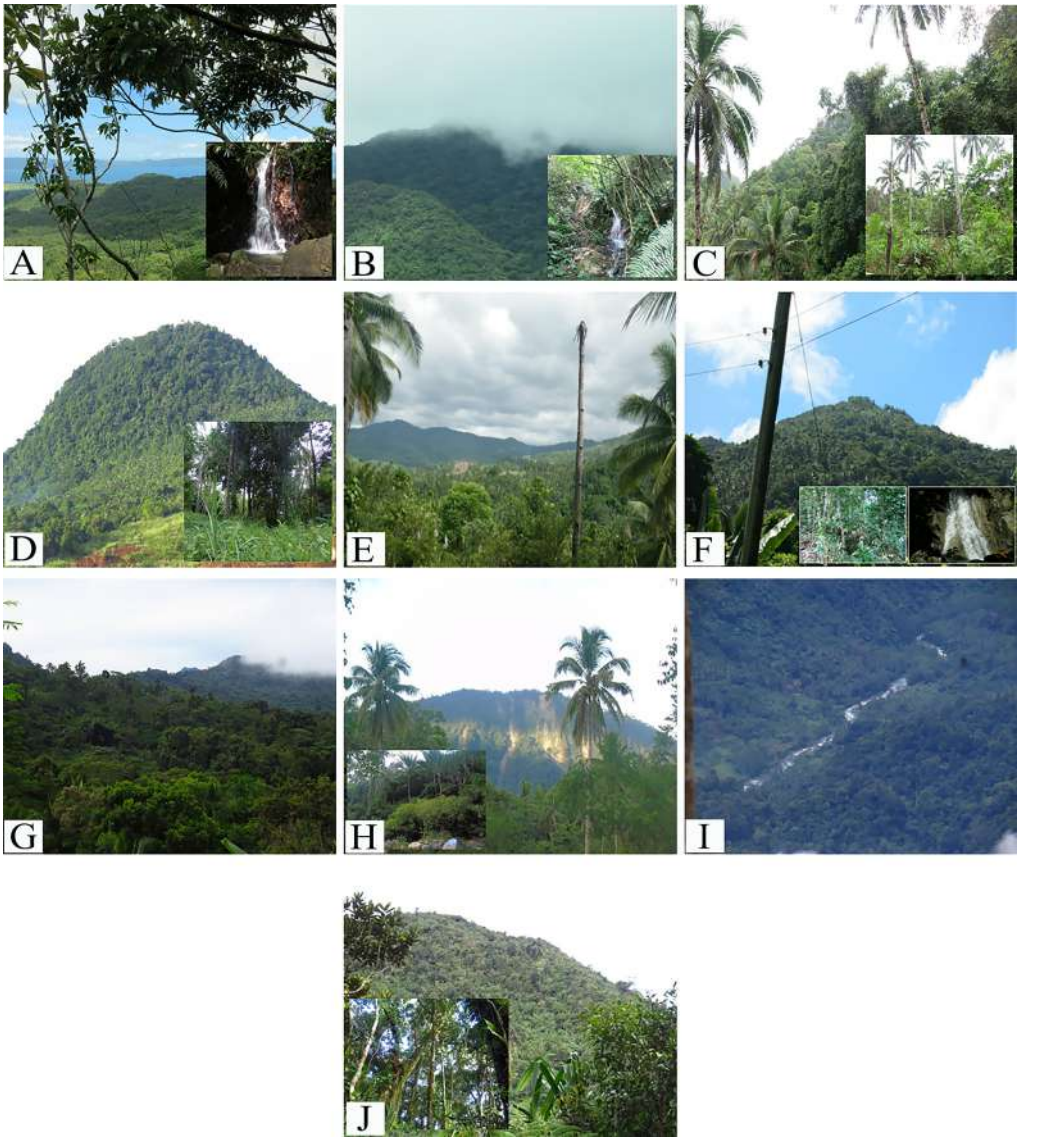

Figure 2. Panoramic view with some inset of understory and ground cover of the sampling sites around Lake Mainit watershed. Site A) Budlingin; B) Mayag; C) Motorpool; D) Mt. Mina-asog; E) Sangay; F) San Pablo; G) Camp Edward; H) Cantugas; I) Pangaylan and J) Canticol.

Site 4: Mt. Mina-asog, La Fraternidad, Tubay, Agusan del Norte (Figure 2D)

Located within the geographic coordinates of 09°10'32.82"N and 125°32'22.47"E, the site is characterized as an agro-secondary forest due to the presence of coconut plantation, fruit trees, banana, and industrial trees. Several stands of bamboo were observed, and some open areas vegetated with *Paspalum conjugatum* and *Dicranopteris liniaris.* Several copra driers and established trails leading towards several directions indicate that human activities frequently accessed the area. Furthermore, the presence of a nearby mining operation and the communities at its base suggests a fairly disturbed area. The transect was established starting from the foot of the hill up to the peak about 440 masl.

Site 5: Barangay Sangay, Kitcharao, Agusan del Norte (Figure 2E)

Site 5 is situated at 09°26'18.86"N and 125°34'13.02"E. Line-transects were established within the proximity to human settlements along the altitudinal range of 110 to 310 masl which cut across open areas and coconut plantation with fruiting and industrial trees to patches of second growth forest. The forested areas are vegetated with several timber producing species such as *Anisoptera thurifera, Calophyllum blancoi, Celtis luzonica, Dipterocarpus grandiflorous, Hopea acuminata, Hopea malibato, Lithocarpus ovalis, Sweetenia macrophylla*, and *Tristanopsis micrantha*. Understory and ground cover plants were *Cyathea contaminans, Drynaria coercifolia, Stenochlaena palustris, Pinangga maculata,* and *Dioscorea hispida*. Grassland ecosystem was also observed in the site as well as canopy vines and ephihpytes. The site is considered a disturbed area because of the presence of cultivated lands, relocation sites and road constructions.

Site 6: Barangay San Pablo, Jabonga, Agusan del Norte (Figure 2F)

The site is located between 09°22'48.20"N and 125°30'5.60"E, and characterized as hilly and mountainous with altitudinal range from 10-300 masl. Line-transects were situated at the lowland portion vegetated with vegetations dominated by *Cocos nucifera*, *Musa* sp., *Imperata cylindrica* and *Chromolaema odorata*. At the southern part of the site is a remnant of a primary forest and a waterfalls which provides potable water to the community at its base. Notable species include *Pterocarpus indicus, Hopea acuminata, Diospyros philippinensis*, and *Parashorea plicata* and the sugar palm, A*renga pinnata*. Anthropogenic disturbance in this site includes the plantation of industrial tree species, firewood gathering, and clearings near its base for agricultural purposes.

Site 7: Barangay Camp Edward, Alegria, Surigao del Norte (09°27'55.76"N; 125°37'46.63"E Figure 2J)

The sampling site is within the timberland classification of the DENR which is also within CADT area. Specifically, the study site is part of Purok 4, Palo kuarenta of the barangay. The site can be accessed with a few minutes ride either by motorcycle or four wheel vehicle approximately 2 kilometers from the barangay proper. The starting point of the 2 km transect was located at an elevation of 600 meters above sea level (masl) and ended at about 800 masl. The site falls into the lowland forest classification with several creeks and rivers traversing some of the sampling points.

Site 8: Barangay Cantugas, Mainit, Surigao del Norte (Figure 2K)

The sampling stations are situated within 09°37'53.94"N and 125°26'43.25"E from the base up to the higher altitudes of a ridge densely vegetated with a second growth forest of large and small trees. Some large trees have huge buttresses dominated by timber producing species like *Shorea contorta, Parashorea plicata, Diospyros philippinensis, Pterocarpus indicus, Dillinia philippinensis*, and *Anisoptera thurifera*. Forest floors exposed to sunlight are vegetated with *Chromolaena odorata, Scleria scrobiculata, Mikania cordata*, ferns such as *Drynaria quercifolia*, and grasses like *Paspalum conjugatum*. Understory plants include *Cyathea contminans* and *Melastoma malabathricum*. Canopy vines and ephiphytes were also observed. Several creeks were noted with clear waters flowing. Approximately 1.3 km from the study site is the population center of Barangay Cantugas.

Site 9: Pangaylan, Santiago, Agusan del Norte (Figure 2L)

The site is one of the rural barangays in the Municipality of Santiago situated in a river valley between 09°15'58.31"N and 125°34'34.58"E surrounded with steep slopes of mountain ranges. The inhabitants derived income primarily from coconut farming while some indulge in small scale mining at the hilly areas of the barangay. The sampling site is located within 9°16'20.20"N 125°35'16.20"E at elevations ranging from 300 to 528 masl. It is vegetated with dense second growth forest with notable flora species that indicates a good quality of the environment.

Site 10: Canticol, Tubay, Agusan del Norte (Figure 2M)

Canticol is among the remaining forested areas in Lake Mainit Watershed's southern boundaries and within the Mt. Hilong-hilong range. It is located within Barangay Doña Telesfora, Tubay, Agusan del Norte. The area is typically a tropical lower montane forest characterized by the moderate abundance of

moss on tree trunks and branches. In general, the area is a secondary forest under continued threat of various anthropogenic factors leaving open areas such as a ridge where active small scale mining was observed. Some portions were remnants of logging area, planted or seeded, and abandoned areas succeeded with grasses and shrubs. The 2 km transect is situated between geographic locations of 9°13'32"N and 125°37'47"E at elevations ranging from 1100 to 1300 masl, which cut across a grassland, early secondary growth, advanced and old-growth forest.

Field sampling and identification of birds

The survey was facilitated by utilizing a rapid assessment method following the standards of Bibby et. al. (1998) with modifications. In the site, local guides were considered as co-researchers with the aim of capacitating local counterparts in biodiversity conservation. The local guides were at first oriented to the rationale of the activity and the specific objectives of the field expedition as well as the modified standard method. Field guides' experiences in attracting, locating and identifying birds were interfaced with the technique employed in the survey.

Seen and heard species of active birds during the day (diurnal) were listed in a prepared field data sheet. Calls of nocturnal birds were also noted during nighttime. Birds were listed following the Line-Transect survey method. The technique involves recording all the birds seen (flying, singing, or feeding) within 20 m of both sides of at least 2 km line-transect established at each site. The line-transect was divided into eight (8) points at a distance of 250 m each. Geographic locations were recorded using handheld GPS receiver and geotagging (DENR-FMB 2013). Binoculars and telephoto cameras were also utilized. For three days per site, transect walks were done early every 0500 hours when bird activity begins to peak and in late afternoon. A total of 10 transects were laid around the watershed. Birds were identified using the photographic field guide by Strange (2000) and Kennedy et. al. (2000). The authenticated bird photograph databases were also utilized in the identification of unidentified birds recorded in photographs. The conservation status of birds was known through the IUCN in 2018.

Results of the Key Informant Interviews (KIIs) conducted and secondary data gathered for the protected area suitability assessment provide insights of the possible threats to biodiversity around the Lake Mainit watershed.

Data Analyses

The diversity indices such as species richness, species diversity, and species evenness were calculated using the PRIMER statistical software version 6.1.6 (Clarke and Gorley 2006). The adequacy of sampling in all sites was evaluated using the sample-based species accumulation curve (Ugland et al. 2003). Shannon-Weiner diversity values were classified with modification (Table 1).

Before the PRIMER software analyses, abundance data were overall transformed using square root for the data. A resemblance matrix was created as input to several analyses like similarities. The non-metric multidimensional scaling (NMDS) with the Bray-Curtis similarity index was used to visualize similarities in the bird composition and assemblage structure across sampling locations. The analysis of similarities (ANOSIM) was utilized to test significant differences in assemblage composition across the sampling sites. Species contributing to the differences between the sampling sites were determined using the similarity percentages (SIMPER).

Adequacy of sampling

The asymptotic sample-based accumulation curve indicates that more efforts can be made

Table 1. Categories of diversity values.

Range of H' values	Description
4.21 - 5.00	Very High
3.41 - 4.20	High
2.61 - 3.40	Moderate
1.81 - 2.60	Low
<1.00 - 1.80	Very Low

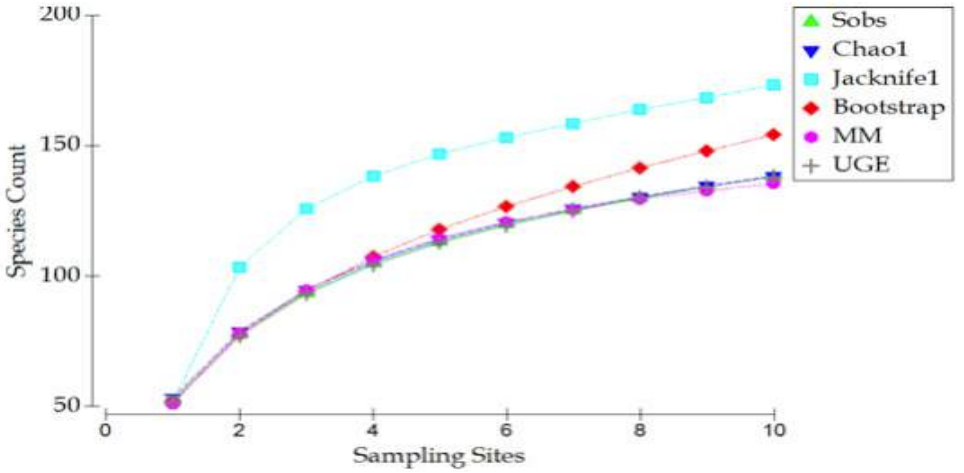

Figure 3. Sample-based species accumulation curve of the bird community around Lake Mainit watershed.

to account for more species in the Lake Mainit watershed (Figure 3). It was depicted comparing the values of the observed species (Sobs=52.00), the Chao 1 mean (53.30), the mean of the Jacknife 1 (52.00), the mean of the UGE equation (51.40) and the Michaelis Menten (MM=51.04) species richness estimators.

3 Results and Discussion

Spatial variation in species composition, species richness, abundance and avifaunal diversity

A total of 6,399 individuals of birds belonging to 50 families in 94 genera and 138 species were recorded from the 10 sampling sites around Lake Mainit Watershed. The family Columbidae, had the highest species richness with 14 species followed by families Dicaeidae, Nectarinadae, and Muscicapidae with 10, 9 and 8 species, respectively. The top five families with the most numbered captured individuals include the Pycnonotidae (n = 887) followed by Apodidae (n = 541), Zosteropodidae (n = 450), Columbidae (n = 396) and Nectariniidae (n = 395). The species *Hypsipetes philippinus* (n = 437), *Zosterops montanus* (n = 403), *Macronus striaticeps* (n = 331), *Pycnonotus goiavier* (n = 307) and *Collocalia esculenta* (n = 303) were the five most abundant species around Lake Mainit watershed. Almost half (45%) of the recorded birds were Philippine endemic (Figure 4A) including the two most abundant birds in the area, *H. philippinus,* and *M. striaticeps*. About 13% (n = 17) of these birds fall in the threatened classification (IUCN, 2018). This consists 8% (n = 11) near threatened and 4% (n = 6) in the vulnerable classification (Figure 4B).

Variation in the species composition, richness, abundance, and diversity were observed across the ten sampling sites. About 72% of the birds were detected from two or more sampling sites. Some bird species were spatially restricted and recorded only at specific locations (28%). Site 1 (Budlingin), had the highest species richness (75), and avifaunal diversity was very high (H'=4.25). Site 4 had the least number of species recorded with only 23 (Figure 4C). Site 10 (Canticol) had the highest yielded number of bird individuals (n=1,944) accounted to 35.4%, and site 7 (Camp Edward) with 1,384 or about 26% of the total bird individuals from all sites (Figure 4D). The least abundant bird individuals were recorded in site 8 (Cantugas) with n=197. High diversity was observed in site 3 (Motor Pool), site 6 (San Pablo), site 7 (Camp Edward), and Site 8 (Cantugas) with H' = 3.94, H' = 3.70, H' = 3.52 and H' = 3.86 respectively (Figure 5). Moderate diversity was recorded in site 2 (Mayag: H' = 3.11), site 5 (Sangay: H' = 2.64), site 9 (Pangaylan: H' = 2.93) and Site 10 (Canticol: H' = 3.21). The diversity of birds was low in Mt. Mina-asog with H' = 2.38. Spatial diversity patterns of birds were probably attributed to habitat heterogeneity since some species prefer a particular habitat (Signor and Pinho 2011).

The observed number of species represents 20% of the 700 bird species recorded in the Philippines (Jensen et al. 2019). It is more than half (70%) of the total 196 bird species in the whole EMBC

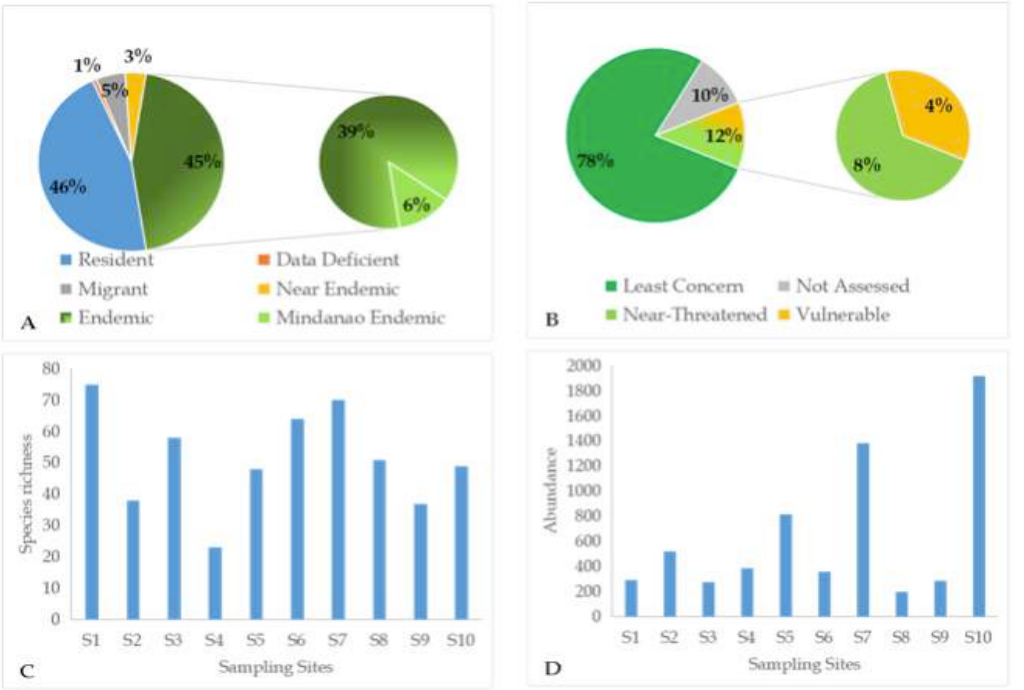

Figure 4. A) Geographic range description; B) Conservation status; C) Species richness and D) Abundance of birds in the 10 sampling sites around Lake Mainit watershed.

in 2008 (Table 2) and exceeds the total 120 birds species recorded in Mt. Hilong-hilong (PEF 2008). The number of endemic birds detected in this study is about 26% of the total endemic birds in the Philippines (Jensen et al. 2019) and is more than half (68%) of the total endemic birds recorded in EMBC. These numbers were also higher than those recorded in Mt. Hilong-hilong. The high occurrence of endemics entails the importance of an area inhabited by unique animals (Ibañez 2010). Records of threatened species are also starting points in prioritizing action plans for conservation (Barov 2011) like determination of protected areas (Birdlife International 2015), which seems applicable to the LMKBA.

For the NMDS ordination, the stress value of 0.06 indicates an excellent fitting of the similarities of the sampling sites in two dimensions (Figure 5B). Most of the sampling sites were clustered on the left side of the diagram, while site 10 separates from the rests on the right side. The illustration indicates that the bird community in site 10 was different to most of the sampling sites. Site 7 and 10 appeared at the center of the diagram indicating similarity in the vegetative cover. The diagram also indicates that the birds observed in site 7 is a mix of

Table 2. Comparison of bird species records in the Philippines, EMBC, Mt. Hilong-hilong and Lake Mainit watershed.

	Phils. (2018)	EMBC (2008)	Mt. Hilong-hilong (2008)	Lake Mainit watershed (2017)
Number of species	700	196	120	138
Number of endemics	241	91	59	62
Number of threatened species	182	22	18	17

Sources: Philippine bird data (Lepage, 2018); EMBC and Mt. Hilong-hilong bird data (PEF, CI, and DENR, 2008); Lake Mainit watershed bird data (Field work data Lador et al., 2013-2017)

species observed from site 10. Site 7 differs to site 10 mainly due to elevation and forest classification by, which site 10 is a lower montane forest, while site 7 lowland forest with trees mostly at advanced secondary growth. The sampling sites in the left side further clustered into three. The sampling sites in the forest category B had formed several clusters. Site 1 and site 3 clustered at 60% similarities in the bird species composition. The sampling sites 2 and 8 formed another cluster close to site 1 and site 3 at 40% similarity. It can be observed that site 9, which has a vegetation typical to the forest category B, clustered at 40% similarity to all of the sampling sites in the forest category C. The results implied that even the sites with similar vegetation cover differ in bird composition. Avifaunal diversity probably attributes the clustering of site 9 to the sampling sites in category C since most of the sampling sites in this category have moderate diversity. Although site 10 has moderate diversity, twelve of the species mostly endemic were restricted only from this site. This

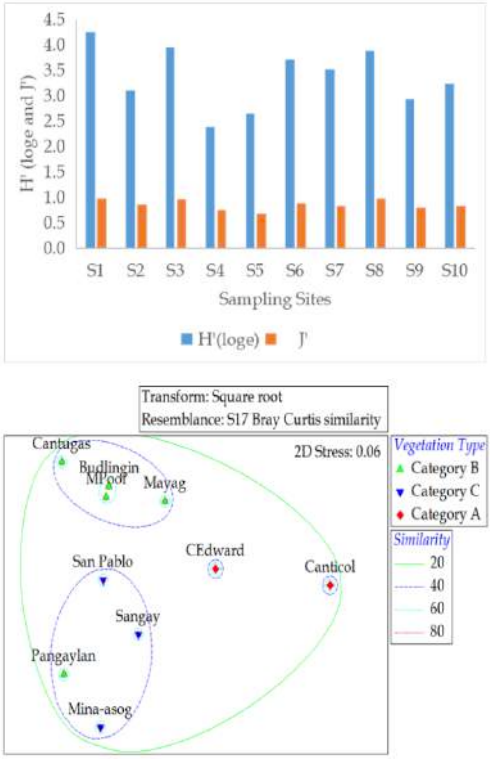

Figure 5. A) Shannon diversity and evenness and B) Non-meteric multidimensional scaling (NMDS) plot based on Bray-Curtis similarities across the ten sampling sites within Lake Mainit watershed.

probably was attributed since site 10 was at higher altitudes (1,100 - 1,300 masl) and has a better forest cover with more mature trees compared to the rest of the sampling sites. The result indicates that forest cover affects bird's species composition (Morante-Filho et al. 2015) which is similar to the differences in species composition and density in old growth, advanced and early secondary growth forests, and in active cultivation observed by Mallari et al. 2011. The occurrence of birds can spatially or temporally differ relative to the availability of potential breeding, foraging and roosting areas (Relox et al. 2011). Moreover, mature forests are essential to threatened and endemic birds (Mallari et al. 2011 and Relox et al. 2011).

Between sampling sites, the analysis of similarity (ANOSIM, R=0.44, p=0.001) revealed a difference with some overlap. The overlap further illustrates the observation of more than half of the species (72%) at most sampling sites, which explains that most of these birds moved or occupied multiple forest types around Lake Mainit watershed. The similarity percentages (Table 3) shows those species contributing to the differences between the sampling sites.

About 34% of these birds were those species unique to the Philippines and in the Mindanao faunal region. There were also those in the threatened classification (7%) like *Buceros hydrocorax, Ceyx argentatus, Dicaeum anthonyi, Eurylaimus steerii, Ficedula basilanica, Loriculus philippensis, Mearnsia picina, Nisaetus philippensis, Pitta steerii,* and *Rhabdotorrhinus leucocephalus* (Figure 6). On the other hand, four species were commonly observed in all sampling sites; three of these were endemic (*Dicaeum bicolor, Hypsipetes philippinus*, and *Phapitreron leucotis*). The results tend to show that there were still potential forested sites around Lake Mainit. According to O'Gorman et al. (2010), high species richness is recorded in habitats with unique species contributing to natural systems' functional diversity. Hence, conservation action needs to be in place within this sampling sites to maintain or further enhance the bird diversity.

Threats to biodiversity

Results of the Key Informant Interviews (KII's) to all barangays of the eight municipalities around Lake Mainit revealed that the hinterland areas were sources of livelihood to the many. Agroforestry is common in most of the sites except in Canticol, where small scale mining is a major threat. Hunting

Table 3. SIMPER analysis matrix showing descending order of species percentage contribution to the differences in the bird assemblage between sampling sites in the three forest category of Lake Mainit watershed.

Between Category B and C	% Contribution	Between Category B and A	% Contribution	Between Category C and A	% Contribution
Aplonis panayensis	3.98	*Zosterops montanus*	4.78	*Zosterops montanus*	4.44
Pycnonotus goiavier	3.66	*Dicaeum hypoleucum*	3.31	*Dicaeum hypoleucum*	3.17
Collocalia troglodytes	2.81	*Dicaeum australe*	3.1	*Dicaeum pygmaeum*	2.54
Collocalia esculenta	2.76	*Macronus striaticeps*	2.73	*Macronus striaticeps*	2.38
Nectarinia jugularis	2.48	*Dicaeum pygmaeum*	2.51	*Dicaeum australe*	2.37
Macronus striaticeps	2.45	*Hypsipetes philippinus*	2.47	*Dicaeum trigonostigma*	2.3
Passer montanus	2.21	*Dicaeum trigonostigma*	2.25	*Hypsipetes philippinus*	2.21
Centropus viridis	1.87	*Periparus elegans*	2.05	*Aplonis panayensis*	2.08
Hypsipetes philippinus	1.84	*Dicaeum nigrilore*	1.93	*Periparus elegans*	2.07
Cypsiurus balasiensis	1.76	*Phylloscopus olivaceus*	1.89	*Dicaeum nigrilore*	1.96

Figure 6. Some photos of notable bird species around Lake Mainit watershed. A) *Bolbopsittacus lunulatus*; B) *Loriculus philippinensis*; C) *Phapitreron leucotis*; D) *Phapitreron amethystinus*; E) *Ducula poliocephala*; F) *Macropygia tenuirostris*; G) *Hypsipetes philippinus*; H) *Pycnonotus urosticus*; I) *Sarcops calvus;* J) *Penelopides affinis*; K) *Buceros hydrocorax*; L) *Rhabdotorrhinus leucocephalus*, M) *Aethopyga primigenia*; N) *Periparus elegans*; O) *Zosterops montanus*; P) *Dicaeum pygmaeum*; Q) *Dicaeum hypoleucum*; R) *Ceyx argentatus*; S) *Macronus striaticeps*; T) *Ptilocichla mindanensis*; U) *Arachnothera flammifera*; V) *Centropus melanops*; W) *Centropus viridis*; and X) *Chrysocolaptes lucidus*.

of wildlife (including birds nests harvesting for food and trade), timber cutting, and harvesting other forest products like wild abaca were common. Conflicting land uses and tenure around Lake Mainit watershed like areas under the indigenous people's claim and claimed areas for mining were some of the significant concerns in the area that needs to be addressed and resolved.

4 Conclusion

Species composition, richness, abundance and diversity of birds in the lake mainit watershed vary across habitat types with some overlap. The overlap explains the presence of mostly similar species in most sites revealing similarities in habitat characteristics. Some endemic and threatened species are restricted only to sites with naturally growing forests less influenced by urban and agriculture activities, usually at high elevations. Around Lake Mainit watershed, birds to which some are unique, and conservation priority persisted in the remaining forest. The establishment of the Protected Area is highly recommended with the consideration of the resource utilization and livelihood of most communities through proper planning and management.

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Statement of Conflict of Interest

The authors declare no conflict of interest.

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