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Avifauna Assemblage in Apo Island, Negros Oriental, Philippines: Outcomes of a Community-based Biodiversity Monitoring Approach

Edmar R. Detecio[1] and Jean Henri M. Oracion[2]*

[1]OVE ARUP, Mandaluyong City 1550, Metro Manila, the Philippines
[2]Department of Biology, Negros Oriental State University,
Dumaguete City 6200 the Philippines

Apo Island belongs to the jurisdiction of the Municipality of Dauin, Negros Oriental, the Philippines, and it has been a part of long-term social and marine studies. However, information on the terrestrial ecosystem is lagging behind. The growing interest of the local community and organizations in terrestrial biodiversity led to the implementation of the biodiversity monitoring system (BMS). This was initiated by the protected area managers through the support of experts in the province. The enhanced BMS aims to equip the local community with knowledge on monitoring, as well as provide reliable baseline information for the protected area. With this effort, this paper provides baseline information initially on the birds of Apo Island, as they are valuable indicators of biodiversity. Birds are ecologically important species, and through their presence, it would be easy to evaluate for any changes in the ecosystem. Data was obtained through the line-transect and point-count method, and a 7-min observation was done at every 250-m point interval. Despite the relatively small land area, the survey specifically observed 27 species belonging to 21 families; nine of these are endemic to the Philippines, 16 are residents, and two are migrants. The island supports higher diversity and abundance, especially during the wet season. Furthermore, eight feeding guilds were also observed that can help shape the structure of other ecological communities. Most of the birds found in Apo Island are widespread in neighboring larger islands – indicative of an occurrence of local migration or colonization – and most of the birds recorded are of "least concern" conservation status. No island endemic is found. The different bird-feeding guilds observed imply various niches occupied that help shape the ecosystem. To better understand the distribution of the birds on the island, characterization of the habitat and quantifying its influence would be the best step forward.

Keywords: biodiversity, birds, citizen science, feeding guilds, island conservation, pied imperial pigeon, protected area

INTRODUCTION

Through the complex geological and climatic history of the Philippines, each island has fostered the independent evolution of a variety of species, resulting in substantial endemism, with 735 documented bird species to date (Allen *et al.* 2020; Myers *et al.* 2000; Brown *et al.* 2013). Located in the country is Apo Island in Negros Oriental. With its vast surrounding seas, it has been the subject of numerous social and marine studies. These studies date back to the 1950s when D.S. Rabor, a late biologist at Silliman University, began his research in Apo Island. Since then, the island has been labeled a "natural laboratory" among scientists for more than 50 years (Raymundo and White 2004).

*Corresponding author: jeanhenri.oracion@gmail.com

Islands can be described in many ways (King 2009), but a common feature is their isolated nature (Gillespie 2007). They have always been fascinating systems to study, leading to the formulation of profound ecological and evolutionary theories (Matthews *et al.* 2022). One fundamental criterion for characterizing the biodiversity of an area is the presence of endemic species (Bonanno 2013). Islands host a variety of bird species (Matthews *et al.* 2022); however, the number of species may not be as high compared to mainland biota. The biodiversity often lacks trophic complexity and functional diversity, which creates niches for other colonizing species. Over time, this strongly contributes to the formation of multiple functional roles in an ecosystem (Pearson 2009).

Birds are valuable indicators of changes in biodiversity patterns, providing key information for building conservation actions and assessing species extinction risks (Mallari *et al.* 2011; Mallari 2009). They are ecologically important and diverse organisms that can occupy isolated islands (Pearson 2009). To prevent their extinction, one effective method is the legal protection of areas (Lovejoy 2006), where collaborative efforts with local communities are vital to the sustainability of the area (Begon and Townsend 2021).

In the case of Apo Island, however, the terrestrial ecosystem remains understudied. In recent years, attention to terrestrial fauna – particularly birds – has garnered interest among the local community and people's organizations who are directly involved in ecotourism activities on the island. Bird data in Apo Island from the previous initial monitoring are delimited by the lack of reliable experts to verify records. This poses risks of bias due to the conduct of the monitoring with limited specialists from the Protected Area Management Office (PAMO), as well as issues related to the availability of up-to-date materials and resources from academic institutions and people's organizations. The site-specific implementation of the biodiversity monitoring system (BMS) faced these underlying concerns.

In response to these challenges, the BMS was enhanced through the initiatives of the PAMO and technical assistance of non-government organizations and academic institutions in 2022. This effort capitalized on the growing interest of the local community to provide them with a better understanding of environmental protection (Danielsen *et al.* 2003). The primary aim is to equip the various organizations – including local guides from the Apo Island Snorkeling Equipment Rental and Guiding Association, *barangay* representatives of Apo Island, volunteer groups, and offices from the Provincial Local Government Unit (LGU) of Negros Oriental – with the necessary knowledge. The representatives were provided with community-based monitoring methodologies such as bird identification, data collection, equipment utilization, and data analyses. This campaign, led by the Department of Environment and Natural Resources (DENR), aims to provide a more holistic protection of the island and its surrounding waters, guiding actions in protected area management.

With the data gathered through the ongoing BMS implemented in Apo Island, this study aims to present the initial bird records to address the gap in terrestrial biodiversity, emphasizing the contributions of citizen science. Additionally, this highlights the importance of the roles of diverse bird communities on the island.

MATERIALS AND METHODS

Site Description

Apo Island is part of the Mindanao Sea, about 7.5 km off the southeastern coast of Negros Island. It is located about 25 km southwest of Dumaguete City and is under the jurisdiction of the Municipality of Dauin, Negros Oriental (Figure 1). The island has a 72-ha land area with an elevation of 200 m above sea level (Raymundo 2002). The volcanic origin of the island provided two major topographic features: the hilly cape comprising the southern and northern terrain and a stretch of moderately flat lowlands in the middle.

The northern terrain is characterized by a moderately subdued plateau divided by rugged ridges and steep, sharp cliff edges along the coast facing the sea measuring up to more than 20 m high, whereas the southern terrain is mainly composed of uneven volcanic rocks that display steep sea cliffs along its edges. Interspersed along the two prominent terrains are the moderately flat lowlands where beaches are also located. The highest elevation on the island is situated in the northern part, which measures up to 200 m above sea level. The island coastline, which consists of steep rocky cliffs and seven beaches, is about 4.5 km long.

The total land area consists of 25.83 ha of areas intended for multiple uses, including residential, commercial, and agricultural purposes, whereas 46.17 ha constitute the different habitat types (*i.e.* grass, shrubs, lowland forest patches, beach forest, wetland areas, other vegetative cover).

Bird Surveys

The data presented are from records collected in 2022 and 2023 through the collaboration of the researchers, citizen science, and the Apo Island Protected Landscape and Seascape (AIPLS) PAMO during the establishment and

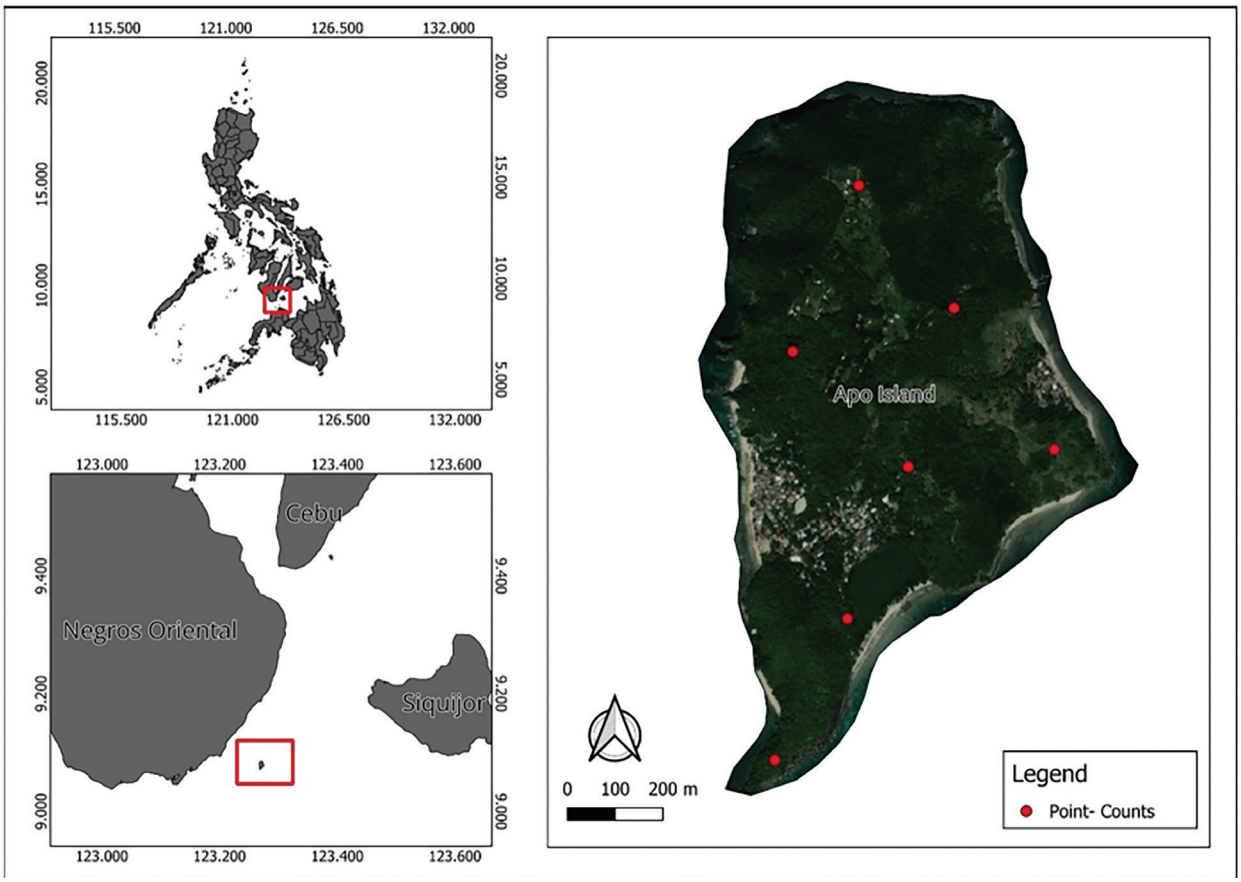

Figure 1. Map showing the location of the Apo Island relative to its neighboring islands. Generated in QGIS software.

implementation of their BMS. Monitoring during the dry season was conducted in February 2022 and March 2023, whereas monitoring during the wet season was conducted in August 2022 and September 2023, thus encompassing the onset of southward migration (Tan *et al.* 2023).

A synchronous survey was employed to traverse the transects simultaneously, which began at 06:00 AM to around 07:00 AM in the morning. We used a combination of line-transect and point-count methods to record the birds from a distance. There are three transect lines established: two of the lines have a length of 250 m, and one is 500 m long with a limited width of 100 m. Point counts along transects were designated at every 250 m with a 50-m radius (100-m diameter) to observe birds for 7 min. A total of seven counting stations were placed. This is to avoid counting birds outside the sampling area, which may lead to overestimation (BMB and GIZ 2017). Each of the lines was placed in the northern, eastern, and southern directions of the island. Since the area sizes of the different habitat types are not considerably large, the transect lines could pass across them. This setup also allows effective coverage of the area.

To check for seasonal variability, the survey was done during wet and dry seasons. All birds observed outside the transects were excluded from succeeding analysis but were retained for further description.

Ultimately, feeding guilds were identified by counting the number of birds belonging to which guild, namely insectivore, frugivore, vertivore, omnivore, invertivore, granivore, nectarivore, and herbivore. This categorization was based on the birds' bill type, with support from identification guides and online databases (*e.g.* IUCN). Lastly, a brief description of some notable species is provided at the end.

Data Analysis

Statistical analyses were performed in R studio and PAST statistical software. The analyses used include the species rarefaction curve with confidence intervals, Shannon-Wiener diversity index, and Simpson's evenness to summarize the two-year dataset. Relative abundance is also added to determine how frequently each species was observed between seasons. Lastly, the chi-squared test for proportion was used to test whether overall bird abundance is influenced by seasonal changes.

RESULTS

The survey on birds in Apo Island documented 27 species belonging to 21 families; nine of these are endemic species to the Philippines, 16 are resident, and five species are migrants (Table 1). The family that consists of the highest number of species is Columbidae, and the rest are represented by a few species. Most of the species observed have a conservation status of "least concern" (LC), except for one – the streaked shearwater (*Calonectris leucomelas*), which is classified as "near-threatened" (NT).

In terms of species richness, the rarefaction curve (Figure 2) shows a minimal confidence interval and a slightly upward trend. It can be seen that it is approaching an asymptote, suggesting that a bit more sampling is required.

A summary of the data reveals a general trend in diversity matrices (Figure 3); they tend to be lower during the dry season and increase during the wet season. Standard error values indicate consistent effective sampling of birds on the island, capturing similar variability in each sampling period. The highest number of species was 24 recorded in August 2022, with other months showing a

Table 1. List of bird species observed in Apo Island. Endemism is denoted as follows: [E] endemic; [R] resident; [M] migrant. Conservation importance is described as follows: [LC] least concern; [NT] near threatened. These descriptions are based on IUCN. The (*) indicates that the bird was excluded from further statistical analyses.

No.	Species name	Common name	Endemicity	IUCN status	Feb 2022 (dry)	Aug 2022 (wet)	Mar 2023 (dry)	Sep 2023 (wet)
	Acanthizidae							
1	*Gerygone sulphurea*	Golden-bellied gerygone	R	LC		✓	✓	✓
	Alcedinidae							
2	*Todiramphus chloris*	White-collared kingfisher	R	LC	✓	✓	✓	✓
	Apodidae							
3	*Collocalia esculenta*	Philippine glossy swiftlet	E	LC		✓	✓	✓
4	*Collocalia troglodytes*	Pygmy swiftlet	E	LC		✓		
	Ardeidae							
5	*Nycticorax nycticorax*	Black-crowned night heron	R	LC		✓		
6	*Egretta garzetta**	Little egret	M	LC				✓
7	*Butorides striata*	Striated heron	R	LC		✓		
	Artamidae							
8	*Artamus leucorynchus*	White-breasted woodswallow	R	LC	✓	✓		✓
	Campephagidae							
9	*Lalage nigra*	Pied triller	R	LC	✓	✓	✓	
	Columbidae							
10	*Chalcophaps indica*	Common emerald dove	R	LC	✓			
11	*Treron axillaris*	Philippine green pigeon	E	LC		✓	✓	✓
12	*Ducula bicolor*	Pied imperial pigeon	R	LC	✓	✓	✓	✓
13	*Treron vernans*	Pinked-necked green pigeon	R	LC		✓	✓	
14	*Streptopelia chinensis*	Spotted dove	R	LC	✓	✓	✓	✓
15	*Geopelia striata*	Zebra dove	R	LC	✓	✓	✓	✓
	Cuculidae							
16	*Centropus viridis*	Philippine coucal	E	LC	✓	✓	✓	✓
17	*Eudynamys scolopaceus*	Western koel	R	LC	✓	✓	✓	✓
	Laniidae							
18	*Lanius cristatus*	Brown shrike	M	LC		✓		✓
	Meropidae							

Table 1. Cont . . .

No.	Species name	Common name	Endemicity	IUCN status	Feb 2022 (dry)	Aug 2022 (wet)	Mar 2023 (dry)	Sep 2023 (wet)
19	*Merops philippinus*	Blue-tailed bee eater	R	LC		✓		
	Muscicapidae							
20	*Copsychus mindanensis*	Philippine magpie robin	E	LC	✓		✓	✓
	Nectariniidae							
21	*Cinnyris jugularis*	Olive-backed sunbird	E	LC		✓	✓	✓
	Oriolidae							
22	*Oriolus chinensis*	Black-naped oriole	E	LC	✓	✓	✓	✓
	Passeridae							
23	*Passer montanus*	Eurasian tree-sparrow	R	LC	✓	✓	✓	✓
	Phylloscopidae							
24	*Phylloscopus borealis*	Arctic warbler	M	LC	✓	✓		
	Pycnonotidae							
25	*Pycnonotus goiavier*	Yellow-vented bulbul	E	LC		✓		✓
	Rallidae							
26	*Hypotaenidia torquata*	Barred rail	R	LC			✓	✓
	Rhipiduridae							
27	*Rhipidura nigritorquis*	Philippine pied fantail	E	LC	✓	✓	✓	✓
	Sturnidae							
28	*Aplonis panayensis*	Asian glossy starling	R	LC	✓	✓	✓	✓
	Procellariidae							
29	*Calonectris leucomelas**	Streaked shearwater	M	NT				✓
	Muscicapidae							
30	*Monticola solitarius**	Blue rock-thrush	M	LC	✓			

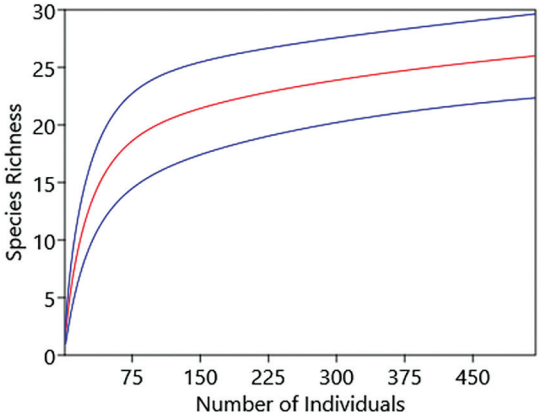

Figure 2. Species rarefaction curve (red) with confidence interval (blue) showing the result of the sampling effort.

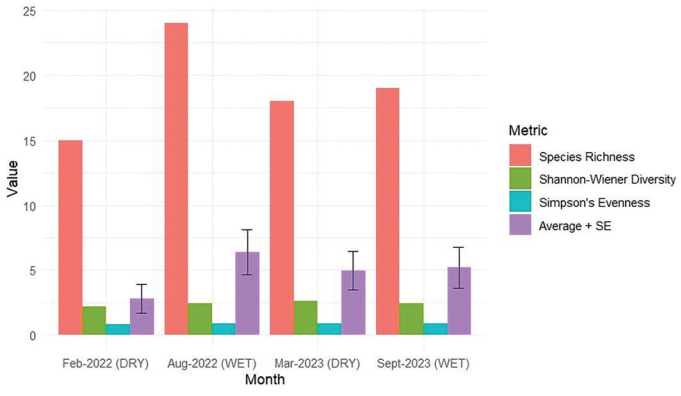

Figure 3. Summary of bird diversity over the two years of monitoring.

relatively consistent number of species observed – proof of consistent bird sampling with minor fluctuations in the area.

In addition, the chi-square test for proportion showed a statistically significant difference in bird abundance across seasonal changes (χ^2 = 17.81; *p*-value = 0.00002). The graph shows a greater abundance during the wet season than in the dry season. The majority of the species are present throughout the duration of the survey, except for a few such as the striated heron (*Butorides striata*), common emerald dove (*Chalcopaps indica*), pygmy swiftlet (*Collocalia troglodytes*), blue-tailed bee-eater (*Merops philippinus*), and black-crowned night heron (*Nycticorax nycticorax*) (Table 1).

In terms of the abundance of each species between seasons (Figure 4), the birds that appear to be consistently high are the Asian glossy starling (*Aplonis panayensis*), zebra dove (*Geopelia striata*), and pied imperial pigeon (*Ducula bicolor*). While the common emerald dove (*Chalcophaps indica*), black-crowned night heron (*Nycticorax nycticorax*), striated heron (*Butorides striata*), Arctic warbler (*Phylloscopus borealis*), barred rail (*Hypotaenidia torquata*), brown shrike (*Lanius cristatus*), and Philippine magpie-robin have the lowest counts. The relative abundance trends for both seasons, however, do not show any recognizable consistent pattern. Some species have high abundance in the dry season and low in the wet season, whereas some show the opposite arrangement.

Feeding Guilds

There are several feeding guilds of birds residing on the island. The survey identified eight groups, and some species may not be exclusive to only one guild. Insectivorous birds (n = 13) were observed to be the most numerous, followed by frugivorous and omnivorous

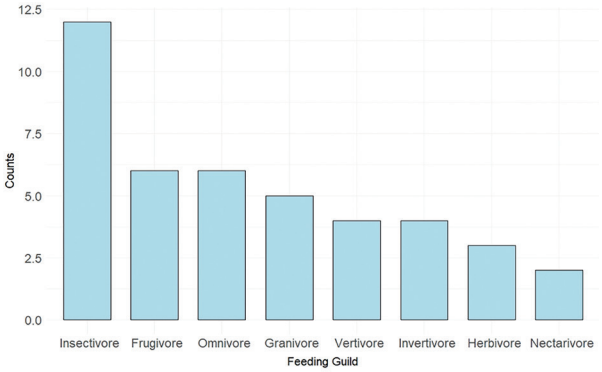

Figure 5. Avian feeding guilds observed in Apo Island. Insectivorous birds are the most abundant.

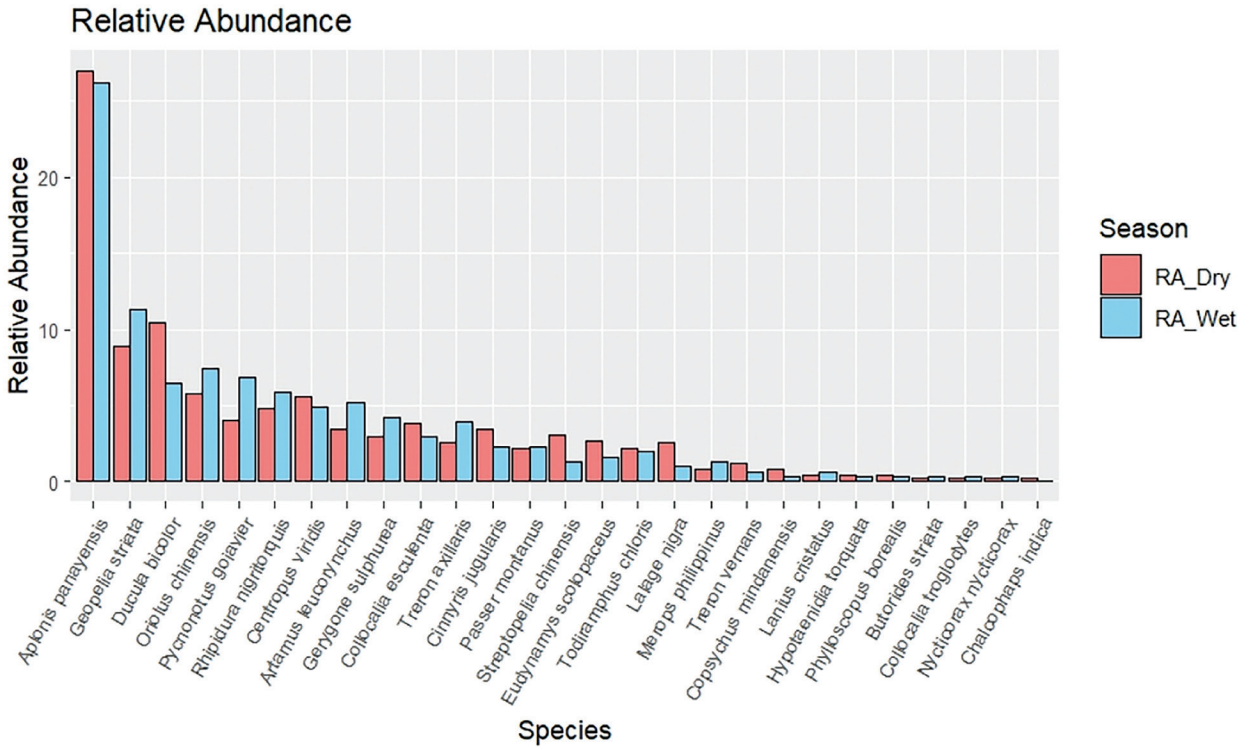

Figure 4. Relative abundance of bird species calculated between dry and wet seasons from the two-year period data collection.

species (n = 6 each), with granivorous birds next (n = 5). Vertivorous and invertivorous birds followed (n = 4 each). Herbivorous birds (n = 3) and nectarivorous birds (n = 2) were the least represented.

DISCUSSION

The bird diversity determines the importance of an area. Of the birds observed during the transect surveys, there are 27 species with LC status recorded in Apo Island. The majority of the species were consistently present on the island, whereas four were recorded only once. The abundance of birds displayed close association with changes in seasons, wherein there is greater abundance during the wet season, as food sources such as fruits and insects tend to become more prevalent (Silva *et al.* 2011; Griz and Machado 2001). Also, there are considerable lowland forest patches connecting other habitat types that make it suitable for birds to thrive in. Notably, these birds are found almost ubiquitously and do not appear to be restricted by the different habitat types composing Apo Island, nor does the elevation create a gradient on the species composition. They are even found in parts where the local community is situated, perhaps engaging in commensal interaction with them.

Meanwhile, few migratory waterbirds were observed, despite the Philippines being part of the East Asian-Australasian Flyway (Tan *et al.* 2023). According to Bairlein (2003), migration is determined by physiology, weather, conspecifics, other species, competition, predation, parasites, time, season, and age many of which may be at play on the island. It could also be attributed to the limited wintering grounds (Murphy *et al.* 2001) in the area, especially since these birds occupy mudflats. Moreover, a large portion of the coastal area is frequently hit by waves, which might not even serve as a suitable feeding ground. Food does not seem to be the issue, as the marine ecosystem is well protected and maintained by the community. Nonetheless, it is still suspected that there could be more interesting pelagic birds feeding on the sea outside the borders of the protected area.

Islands can be categorized into many types (Ali 2018), and it is common knowledge in biology that unique fauna can arise on islands due to isolation (Gillespie 2007). However, no endemic birds were found to exist exclusively in Apo Island. Most of these species do not seem to be the specialized ones living in restricted habitats and ranges and are even ubiquitous on the nearby larger islands associated with the lowlands (*e.g.* Negros, Siquijor, Cebu, Mindanao). This is based on a priori knowledge from the birds listed in studies conducted by Brooks *et al.* (2002), Paguntalan *et al.* (2004), Bucol and Bucol (2007), and Paguntalan *et al.* (2011). This distribution suggests that birds moving from nearby islands have successfully colonized Apo Island or they may have been accidentally introduced there. However, in terms of species richness, Apo Island has fewer species compared to nearby islands with more heterogeneous habitats and larger areas available for birds.

Functional diversity on the island is well represented by a variety of bird-feeding guilds, where their presence is fundamental in shaping the community structure of other species. Over time, this strongly contributes to the formation of multiple functional roles in an ecosystem and biological interconnectivity (Pearson 2009). The findings of this study are contrary to the established theory that islands tend to lack trophic complexity and functional diversity (Pearson 2009). The diverse presence of birds on the island, despite the small land area, might be explained by the variety of food resources available, or the distance from the mainland may not be sufficient to create isolation. Moreover, many of these birds are capable of consuming various food sources and, thus, can be classified into multiple feeding guilds.

Insectivorous birds are the most abundant among the others, and could potentially be attributed to the abundance of insects on the island. Insectivorous birds are known to be the most common in the tropics. Arthropods normally exhibit a considerable abundance on an island, with an increase during the wet season (Silva *et al.* 2011). This might be the underlying reason why most of the residing bird species mainly forage on insects, as they could help maintain the insect population.

On the other hand, phytophagous birds, particularly frugivorous and granivorous species, as well as omnivorous ones, are vital in seed dispersal. The species that most notably represent this feeding guild include species under the family Columbidae, among others. Their roles are considerably relevant in fostering vegetational heterogeneity in the island (Nogales *et al.* 2024). Specifically, studies show that omnivorous birds play keystone roles in maintaining a balance between plant-animal communities (Carlo and Morales 2016). However, the tropical island climate poses challenges for plant growth. Even the locals have faced similar issues, failing to plant trees in scrubland parts to expand vegetation cover (E. Detecio, pers. comm., June 2022). Lastly, despite being an Island, very few bird species are found capable of hunting macroinvertebrates and fishes, such as the birds under the family Ardeidae and Alcidinidae considering the vastness of the marine reserve around Apo Island.

Even though most of the birds observed so far are not of high conservation importance, this does not imply that the terrestrial ecosystem should be neglected. Birds inhabit this area as a place of refuge, likely due to readily

available resources that influence their distribution such as cover, water, and food (Mengesha and Bekele 2008). Therefore, any form of reducing the forest cover may alter the population size of certain species (Mallari *et al.* 2011). The climate on islands is also a key factor that dictates how vegetation is structured. Changes in the precipitation patterns are unpredictable, which could promote natural disturbances leading to the destruction of the habitat and increase the mortality of fauna species associated with it (Caujapé-Castells *et al.* 2010).

This information gathered so far through community-based monitoring may be used to alert the authorities of any changes in the ecosystem. Nonetheless, it is recognized that enforcement of policies and management in the area remains consistent despite changes in political leadership (Raymundo 2002). With the aid of the DENR, which has adopted a more inclusive approach by encouraging citizen science, they have successfully protected both land and seascape over the years. This implies that the island indeed provides a secure reserve for the birds, highlighting the importance of continued conservation efforts to maintain its ecological integrity.

Species Accounts

This section highlights only two notable species in Apo Island, namely the pied imperial pigeon (*Ducula bicolor*) as the flagship species and the near-threatened streaked shearwater (*Calonectris leucomelas*). The pied imperial pigeon is described to be the flagship species of Apo Island for its charismatic appearance, and it easily stands out because of its bright coloration (Figure 6). They can be used as effective conservation tools that easily attract the attention of the public due to their recognizable features. It is often observed singly, or in small groups of at least two to five individuals, often found perched in exposed branches of trees in the proximity of the beach. In Apo Island, they utilize different microhabitat types in the island including farm lots, beach forests, and mixed grassland areas. This species is observed flying out southward in the early morning and congregating back on the island by early dusk.

Figure 6. Photo documentation of the pied imperial pigeon (*Ducula bicolor*), the flagship species of Apo Island.

The Apo Island also has attracted a migratory seabird species that was not recorded in the past. Two individuals of streaked shearwater (*C. leucomelas*) were initially observed beyond the monitoring of wet season in 2021 (September). In 2022, a single individual was observed during the monitoring activities hovering above the Baybay Reef, just fronting the protected area office located in the western portion of the island.

CONCLUSION

Apo Island, despite its small land area, supports a diverse range of bird species. This diversity may not solely be due to isolation, as many of these species are also found on neighboring islands, particularly in the lowland areas. Some of these birds might have been introduced to the island. The greater bird diversity and abundance during the wet season suggests that food availability, which likely increases during the wet season, plays a significant role. Migration is unlikely to be a major factor, as only a few migrants were observed, contributing minimally to seasonal changes in diversity and abundance. The diverse bird species on Apo Island, each occupying various ecological niches, contribute to shaping the island's ecological community. This underscores Apo Island's importance not only as a habitat for various bird species but also as a crucial component of broader ecosystem dynamics. Therefore, unwavering protection of the island is essential. Integrating knowledge from biological and social sciences, along with engaging citizen science, is crucial for the sustainability of this conservation effort.

RECOMMENDATION

For further improvement of the island's ecosystem, locals recommend planting native fruiting trees that can thrive in the microclimate to serve as a food source for the birds. For further research, it is recommended to include measuring environmental parameters and habitat characterization to help explain the factors driving bird distribution on the island, delineating the niches they occupy. Additionally, other terrestrial fauna should be studied to gain a more comprehensive understanding of the island's fauna assemblages, potentially discovering other endemic species not identified in this study.

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REFERENCES

ALI JR. 2018. Islands as biological substrates: continental. Journal of Biogeography 45(5): 1003–1018.

ALLEN D, BERRYMAN A, BRADSHAW C, LANGLEY N. 2020. Birds of the Philippines. Lynx.

BAIRLEIN F. 2003. The study of bird migrations – some future perspectives. Bird Study 50: 243–253.

BEGON M, TOWNSEND CR. 2021. Ecology: from individuals to ecosystems. John Wiley and Sons.

[BMB] Biodiversity Management Bureau, [GIZ] Deutsche Gesellschaft für Internationale Zusammenarbeit. 2017. Manual on biodiversity assessment and monitoring system for terrestrial ecosystems. Manila, the Philippines. p. 1–11.

BROWN RM, SILER CD, OLIVEROS CH, ESSELSTYN JA, DIESMOS AC, HOSNER PA, LINKEM CW, BARLEY AJ, OAKS JR, SANGUILA MB, WELTON LJ, BLACKBURN DC, MOYLE RG, TOWNSEND PETERSON A, ALCALA AC. 2013. Evolutionary processes of diversification in a model island archipelago. Annual Review of 202 Ecology, Evolution, and Systematics 44: 411–435. https://doi.org/10.1146/annurev-ecolsys-110411-160323

BONANNO G. 2013. Adaptive management as a tool to improve the conservation of endemic floras: the case of Sicily, Malta and their satellite islands. Biodiversity and Conservation 22: 1317–1354.

BUCOL AA, BUCOL AB. 2007. An assessment on the status and distribution of endemic and threatened birds of Siquijor Island, Philippines. Silliman Journal 48(1).

BROOKS TM, EVANS TD, DUTSON GC, ANDERSON GQ, ASANE DC, TIMMINS RJ, TOLEDO AG. 1992. The conservation status of the birds of Negros, Philippines. Bird Conservation International 2(4): 273–302.

CARLO TA, MORALES JM. 2016. Generalist birds promote tropical forest regeneration and increase plant diversity *via* rare-biased seed dispersal. Ecology 97(7): 1819–1831.

CAUJAPÉ-CASTELLS J, TYE A, CRAWFORD DJ, SANTOS-GUERRA A, SAKAI A, BEAVER K, LOBIN W, FLORENS FBV, MOURA M, JARDIM R, GÓMES I, KUEFFER C. 2010. Conservation of oceanic island floras: present and future global challenges. Perspectives in Plant Ecology, Evolution, and Systematics 12(2): 107–129.

DANIELSEN F, MENDOZA MM, ALVIOLA P, BALET, DS, ENGHOFF M, POULSEN MK, JENSEN AE. 2003. Biodiversity monitoring in developing countries: what are we trying to achieve? Oryx 37(4): 407–409.

[DENR-XI] Department of Environment and Natural Resources Region 9 Office. 2022. DENR XI conducts PA benchmarking in Apo Island and Balinsasayao Twin Lakes. Retrieved from https://r11.denr.gov.ph/index.php/news-events/press-releases/1491-denr-xi-conducts-pa-benchmarking-in-apo-island-and-balinsasayao-twin-lakes

GILLESPIE RG. 2007. Oceanic islands: models of diversity. Encyclopedia of Biodiversity. p. 590–599.

GRIZ LMS, MACHADO ICS. 2001. Fruiting phenology and seed dispersal syndromes in Caatinga, a tropical dry forest in the northeast of Brazil. Journal of Tropical Ecology 17(2): 303–321.

KING R. 2009. Geography, islands, and migration in an era of global mobility. Island Studies Journal 4(1): 53–84.

LOVEJOY TE. 2006. Protected areas: a prism for a changing world. Trends Ecol Evol 21: 329–333.

NOGALES M, MCCONKEY KR, CARLO TA, WOTTON DM, BELLINGHAM PJ, TRAVESET A, GONZÁLEZ-CASTRO A, HELENO R, WATANABE K, ANDO H, ROGERS H, HEINEN JH, DRAKE DR. 2024. A review on the state of the art in frugivory and seed dispersal on islands and the implications of global change. The Botanical Review. p. 1–26.

MALLARI NA, COLLAR N, LEE DC, MCGOWAN PJK, WILKINSON R, MARSDEN SJ. 2011. Population densities of understorey birds across a habitat gradient in Palawan, Philippines: implications for conservation. Oryx 45: 234–242.

MALLARI NAD. 2009. Maximising the value of ecological and socio-economic data in support of conservation

planning for key understorey bird species in Palawan, Philippines [doctorate dissertation]. Manchester Metropolitan University, Manchester, UK.

MENGESHA G, BEKELE A. 2008. Diversity and relative abundance of birds of Alatish National Park, North Gondar, Ethiopia. International Journal of Ecology and Environmental Sciences 34(2): 215–222.

MATTHEWS TJ, WAYMAN JP, CARDOSO P, SAYOL F, HUME JP, ULRICH W, TRIANTIS KA. 2022. Threatened and extinct island endemic birds of the world: distribution, threats, and functional diversity. Journal of Biogeography 49(11): 1920–1940.

MURPHY MT, PIERCE A, SHOEN J, MURPHY KL, CAMPBELL JA, HAMILTON DA. 2001. Population structure and habitat use by overwintering neotropical migrants on a remote oceanic island. Biological Conservation 102(3): 333–345.

MYERS N, MITTERMEIER RA, MITTERMEIER CG, DA FONSECA GA, KENT J. 2000. Biodiversity hotspots for 236 conservation priorities. Nature 403: 853–858. DOI: 10.1038/35002501

PAGUNTALAN LMJ, JAKOSALEM PGC, PEDEGROSA MG, CATACUTAN MJG. 2004. A study on the birds of small islands off the coast of Cebu Island, Philippines. Silliman Journal 45(2).

PAGUNTALAN LMJ, JAKOSALEM PG, LAGERQVIST M, NORDIN J, FERNANDEZ G, DE LA CRUZ M, BAYSA A. 2011. Bird observations on the Zamboanga Peninsula, Mindanao, Philippines. Forktail 27: 15–22.

PEARSON DE. 2009. Biological invasions on oceanic islands: implications for island ecosystems and avifauna. In: Seabirds in danger: invasive species and conservation of island ecosystem. p. 3–16.

RAYMUNDO LJ. 2002. Community-based coastal resources management of Apo Island, Negros Oriental, Philippines: history and lessons learned. In: Report from the first ICRAN regional workshop on experience sharing between demonstration and target sites in the East Asian seas; 26–27 Aug 2002.

RAYMUNDO LJ, WHITE AT. 2004. 50 years of scientific contributions of the Apo Island experience: a review. Silliman Journal 45(2).

SILVA NAPD, FRIZZAS MR, OLIVEIRA CMD. 2011. Seasonality in insect abundance in the" Cerrado" of Goiás State, Brazil. Revista Brasileira de Entomologia 55: 79–87.

TAN HZ, NYANASENGERAN M, DY IC. 2023. Frequent, year-round monitoring reveals significant shorebird abundances in northern Manila Bay, Philippines. Wader Study 130(3): 000–000. DOI: 10.18194/ws.00319