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Avifaunal assemblage in Barangay Lumbia, Cagayan de Oro City, Philippines

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Abstract

The threats to the Philippine avifauna have been increasing through the years despite the fact that the country has a rich and diverse bird life. Habitat destruction has affected 97% of threatened birds in the country especially in Barangay Lumbia which is under the pressure of rapid urban development. Moreover, avifauna diversity in Northern Mindanao is still poorly known. To determine the species richness, diversity, endemism and conservation status of birds, this study was conducted from September to December 2016 in three sampling sites of Barangay Lumbia, Cagayan de Oro City. Mist-netting technique was used in the sampling sites of the barangay. Conservation status, endemism and biodiversity indices of birds were determined. Twenty seven species of birds belonging to 20 families and 27 genera with percentage endemism of 41% were documented. Endemicity of birds was relatively high despite the high influx of human settlements and the threat of habitat loss. All the documented species were under the Least Concern status. High species of diversity of birds (H' = 2.92) with almost even distribution was also recorded. The high diversity is attributed to the occurrence of rich vegetation and mini forest. Conversion of forest areas into urban and agricultural areas was observed as the major threats thus implying the need for protection and conservation of birds in the area.

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Introduction

The Philippines is a treasure trove in terms of the wealth of biodiversity they contain and their tremendous benefits to human health and wellbeing. It is recognized as one of 17 megadiversity countries, which contains two-thirds of the earth's biodiversity and about 70-80 percent of the world's plant and animal species. In fact, the country is believed to harbor more diversity of life than any other country on Earth per hectare basis. It also ranks fourth in bird endemism (DENR, 2009).

According to Relox *et al.* (2011), avifauna is a terrestrial warm-blooded and oviparous vertebrate characterized by feathers for insulation. Most groups of birds can fly with the exemption of ratites which are flightless. They have high rate of metabolism corresponding to their high rate of food intake. Majority of the bird species are diurnal or active during the day and their peak activity in the early morning is spend as foraging time. However, some birds such as owls and nightjars prefer to forage at night and referred to as nocturnal or crepuscular. Avifauna makes up also as the most diverse terrestrial vertebrates in the world. According to Wild Bird Club of the Philippines (2017), out of the approximately 10,000 birds all over the world, the Philippines harbors 691 species of which 239 species are found nowhere else in the word and 93 of them are already listed as globally threatened species and 79 near threatened species. This spectacular diversity as well as endemism is primarily because of the geographical location of the country, the isolation of mountain peaks, the separation of islands and a wide range of habitat types.

Due to the country's highly diverse with rich endemism, but highly threatened biodiversity, Philippines is already considered a top priority in terms of global conservation (Myers *et al.,* 2000).

Barangay Lumbia, which is one of the barangays in Cagayan de Oro City, is situated in the hinterlands. It is situated at 8.4° North latitude, 124.59° East longitude and 174 meters elevation above the sea level (Maps-StreetView, 2011).

The location of this barangay is very favorable for wild life community because of its rich vegetation. However, this barangay is also greatly evolving through time by human activities. The vast area of natural habitats are vastly declining because most of these areas already have environmental changes like the establishment of industries, schools and the conversion of forest land and riparian zone into residential subdivisions. Currently, it has been already identified as a future growth center of Cagayan de Oro (CDODev, 2016). It is also one of the few areas in the city which becomes the permanent place of residence of families displaced during the flood brought about by Typhoon Sendong/Tropical Storm Washi that struck Cagayan de Oro City in December, 2011.

The relocation of many families of Typhoon Sendong (TS) Survivors offered by the Jesuits of Xavier University – Ateneo de Cagayan (Corrales, 2011) poses a precarious situation on the carrying capacity of Barangay Lumbia. Both residents and TS Survivors compete not only on the economic and social resources of the barangay but also on its environmental resources. With this situation at hand, it is imperative to asses, inventory and establish baseline information about the bird species in the area since Barangay Lumbia is already under the pressure of rapid development and an increasing number of human settlements. Furthermore, the baseline data can contribute much towards the conservation and protection on this important group of animal with the initiative coming from the local government and its partners. Hence, the main aim of this study is to assess the avifauna in Barangay Lumbia, Cagayan de Oro City. Specifically, this study aims to provide trends on species richness, endemism, conservation status, relative abundance, and diversity of avifauna in the aforementioned area.

Materials and methods

Sampling area

The research was conducted in Barangay Lumbia, Cagayan de Oro City, Mindanao, Philippines (Fig. 1) from September to December 2016.

Its GPS reading is 8°23'45" N and 124°35'38" E and is approximately 10 kms away from the city proper. It is home to fertile mountains, lush forest reserves and caves waiting to be explored. It is also a developing barangay and has been planned as the Cagayan de Oro's future city center.

Many project proposals are presented in Lumbia like hospital-hotel-shopping complex since the barangay is not prone to flooding. In spite of these environmental disturbances, there are still some areas in Lumbia that are still displaying rich fauna and flora that can be a site for study.

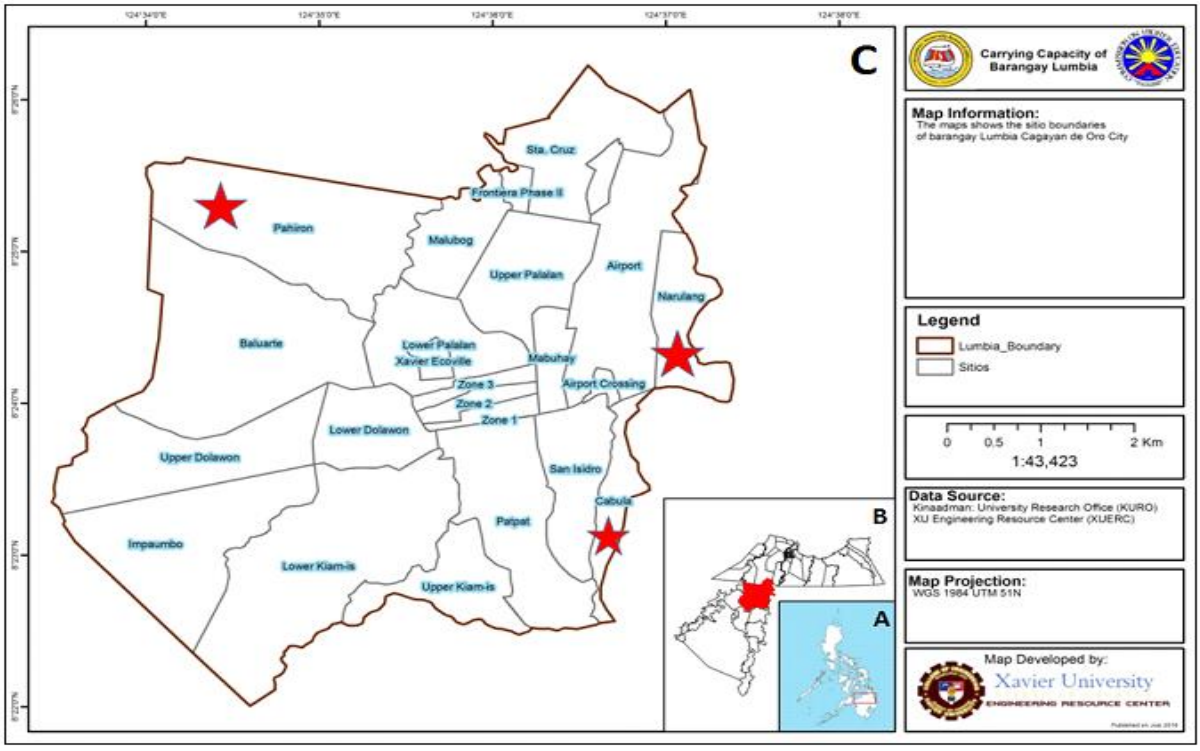

Fig. 1. Map of the Philippines (A) and Cagayan de Oro City (B) showing the location of the Study Areas in Barangay Lumbia (C).

Sampling sites

A total of three (3) sampling sites were established and sampled; Sitio Cabula, Sitio Narulang and Sitio Pahiron (Fig.2). Site 1 (Sitio Cabula; 8°22'52.22"N and 124°36'37.02"E) is a riparian zone having a mini forest. The site is characterized by anthropogenic activities such as the presence of pool resorts, mining industry and human settlements. On the other hand, Site 2 (Sitio Narulang; 8°24'55.81" N and 124°37'5.32"E) is an agricultural area filled mainly with agricultural crops, fruit trees, and some human settlements. Lastly, Site 3 (Sitio Pahiron; 8°25'01.94" N and 124°31'54.77" E) is slightly dominated by coconut and mango plantations with patches of forest (mini forest). The site is also sparsely inhabited by humans.

Collection and determination of avifauna

Mist netting was the process used in capturing the bird species. The method is highly efficient and commonly used by scientist doing this study. This involves setting up a series of pole-mounted monofilament nets measuring 36 mm mesh size and 12 meters long, along flight paths (Alcala, 2009). Approximately 20 mist nets were set in all sampling sites in two to three netting days per site. They were strategically deployed in flyways, forest edge, foraging areas and forest interior in each site sampling site. Mist nets were then left open from 0500hrs-1700hrs to capture diurnal birds and 1700hrs-0600hrs to collect nocturnal birds. All mist nets were checked at least twice in the morning, afternoon and evening. All birds captured were retrieved from the mist nets and were placed immediately in the net bags for recording and identification proposes.

Distinguishing morphological characteristics of each bird species were determined and compared to the descriptions of birds of Kennedy *et al.* (2000) in A Guide to the Birds of the Philippines.

Captured birds were then released back to its natural habitat after identification. The distribution/residency and conservation status of birds was based on the Checklist of Birds of the Philippines 2017 (Wild Bird Club of the Philippines, 2017).

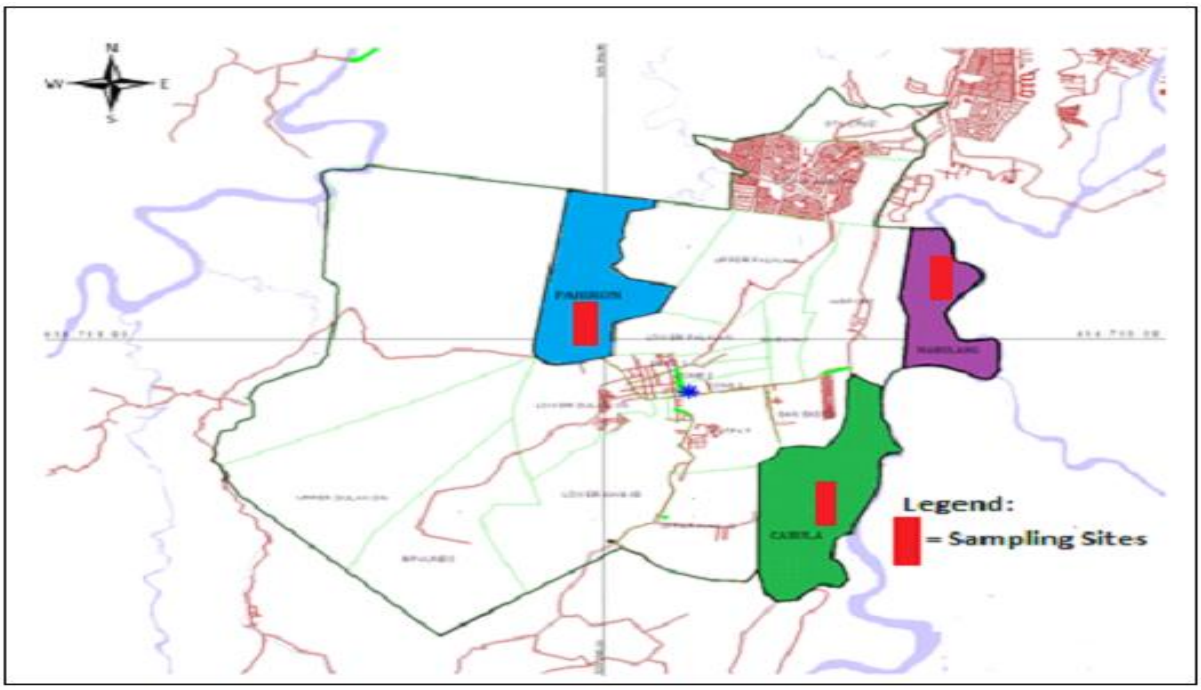

Fig. 2. Establishment of the sampling sites in the study area.

Data analysis

Biodiversity indices such as relative abundance (RA) and Shannon-Weiner index (H') were computed to give quantitative description of the species composition of the bird species in the area. A diversity index is a mathematical measure of species diversity in a community. Diversity indices provide more information about community composition and also rarity and commonness of species in a community.

Relative abundance

Relative abundance (RA) refers to the relative representation of species in an area.

This is computed through counting the number of individuals of each species in a community and identifying the percentage of each species that is part of the total number of all individuals of other species that were sampled.

$$p_i = \frac{n_i}{N} x\ 100$$

Where: n_i is the number of individuals of the same species N is the total number of individuals for all species

Shannon's Weiner function of diversity

Shannon-Weiner Index is an index of diversity which considers both species richness and evenness.

$$H' = -\sum p_i \ln p_i$$

Where:

H = Shannon's index of general diversity;

p_i = the number of individuals species i/total number of samples.

Results and discussion

Species Richness and Abundance

Twenty seven bird species belonging to twenty families and 27 genera with a total of one hundred five individuals were recorded in Barangay Lumbia, Cagayan de Oro, Philippines (Table 1).

Table 1. Species composition, distribution and abundance of birds in the three sampling sites of Barangay Lumbia, Cagayan de Oro City, Philippines.

Scientific Name	Number of Individuals			Total	Relative Abundance (%)
	Site 1	Site 2	Site 3		
Family Alaudidae					
Alauda gulgula (Oriental Skylark)	0	0	1	1	0.95
Family Alecdinidae					
Halcyon gularis (Brown-breasted Kingfisher)	0	0	1	1	0.95
Family Apodidae					
Aerodramus mearnsi (Philippine Swiftlet)	6	2	0	8	7.62
Family Caprimulgidae					
Caprimulgus manillensis (Philippine Nightjar)	0	0	1	1	0.95
Family Campephagidae					
Lalage nigra (Pied Triller)	0	0	2	2	1.90
Family Columbidae					
Chalcophaps indica (Grey-capped Emerald dove)	0	0	2	2	1.90
Geopelia striata (Zebra dove)	7	5	4	16	15.24
Macropygia tenuirostris (Philippine Cuckoo-dove)	0	0	2	2	1.90
Phapitreron brevirostris (Short-billed Brown Dove)	3	4	3	10	9.52
Spilopelia chinensis (Spotted Dove)	0	0	3	3	2.86
Family Cuculidae					
Surniculus velutinus (Philippine Drongo-cuckoo)	0	0	1	1	0.95
Family Dicaeidae					
Dicaeum australe (Red-striped Flowerpecker)	2	1	2	5	4.76
Family Estrildidae					
Lonchura atricapilla (Chestnut Munia)	2	2	2	6	5.71
Family Halcyonidae					
Todiramphus chloris (Collared Kingfisher)	2	3	1	6	5.71
Family Laniidae					
Lanius cristatus (Brown Shrike)	0	0	1	1	0.95
Family Meropidae					
Merops viridis (Blue-throated Bee-eater)	0	0	1	1	0.95
Family Muscicapidae					
Copsychus mindanensis (Philippine Magpie-Robin)	0	0	1	1	0.95
Cyornis rufigastra (Magrove Blue Flycatcher)	0	0	1	3	2.86
Ficedula narcissina (Narcissus Flycatcher)	0	2	1	1	0.95
Family Nectariniidae					
Cinnyris jugularis (Olive-backed Sunbird)	0	1	2	3	2.86
Family Oriolidae					
Oriolus chinensis (Black-naped Oriole)	0	0	1	1	0.95
Family Passeridae					
Passer montanus (Eurasian Tree Sparrow)	0	0	3	3	2.86
Family Psittaculidae					
Bolbopsittacus lunulatus (Guaiabero)	0	0	2	2	1.90
Family Pycnonotidae					
Hysipetes philippinus (Philippine Bulbul)	0	0	1	1	0.95
Pycnonotus goiavier (Yellow-vented Bulbul)	5	6	1	12	11.43
Family Rhipiduridae					
Rhipidura nigritorquis (Philippine Pied Fantail)	0	2	2	4	3.81
Family Sturnidae					
Aplonis panayensis (Asian Glossy Starling)	3	3	2	8	7.62
TOTAL	30	31	44	105	100%

Data on bird abundance showed that *Geopilia striata*, *Pycnonotus goiavier* and *Phapitreron brevirostris* constituted 15.24%, 11.43% and 9.52% respectively of the communal bird counts. *G. striata* is a communal grass seed-eater that was introduced in the Philippines and usually resides in open lowland areas and farmland while *P. goiavier* is a resident breeding omnivore which is usually found in all terrestrial habitats except primary and secondary forests. The ability of these species to dominate bird populations in the area categorizes them as 'urban exploiters' (Mckinney, 2002; Vallejo,*et al.,* 2008). So those 2 species aforementioned may have directly benefited from conversion of the barangay into an urban and develop area. Whereas, the abundance of *P. brevirostris* was primarily because the area from where this species was collected had an abundance of Talisay gubat (*Terminalia foetidissima*) whose fruits are the main diet of the bird species.

Table 2. Residency and conservation status of birds in Barangay Lumbia, Cagayan de Oro City, Philippines.

Family	Species	Residency	IUCN Status
Alaudidae	*Alauda gulgula*	Resident	
Alecdinidae	*Halcyon gularis*	Endemic	
Apodidae	*Aerodramus mearnsi*	Endemic	
Caprimulgidae	*Caprimulgus manillensis*	Endemic	
Campephagidae	*Lalage nigra*	Resident	
Columbidae	*Chalcophaps indica*	Resident	
	Geopelia striata	Introduced	
	Macropygia tenuirostris	Near Endemic	
	Phapitreron brevirostris	Endemic	
	Spilopelia chinensis	Resident	
Cuculidae	*Surniculus velutinus*	Endemic	
Dicaeidae	*Dicaeum australe*	Endemic	
Estrildidae	*Lonchura atricapilla*	Endemic	
Halcyonidae	*Todiramphus chloris*	Resident	Least Concern
Laniidae	*Lanius cristatus*	Migrant	
Meropidae	*Merops viridis*	Resident	
Muscicapidae	*Copsychus mindanensis*	Endemic	
	Cyornis rufigastra	Resident	
	Ficedula narcissina	Migrant	
Nectariniidae	*Cinnyris jugularis*	Resident	
Oriolidae	*Oriolus chinensis*	Resident	
Passeridae	*Passer montanus*	Introduced	
Psittaculidae	*Bolbopsittacus lunulatus*	Endemic	
Pycnonotidae	*Hysipetes philippinus*	Endemic	
	Pycnonotus goiavier	Resident	
Rhipiduridae	*Rhipidura nigritorquis*	Endemic	
Sturnidae	*Aplonis panayensis*	Resident	

A number of bird species had only 0.95% relative abundance where they were only captured and documented once in the whole sampling period and among these were *Ficedula narcissina, Halcyon gularis* and *Oriolus chinensis*. *F. narcissina* low abundance is due to the fact that it is a rare migrant from northeast Asia, and only visits here in the Philippines from October to March (Kennedy *et al.,* 2001). On the other hand, *H. gularis* low abundance can be due to the fact that the area particularly in Sitio Pahiron (Site 3) where the species was captured doesn't have immediate water bodies like a river and this bird is considered as a river kingfisher, which resides primarily near the water bodies for its food. Lastly, *O. chinensis* low abundance can be associated to the fact that it rarely descent to the ground where it only forages high in trees and usually stay within canopies as stated by Weerd and Hutchinson, 2004.

Table 3. The biodiversity indices of the three sampling sites of Barangay Lumbia, Cagayan de Oro City.

Biodiversity Index	Site 1	Site 2	Site 3	Overall Total
Species Richness	8	11	26	27
Number of Individuals	30	31	44	105
Shannon Diversity	1.96	2.26	3.15	2.92
Evenness	0.94	0.94	0.97	0.89

Residency and conservation status

Table 2 shows the residency and conservation status of the captured birds in the area. Residency status was determined whether they are endemic, resident, introduced or migrant.

Endemic species refers to the species that are confined in a particular island and/or several islands of a country and do not occur anywhere else outside its geographical boundaries. Eleven (11) or 41% of the total captured bird species in the area were categorized as Philippine endemic (Fig. 3).

The number of these endemic species was relatively high despite the influx of human settlements and the conversion of forest areas and riparian zones into industries, subdivisions, commercial areas and agricultural areas. As such, the presence of these endemic species makes Barangay Lumbia an important urban bird area.

This study also indicates that although these endemic bird species were present, their number represents only 5% of the two hundred twenty four (239) endemic species found here in the country. According to Vallejo *et al.* (2008), this kind of result may have been affected by successful colonization by other introduced or resident species or as a direct result maybe of habitat conversion from its original state which was observed in the area. Furthermore, Delacour & Mayr, (1946) emphasized that as most endemic species are forest birds, the depletion of the forests vegetation will eventually result in the decline of the species endemism. Suarez and Sajise (2010) even pointed out that habitat loss is one of the major drivers of biodiversity loss. Near endemic, on the other hand, signifies that a species can be found mainly in the Philippines but occur on a few nearby small islands in other countries. One bird species, in particular, the Philippine Cuckoo-dove (*Macropygia tenuirostris*), can be found mainly in the Philippines but also occurs in Lan Yu islands, Southern Taiwan.

On the other hand, eleven (11) or 41% of the total captured bird species are considered as resident birds. Resident birds are those which live their entire life cycle in the country.

The other two (2) of the captured bird species are considered as migrant species. Migrant means a bird in passage which breeds outside the country during summer months and migrate to the country especially during the winter season. Lastly, the remaining two (2) species, the Zebra Dove (*Geopelia striata*) and Eurasian Tree Sparrow *(Passer montanus)* are considered as an introduced species. Introduced birds are not originally resident, endemic, or migrant in the Philippines but have been brought to the Philippines from other countries.

All of the species' conservation status was categorized as Least Concern, which means all the taxa documented were abundant and widespread.

However, even though the species were categorized as Least Concern, some of the species such as the Grey-capped Emerald dove (*Chalcophaps indica*), Philippine Drongo-cuckoo (*Surniculus velutinus*), Oriental Skylark (*Alaude gulgula*), and Collared Kingfisher (*Todiramphus chloris*) were already considered to have a decreasing population trend. The rest of the species were having either stable or increasing population trend (Birdlife International, 2014).

Species diversity

Shannon-Weiner Index is an index of diversity which considers both species richness and evenness which treats the species as mathematical symbols and their relative population sizes as the probability. This would mean that the index would increase if there are additional unique species or greater species evenness. The species diversity of birds in all sites was computed and the results showed an overall species diversity of H' = 2.92 (Table 3).

The species diversity result was lower to the study done by Calimpong and Nuñeza (2015) but comparatively higher compared to the studies conducted by Saguindang *et al.* (2002), Vallejo *et al.* (2008) and Relox *et al.* (2011).

The high species diversity could still be attributed to the abundance of the vegetation and the presence of mini forest in the area. Likewise, Arances *et al.* (2006) stated that numerous studies have shown that the numbers and kinds of birds that occur are related to the physical and biological attributes of the habitat where they live. This is quite true in the attributes possessed by the presence of mini forest in the study area.

Fig. 3. Philippine bird endemics and near endemic (3A. *Bolbopsittacus lunulatus;* 3B. *Halcyon gularis;* 3C. *Aerodramus mearnsi;* 3D. *Caprimulgus manillensis;* 3E. *Phapitreron brevirostris;* 3F. *Surniculus velutinus;* 3G. *Dicaeum australe;* 3H. *Lonchura atricapilla;* 3I. *Copsychus mindanensis;* 3J. *Hysipetes philippinus;* 3K. *Rhipidura nigritorquis;* 3L. *Macropygia tenuirostris*) captured in Barangay Lumbia, Cagayan de Oro City, Philippines.

Another explanation that may support the more abundant and diverse birds in the area is the diversity of frugivore birds. The number of these birds are usually correlated to the richness of fruiting plant species and as stated also by Styring *et al.* (2011), canopy height and shrub cover are also important factors in the increased of species richness and diversity of bird species. These birds are likewise diverse in primary forest and often require larger foraging areas.

This was emphasized in the study done by Azman *et al.* (2011) that bird diversity is higher in areas of rich vegetation such as the primary and secondary forest.

In some cases, the loss of primary forests allows these birds to forage in secondary forest including the mini forest.

Gray *et al.* (2004) even added that the degradation and fragmentation of forest ecosystem has a strong impact upon the birds since the secondary forest is also in close proximity to an original forest. Moreover, Harvey *et al.* (2006) as cited by Calimpong and Nuñeza (2015) reported that tree covers in secondary and riparian forests would be associated with higher animal species richness and abundance since they are likely to provide resources and habitat for the species originally present in the area than highly modified tree covers.

This supports the high number of species and diversity of birds in the area particularly in Sitio Pahiron (Site 3).

Conclusion

Twenty seven species of birds belonging to 20 families and 27 genera with percentage endemism of 41% were recorded in Barangay Lumbia, Cagayan de Oro City using mist-netting technique. Endemicity of birds in the area was relatively high and all species were listed as Least Concern. *Geopilia striata* was the most abundant species and there was a high species diversity of birds recorded in the area. Conversion of forest lands and riparian zone into urban areas and the influx of human settlements were observed to be the major threats to bird diversity.

However, these findings show that even under the pressure of rapid development of Barangay Lumbia, the area still harbors a viable complex ecosystem for bird communities and suggests conservation and protection efforts of the area.

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