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**Research Article**

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**Avian Diversity, Feeding Guilds and Conservation Status in Mt. Pantaron, San Fernando, Bukidnon, Philippines**Mary Cor S. Salolog<sup>1</sup>, Heidi C. Porquis<sup>1</sup>, Arturo G. Gracia, Jr<sup>2\*</sup><sup>1</sup>Department of Biology, Central Mindanao University, Musuan, Bukidnon, Philippines<sup>2</sup>Department of Natural Sciences and Mathematics, Surigao del Sur State University-Main Campus, Surigao del Sur, Philippines

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**Abstract**

Bird conservation is one of the main concerns of conservation societies due to its crucial role in maintaining ecosystem balance. However, for this to be realized, there is a need for continuous updating on ecological information necessary for conservation planning, especially for less explored habitats. Hence, this study was conducted to evaluate the diversity and status of birds in one of the understudied areas in Bukidnon, Philippines. Mist-netting for a total of 200 net-days, transect-line, and point-counts were carried out to record the birds. A total of 31 species with 386 individuals in 23 families were noted. Overall diversity value was relatively higher with H' index of 2.87, equitability value of 0.84, and a level of dominance (D) of only 0.08. Thus indicating that the habitat is diverse. However, concerning the uniformity of the population within the community, the birds' assemblage was noted to be moderately even with J' value of 0.56. The assemblage of birds was a mixture of insectivores, frugivores, carnivores, nectarivores, granivores, and omnivores which are essential for seed dispersal, pollination, pest control, and ecosystem reconstructing. Seven endemic species were noted. Among the birds, *Padda oryzavora* was the threatened species observed, while nine species were assessed to have a declining population. The threats observed in the area include hunting traps called "pulot," slingshot, slash and burn (*Kaingin*), and mist-netting. Based on the results, despite the limitations on the actual observation and documentation, Mt. Pantaron Range was found to house various species of avian fauna, which is worth saving from the different threats like habitat destruction and unregulated exploitation.

**Keywords:** Assemblage, Birds, Feeding Guild, Species Richness, and Threats**Introduction**

Biodiversity conservation has been one of the pressing global issues in the last few decades. The avian fauna particularly has drawn much public attention because of their fascinating appeal and the various unique roles they play in the

web of life. Both enthusiasts and researchers alike have intensified activities towards generating public awareness and support for this taxon. National and global databases are being developed. But these data need continual updating, and here is where local inventories become relevant.

Barangay Kawayan is one of the 24 barangays in the municipality of San Fernando, Bukidnon. This 3,402.21-hectare community is nested in the Pantaron Range, which is a proposed protected area in the province of Bukidnon (Barangay Kawayan Development Plan, 2008). Information obtained from the elderly residents of this barangay indicates that back in the 1960s, the area was still considerably forested, with large tall trees such as *Shorea contorta* White Lawaan, *Shorea negrosensis* Red Lawaan, *Shorea polysperma* Tanguile, *Dacrydium* sp. Tiger tree, and *Pterocarpus indicus* Narra being relatively common. The same report also indicates the presence of different animals like hornbills, owls, doves (*balud*, *punay*, and *manatad*), parrots, *kuruwakwak* (black Pigeon), hawk, falcon, eagles, flying lemur, tarsier, and herptiles.

However, logging operations began in 1971 (Gallardo, 2008). The first concessioner, Balor Ansans, opened the first road to the Barangay. Other logging operators followed. These include the Alejandro Almendras Group, the NAREDICO, El Labrador, the Balderama, some Koreans, and Japanese. Based on this information, the latter was interested in the local fauna and treasure hunting. But opposition against these logging and other activities soon began and intensified. Local and indigenous people, such as Tigwahonon, Manobo and the migrants, started rallies and pickets from the barangay up to the capital town, now the City of Malaybalay. As a result, logging operations were terminated.

What had existed and what is left of Barangay Kawayan's avian resources have not been recorded formally through the scientific process. In fact, not even a single scientific report on avian diversity, guild composition, or status and other ecological information is available for public scrutiny or for future scientific investigations. This is despite the fact these ecological data are necessary for conservation planning, especially for areas that are highly susceptible to anthropogenic activities and less explored. Thus, this study is intended to generate this important database of the avian fauna in the area. This necessity is further pressed by the current project of the national government to open the Bukidnon-Davao Road via San Fernando. This means that development will be intensified around the area, and it will most likely primarily affect its avian populations.

## Materials and Methods

### *Place and duration of the study*

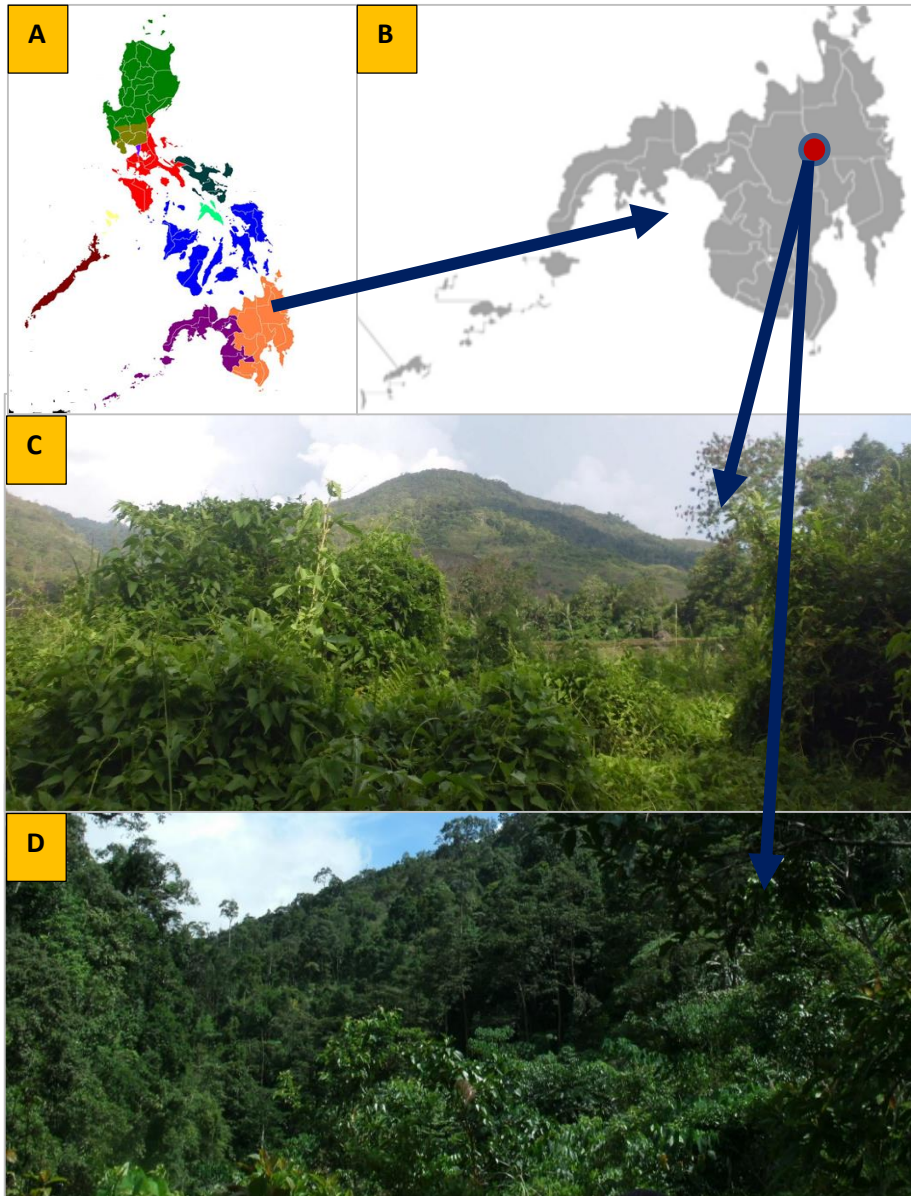
The study was conducted in two varying vegetation types of Mt. Pantaron located at Barangay Kayawan, San Fernando, Bukidnon, Philippines, positioned at 7.892737 North and 125.395830 East (Figure. 1A-B). The first station was located at the agroecosystem part of the mountain range (Figure. 1C), while the second station was situated at the lower montane part of the mountain (Figure. 1D). The main fieldwork was conducted from December 20-24 and 26-29, 2010, covering nine days of field working days. On September 8 and 9, 2014, a supplementary survey was conducted in the area. However, the approach was performed passively and was more on the perspective of opportunistic observations only.

### *Habitat Description*

The dominant plant species in the agroecosystem consist primarily of grasses, sedges, ferns, *Cocos nucifera*, and scarcely distributed trees, mostly fruit trees. The topography was generally plain. Availability of water bodies was evident for there were streams near the sampling areas at a distance of at least 20 metres to 100 metres. Some parts of the transect also by-passed areas that are just adjacent to rice fields with water irrigations. The closest human settlement was observed to be at least 500 metres away from the nearest sampling point. Canopy cover was almost absent considering the plant structure present in the area was below human height. As for the sampling station in the lower montane forest, the area was dominated by various species of trees, ferns and shrubs. The topography was quite angular for a terrain was quite elevated with a slope that ranging from 30-50 degrees. The forest canopy was around 80 to 90 percent. Occasional fallen logs were also observed inside the habitat, and leaf litter was quite thick. Presence of water bodies was also prominent in some points of the sampling area within this habitat. The distance of the nearest human settlements to the sampling area was estimated to be around 1.5 kilometres.

### *Sampling Techniques and Data Collection*

Since the study was performed by researchers who have limited knowledge in bird call identification, only the traditional mist-netting and ocular surveys were conducted. For mist-netting, three partitions were considered. The first was the ground net, established around 0 to 5 metres above the ground. The second one was the sub-canopy net, set around 10 to 15 metres; lastly, the canopy or Skynet was established 20 metres above the ground. All mist-nets had a dimension of seven metres long, five metres wide, and 30 mm mesh.



**Figure 1.** Geographic location of the study area (A and B). A portion of the sampled habitat in Brgy. Kayawan, Mt. Pantaron: Agroecosystem (C) and Lower Montane (D).

The checking and monitoring of nets were performed at intervals of one to two hours from 5:00 AM to 6:00 PM. A total of 100 mist-net days were accumulated throughout the sampling period per sampled habitat, thus, garnering an overall sampling effort of 200 net days.

For the ocular survey, the established human trail was followed and served as the transect line. This trail or transect line bypassed the two sampled stations. Along this transect, point stations were considered. All observations that were noted in the agroecosystem were pooled together. The same was done for the birds observed in the lower montane area. A total of 64 observation hours were recorded. Of these, 54 hours were contributed from the first visit and ten hours from the second visit. All bird species that were observed visually were noted. The book of Kennedy et al. (2000) entitled "A guide to the birds of the Philippines" was used as the key guide in the identification and verification of these observed birds in the area. After the identification, the birds were grouped according to their foraging types. The assignment into what foraging guild the birds belong to was based on the feeding report of Kennedy et al. (2000) and IUCN (2021). Numerical representation of the different foraging type depended on how many species fell into the respective guilds.

#### *Data Analysis*

The Biodiversity Professional Software by McCleese (1997) was used in the determination of the similarity index across the sampled habitat. The Paleontological Statistical Software by Hammer et al. (2001) was used to determine the diversity indices, descriptive statistics and species rarefaction. Visual presentations were created using Microsoft Excel 2016. Assessments were based on the current International Union for Conservation for Nature's report (IUCN). The primary diversity indices used were species evenness ( $J'$ ), Simpson Diversity Index ( $D$ ) which is a measure of species dominance, and Shanon-Weinner Diversity Index ( $H'$ ). The species evenness is a measure for species abundance uniformity within the community, wherein the more even the population of the species is, it suggests a higher diversity. This measure is represented through a numerical value of zero to one, with one as the highest value and suggesting higher diversity. The dominance on the other hand is the inverse of diversity and evenness, wherein if the value of dominance is closer to one, this suggests low diversity, and a value of zero entails the opposite. The  $H'$  index represents the totality of the whole diversity of the area which is calculated using the data set on species richness and abundance. The higher the value, the more diverse the habitat is. However, using  $H'$  index alone can be subjected, especially into the idea of what value should be considered as a

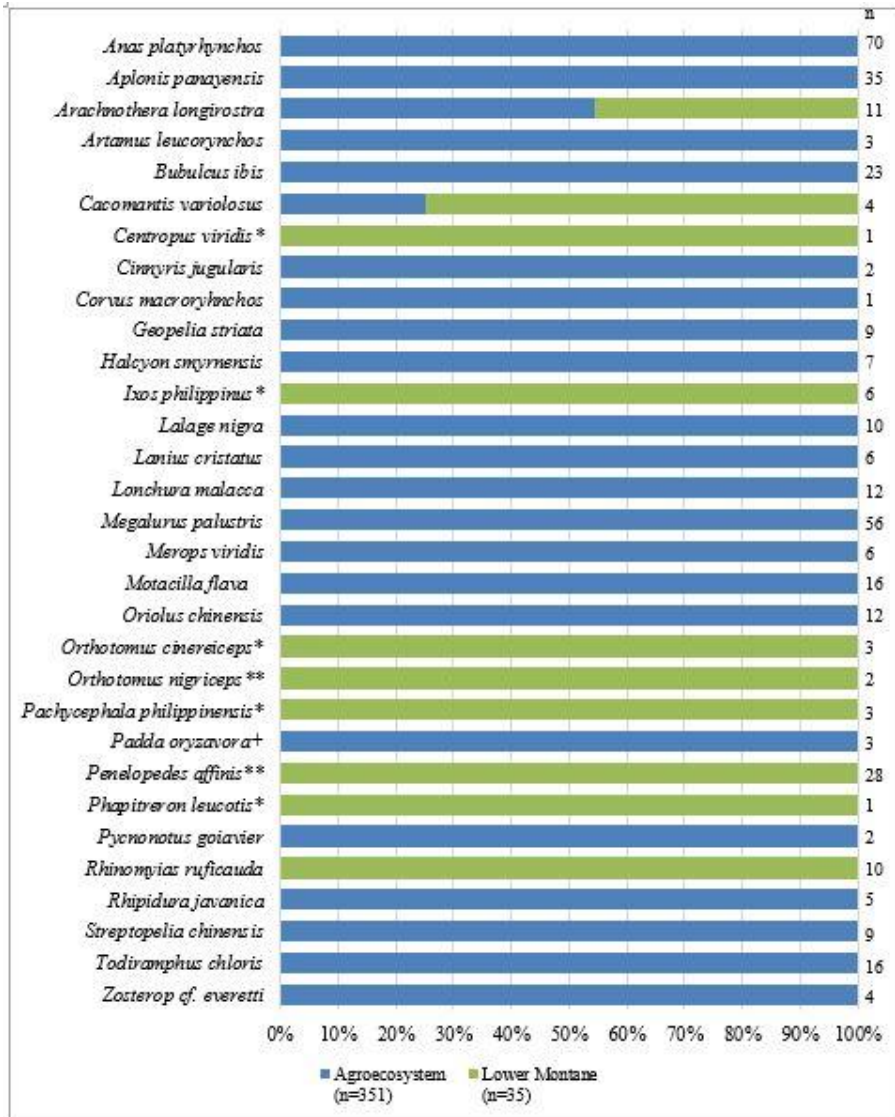
marker in saying that the area is diverse. Hence, the value of equitability was calculated to serve as reference for making a remark. The equitability was determined by calculating the ratio of the H' value the H' index theoretical value. An equitability value of one suggests the highest diversity while zero indicates the opposite.

## Results and Discussion

### *Assemblage and Diversity*

A total of 386 individuals classified into 23 families, grouped into 30 genera, and identified as 31 different species of birds were recorded. Of these, four species namely *Anas platyrhynchos* (n=70, 18%), *Lonchura malacca* (n=56, 15%), *Aplonis panayensis* (n=35, 9%), and *Padda oryzavora* (n=28, 7%) were the abundantly observed (Figure 2). These four species comprised 49% of the abundance proportion in the area. The high number of *A. platyrhynchos* is associated with its behavioural characteristics. These wild ducks are always in a group wherever and whenever they are (Kennedy et al., 2000), just like the other duck species. Meanwhile, the most prominent part in abundance is the high number of observations of the threatened species *Padda oryzavora*. The species is considered to fall under the vulnerable criterion of the IUCN assessment, yet it was among the most well-numbered bird in the area.

The overall avian faunal composition observed comprises 4.5% of the total species in the Philippines (n=691: Allen et al., 2017) and 0.3% based on the global records (n=10,000: Thayer, 2017). The totality is comparatively lower to the reports of Gracia et al. (2021) in Awasian Water Forest Reserve in Mt. Hilong-hilong (n=82); Calimpong & Nuñez (2015) in Bega Watershed, Prosperidad (n=83); Nuñez et al. (2017) in Mt. Matutum Protected Landscape (n=81); Lagat and Causareen (2019) in Upland Cavite (n=121); Amoroso et al. (2018) in Mt. Hamguitan Expansion Site (n=41); Mohagan et al. (2015) in Mt. Apo Long-Term Ecological Research site (n=38); and Alviola et al. (2010) in Malagos, Watershed, Davao del Sur (n=54). However, this low representation of birds in the area compared to the other sampled habitats across the Philippines, as mentioned above, does not necessarily mean that the site is poor in terms of bird assemblage. It is important to elucidate that as compared with other findings, just like in the case of Gracia et al. (2021), Nuñez et al. (2017), Mohagan et al. (2015), Alviola et al. (2010), and the rest of the studies, they had someone who



**Figure 2.** The proportion of species abundance across sampled habitats. Note: The species name with a single asterisk at the upper right denotes that the bird is a Mindanao Endemic. Two asterisks denote Philippine Endemic. Meanwhile, the plus sign means that the bird is a threatened species.

is actually well-versed in documenting the birds through vocalization. Others had access to more sophisticated tools that are used for birding, thus, maximizing the potential of observing more species in the area even if these are

not seen. On the contrary, the current study was highly dependent on documenting species through mist-netting, for it was the most reliable thing to do during that time. Also, although an ocular survey was also performed, but due to lack of mastery on bird identification, other observed species were counted as part of the data mortality to avoid the issue on uncertainty.

With regards to comparative ecological information between the sampled habitats, the agroecosystem was noted to hold more species ( $n=23$ ) than the lower montane forest ( $n=10$ ). Also, abundance was relatively higher in the agroecosystem comprising 91% ( $n=351$ ) of the total population than the lower montane, which covers only 9% ( $n=35$ ) of the accumulated record (Figure 2). Species diversity-wise, still, the agroecosystem had the highest values in terms of Shannon index ( $H'=2.64$ ) against the lower montane's value of  $H'=2.07$  (Table 1).

**Table 1.** Ecological information in two sampled vegetations and for the entire site of Mt. Pantaron.

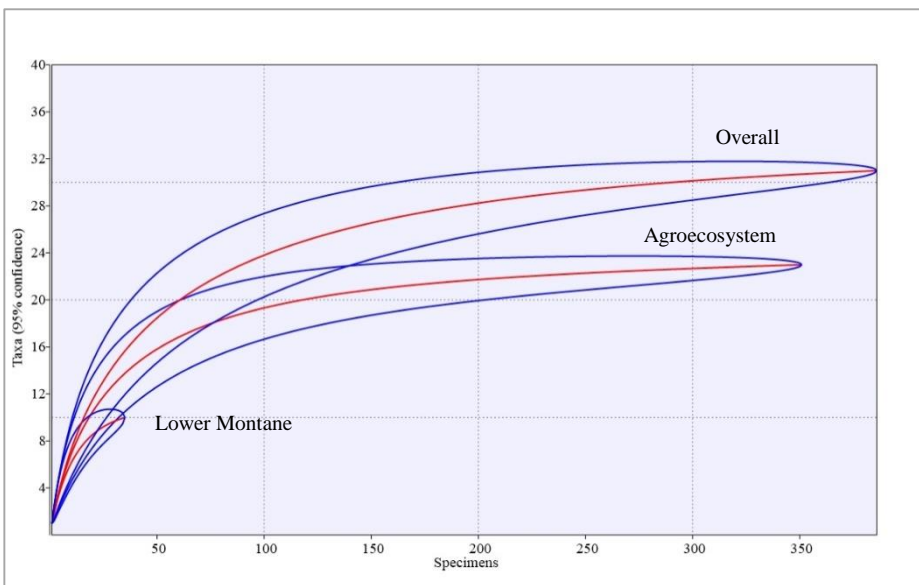
Ecological Information	Site		
	Agroecosystem	Lower Montane	Overall
Shannon-Weiner Diversity Index ( $H'$ )	2.64	2.07	2.87
Species Evenness ( $J'$ )	0.61	0.79	0.56
Species Dominance ( $D$ )	0.09	0.15	0.08
Equitability value	0.84	0.90	0.84

The high bird abundance in the agroecosystem was already expected, for it is usually a given idea (Harvey & Villalobos, 2007) as species commonly found in this type of habitat are generalist (Van Der Wal et al., 2012). Also, most of the time, the species inhabiting such areas are dominant ones with a wide distribution range (Tanalgo et al., 2015). However, the rest of the results opposed the commonly reported ecological scenario, such as in the studies of Mohagan et al. (2015), Barzan et al. (2015), and Laube et al. (2007) that forested areas are more species-rich and diverse habitats. Although at some point, it does align with the findings of Mulwa et al. (2012). Still, this study could not concur that the agroecosystem harbours more species than the lower montane. The primary reason for this aligns and lies on a single concept - the sampling limitation.

This result is a pure manifestation of the barriers observed during the conduct of the study. Unlike in the lower montane, the area in the agroecosystem is more open with fewer ocular barriers. Hence, the birds that were present at that time



were much easier to track and observe. When doing the actual visual survey in the lower montane, the high density and cover of shrubs and trees made it more challenging to see the birds. This claim is further supported by the reports of Maghuyop et al. (2000), Saguindang et al. (2002), and Dumalahay (2009) that dense and closed forest cover result in low bird counts. Although some familiar bird calls and bird appearances were noted, it was still not enough to contribute to the list. This limitation is clearly manifested in the simulated species rarefaction (Figure 3). As shown, the graph projection in the lower montane is way too small and suggests an increasing pattern. This graph entails that the data does not yet reach the saturation level; thus, the probability of observing more species in the area is still high. On the contrary, the graph representation for the agroecosystem is already projecting an asymptote pattern. This result entails data saturation. The graph further suggests that the chance of observing additional species is now lower.



**Figure 3.** Species rarefaction for the two sampled habitats and for the entire Mt. Pantaron.

On the other hand, despite the limitations incurred in the lower montane, the overall diversity index was recorded to be generally higher, with a Shannon-Weinner index of 2.87, equitability value of 0.84, and a level of dominance of only 0.08 (Table 1). The result suggests that Mt. Pantaron itself is an abode for avian fauna. However, species evenness-wise ( $J'$ ), the value is observed to be moderately even with  $J'=0.56$ . The species evenness is highly influenced by the

dominant species recorded in the agroecosystem, especially by these four dominant birds, namely *A. platyrhynchos*, *L. malacca*, *A. panayensis*, and *P. oryzavora*. Ecologically, the presence of dominant species affects the evenness of the community. The higher the number of dominant species and their representation (outliers), the lower the evenness would be. In relation to diversity, the lower the evenness, the diversity value would also fall, for it is directly proportional. But it is also crucial to point out this is just one of the components that contribute to diversity. Factors such as species richness and composition are also essential contributors that influence the diversity value. Thus, despite the presence of those dominant species, the area still holds high diversity. Further, a lot more species were noted to be evenly distributed within the community. Hence, those species outliers contributed only a minor fallback to the  $H'$  index. That is clearly observed through the obtained value on dominance ( $D = 0.08$ ) - another ecological measure that is inversely proportional to the Shannon Index.

#### *Feeding guilds*

The identified species were assessed based on their diet. Results revealed that the birds belong to six different feeding guilds. The well-represented group was the Insectivores with 16 species, followed by Frugivores ( $n=5$ ), Granivores ( $n=4$ ), Carnivores ( $n=3$ ), Nectivores ( $n=2$ ), and Omnivores ( $n=2$ ) (Figure 4). The findings suggest that the habitat has good ecological support that ranges from seed dispersal, pollination, pest control, and ecosystem re-constructing, which are an important component for any ecosystem to thrive (Heine & Speir, 1989; Kati & Sekercioglu, 2006). This is because the presence of different ecological niches is vital in any community for it supports each other to maintain the balance of the ecosystem (Tabur & Ayvaz, 2010; Law, 2019). Meanwhile, the high concentration of the insectivores is highly associated to the fact that most of the species are those found in the agroecosystem going to the forest edge, where insect diversity is noted to be high - a concept which is primarily anchored on the idea of the predator-prey relationship. At some point, this also explains why there was low to no representation of the large frugivores in the site - an observation which aligns to the report of Sekercioglu (2012). As mentioned, the sampling conducted was more biased on the agroecosystem due to various limitations. Also, knowing that the habitat is an open area dominated by grasses and sedges (reasons for observing granivores) where there were only limited fruit trees, the chance of documenting fruit-eating birds or even nectar-feeding and flower-pecking bird species was also limited. This is because bird assemblage is highly associated with food availability (Bhatt & Joshi, 2011).

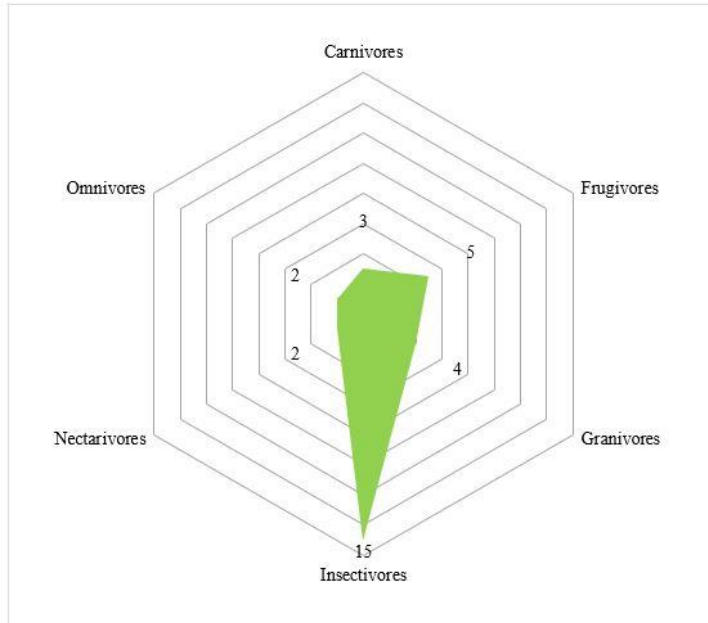
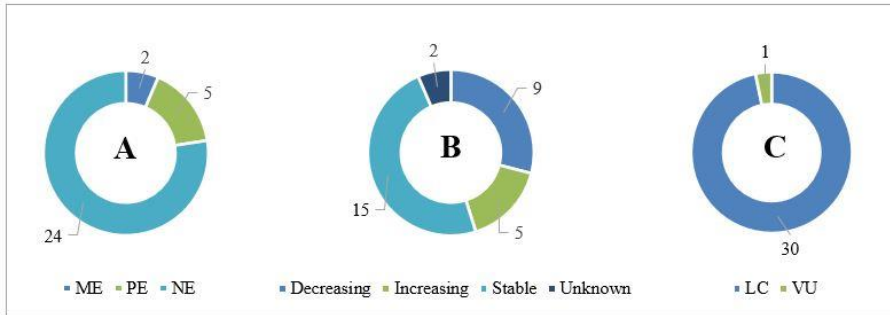


Figure 4. The distribution of the species in terms of their feeding guilds.

#### *Endemism, status, and threats*

Only seven endemic species of birds were noted, comprising 22% of the records. Five were geographically restricted in the Philippine archipelago (*Centropus viridis*, *Ixos philippinus*, *Orthotomus cinereiceps*, *Pachycephala philippinensis*, and *Phapitreron leucotis*), while two were restricted in the Mindanao faunal region (*Orthotomus nigriceps* and *Penelopedes affinis*) (Figure 5A). It was observed that despite the agroecosystem being the most species-rich habitat, not even a single endemic species was found in the area. All the endemic species, either Philippine or Mindanao endemic, were documented in the lower montane forest even with limited observation. This result suggests that highly specialized species are associated with a more intact forest and are most likely to shun areas with a high level of human disturbance (Dans & Gonzalez, 2010). The finding further suggests that a more extensive and intensive study with an increased focus on this type of vegetation is necessary because more endemic species are still waiting to be found.

In terms of conservation status, the species *P. oryzavora* is the only threatened species recorded. While for the population trend, a noteworthy remark is the documentation of the nine species with decreasing numbers based on the IUCN



**Figure 5.** Percentage distribution of species in term of Endemicity (A), Population Trend Status (B), and Conservation Status (C).

assessment (2021) (Figure 5B and 5C). These species include *Lalage nigra*, *Lanius cristatus*, *Motacilla flava*, *Oriolus chinensis*, *Pachycephala philippinensis*, *Padda oryzavora*, *Penelopides affinis*, *Rhinomyias ruficauda*, *Todiramphus chloris*, and *Zosterops cf. everetti*. The presence of these species in the area, including the endemic ones, suggests a call for conservation measures and management plans, especially that couple of threats were also noted in the site. These threats include habitat destruction through slash and burn (*Kaingin*), unregulated anthropogenic activities through bird hunting (*Pulot*), and trapping of birds with high economic demand like the threatened species *P. oryzavora* that are usually being traded in the nearby city. Also, considering the idea that the constructed road that cuts across the mountain range itself is about to open to the broader public. Thus, possible development in the area could lead to an environmental problem that will lead to species displacement if measures are not prepared in advance.

## Conclusion and recommendation

Based on the results, Mt. Pantaron is an ideal abode for various bird species. The area showed a high diversity value, diverse composition of ecological niche, and home to endemic birds, threatened, and those who have a declining population. With this, it is recommended that conservation initiatives for the area be considered, especially evident threats that could affect the area's biodiversity. Furthermore, a more rigorous study is suggested to further enhance the profiling of the birds in the area, particularly in the lower montane forest. These are highly necessary for crafting efficient and pragmatic conservation measures.

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