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Cover: Common Keeled Skink *Eutropis carinata* in oil pastels, colour pencils, & micron pen adapted from photograph by H. Byju © Pooja Ramdas Patil.

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Avifaunal diversity in urban greenspaces within Cotabato city, Mindanao Island, Philippines

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Abstract: Information about the diversity of avifauna in urban green spaces in the Philippines needs to be more extensive. More so, data on birds in green spaces of the country's Bangsamoro Region in Muslim Mindanao (BARMM) remain largely unreported. This gap highlights the need to document the avifaunal diversity in the urban green spaces of Cotabato City. Bird species were accounted for using the point count method from September to December 2021 in three different urban green spaces within the commercial center of Cotabato City. Twenty-one avian species representing 17 families were documented. Among the surveyed three green spaces within Cotabato City, Notre Dame University (NDU) has the highest species richness (N = 20), followed by PC Hill (N = 14), and Mother Barangay Rosary Heights (N = 9). Of the 21 species of birds documented, 19% are Philippine endemic, and all of these were recorded only at Notre Dame University. Data from the present study suggest the capacity of green spaces in urban Cotabato City to cater to different bird species, including the endemic ones. Since the results present preliminary data, intensive surveys can be done on these sites by future researchers. Also, surveying more urban green spaces in Cotabato City may add information on the city's urban birds. Substantial data from these future surveys may be helpful in the urban planning of Cotabato.

Keywords: BARMM, birds, city planning, critically endangered, ecological value, endemic, species richness, urban areas, vegetation.

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INTRODUCTION

Urban green spaces are locally fragmented and patchy vegetation areas within the city (Li et al. 2019) that provide habitats for different fauna, especially birds (Leveau et al. 2019). These areas come in various forms, including lakes, parks (Sulaiman et al. 2013; Yang et al. 2020), gardens (Parker et al. 2013), school campus vicinity (Ong et al. 1999; Vallejo & Aloy 2014), and hills (Jha 2019; Banzon et al. 2022). Moreover, urban green spaces provide ecosystem services ranging from regulating services (e.g., erosion control) to socio-cultural services (e.g., recreation) (Sultana & Selim 2021). In the Philippines, urban green spaces have been noted to provide opportunities for physical exercise and recreation among city residents (Saloma & Akpendonu 2022).

The island of Mindanao is home to endemic, vulnerable, and economically important species in the Philippines (Amoroso 2000; Tanalgo et al. 2023). Most of these species are birds according to several accounts on the island, which were recorded mostly from Agusan, while information regarding the matter was scant in the Bangsamoro region (Agduma et al. 2023; Cruz et al. 2023). Progressive human activities related to urbanization further put endemic and vulnerable bird species at risk in Mindanao (Bett et al. 2017; Agduma et al. 2023). Habitat loss due to urbanization is one among the drivers of diversity decline (Daipan 2021). Urban green spaces are possible means to find a way around deforestation and related threats especially in already urbanized areas (Wolff et al. 2018). The said urban vegetation may support conservation of birds (Cruz et al. 2023), as it harbors different birds in terms of endemicity depending on habitat type related to the degree of disturbance and land-use (Tanalgo et al. 2015, 2019). Among all wildlife fauna, birds directly benefit from urban green spaces (Muhlbauer et al. 2021; Prihandi & Nurvianto 2022). There are studies done in the Philippines documenting the presence of birds in various urban green spaces (Vallejo & Alloy 2014; Banzon et al. 2022). However, these studies were limited and data can be considered as not encompassing since it covers only limited areas in the country. Thus, there is a need to conduct bird surveys in other urban green spaces in Mindanao, especially in a less studied region of the island such as in the Bangsamoro Autonomous Region Muslim in Mindanao (BARMM).

Cotabato City is an urban area in the BARMM. It is located between the Rio Grande de Mindanao and the Tamontaka River, which makes it a catch basin of floodwater from the Ligawasan marsh in Maguindanao. Ironically, the region is rich in flora and fauna, however, published biological studies in the area remain scanty to date. The latter may be attributed to past and ongoing sociopolitical conflicts in the region. Recently, De Vera et al. (2023) documented 33 non-endemic and 10 endemic bird species from Timaco Hill, an isolated hill considered as Cotabato City's remaining pristine forested area. This study aims to determine the bird species and their diversity in selected urban green spaces within Cotabato City. The local government units and other government and private agencies may benefit from this study by formulating policies and plans that may support wildlife species such as birds within Cotabato City.

MATERIALS AND METHODS

Selection and size estimate of the urban green spaces surveyed

Selected urban green spaces within the commercial center of Cotabato City, Maguindanao del Norte, Philippines were surveyed in this study. The Notre Dame University (NDU), Mother Barangay Rosary Heights (MBRH), and PC Hill were the sites surveyed for birds and were at least 1.25 km (± 0.29) away from each other. These sites were selected based on accessibility, the presence of vegetation patches, and the absence of data on birds (Image 1). Before the survey, permits to enter and consent to conduct the bird survey were secured from the land managers and pertinent offices. All study sites were situated in the commercial area of Cotabato City. Each study site has a unique vegetation and level of disturbance. To determine the approximate land size, GPS coordinates of the perimeter of each urban green space were obtained. Thereafter, the coordinates were plotted on a digital map, then a polygon was drawn and used to determine the size of the surveyed area. The urban green spaces surveyed were described accordingly.

Notre Dame University (NDU)

The Notre Dame University (NDU) (7.2172N, 124.2438W) is characterized by open field with patches of vegetation. Compared to the other urban green spaces surveyed in this study, the NDU has more open spaces. Some sections of manmade paths were covered with large trees such as Acacia and *Albizia saman*. The open spaces were surrounded by infrastructures such as classrooms. The daytime population of NDU is approximately 4,000 which includes students, faculty, staff, and other employees.

Image 1. Location map showing the three urban green spaces surveyed in Cotabato City. (Map generated from QGIS 3.24.1).

PC Hill

The PC Hill (7.2198, 124.2445) is characterized by a secondary growth forest patch. It has one of the highest elevations within the Cotabato City (59 m) along with the Timaco Hill. Trees such as Acacia, *Albizia saman*, and Mahogany *Swietenia mahogani* and grasses and sedges are common along the concrete roads. Residential infrastructures are common in the area with the presence of common fruit-bearing trees such as Mango *Magnifera indica* and Guava *Psidium guajava L.* Vehicles and motorcycles were common in the area.

Mother Barangay Rosary Heights (MBRH)

The Mother Barangay Rosary Heights (MBRH) (7.2116, 124.2438) is characterized by the presence of residential infrastructures with cultivated ornamental shrubs. Tree strands are also observable in the area and are close to residential infrastructures. The presence of trees is also observable along the concrete roads with the presence of grasses and sedges. Open spaces and vegetation are minimal in this area.

Avifaunal species documentation

Avifaunal surveys in the selected sites were conducted by same individual surveyors from September to December 2021. The point count method (Sutherland et al. 2004) was followed to document birds. Fifteen observation points were established within each urban green space within an approximate 200 m interval along existing manmade or natural trails. Avifaunal surveys were done from 0500–0900h with 15 minutes of observation per point. Surveys were done at a slow and constant pace to omit possible observation biases. Birds that were seen and heard through calls within 30 m from the observer were recorded. Species identification and ecological status of birds were done by referring to literature by Kennedy et al. (2000), Allen (2020), and other avifaunal databases (Birdlife International 2022; eBird 2023).

Avifaunal species diversity

The species richness of each urban green space surveyed was determined based on the total number of species accounted for. The percentage of species richness was calculated by dividing the number of species in each urban green space by the total number of bird species in all sites surveyed. Simpson's reciprocal diversity index was used to compare the bird diversity in each urban green space surveyed and this was performed using a free software package, Paleontological Statistics (PAST) version 4.03.

RESULTS AND DISCUSSION

Avifaunal species composition

Twenty-one avifaunal species representing 17 families were documented from the three urban green spaces of Cotabato City from September to December 2021 (Table 1). The campus of NDU had the highest avifaunal species richness (95%), followed by PC Hill (67%), and MBRH (43%) (Table 2). Among the avifauna families, the family Columbidae with three representative species (*Streptopelia tranquebarica*, *Columba liva*, *Geopelia striata*) was observed in all urban green spaces. The occurrence of Columbidae species

Table 1. Bird species observed in different urban green spaces within Cotabato City with notes on IUCN and DAO 2019-09 (Updated National List of Threatened Philippine Fauna and their Categories) status and endemicity.

Family name	Scientific name	Common name	Location		
			MBRH	PC HILL	NDU
Alcedinidae	*Todiramphus chloris* LC/OWS*	Collared Kingfisher	0	0	13
Apodidae	*Collocalia isonota* LC/OWS+	Ridgetop Swiftlet	0	0	1
Ardeidae	*Egretta garzetta* LC/OWS*	Little Egret	0	12	2
Campephagidae	*Lalage nigra* LC/OWS*	Pied Triller	0	8	0
Columbidae	*Streptopelia tranquebarica* LC/OWS*	Red Turtle Dove	3	13	2
Columbidae	*Columba livia* LC/OWS*	Rock Dove	34	28	5
Columbidae	*Geopelia striata* LC/OWS*	Zebra Dove	9	17	21
Corvidae	*Corvus macrorhynchos* LC/OWS*	Large-billed Crow	0	16	21
Dicaeidae	*Dicaeum australe* LC/OWS+	Red-keeled Flowerpecker	0	0	1
Estrildidae	*Lonchura atricapilla* LC/OWS*	Chestnut Munia	13	32	21
Estrildidae	*Lonchura leucogastra* LC/OWS*	White-bellied Munia	0	0	9
Estrildidae	*Lonchura oryzivora* LC/OWS*	Java Sparrow	19	11	26
Hirundinidae	*Hirundo javanica* LC/OWS*	House Swallow	0	13	27
Laniidae	*Lanius cristatus* LC/OWS*	Brown Shrike	0	0	3
Megalaimidae	*Psilopogon haemacephalus* LC/OWS*	Coppersmith Barbet	0	0	1
Nectariniidae	*Cinnyris jugularis* LC/OWS*	Olive-backed Sunbird	19	31	8
Passeridae	*Passer montanus* LC/OWS*	Eurasian Tree Sparrow	35	23	48
Psittaculidae	*Loriculus philippensis* LC/CR+	Philippine Hanging Parrot	0	0	1
Pycnonotidae	*Pycnonotus goiavier* LC/OWS*	Yellow-vented Bulbul	21	44	37
Rhipiduridae	*Rhipidura nigritorquis* LC/OWS+	Philippine Pied Fantail	0	21	18
Sturnidae	*Aplonis panayensis* LC/OWS*	Asian Glossy Starling	27	42	51

LC—Least concern | CR—Critically Endangered | OWS—Other wildlife species | *—non-endemic | +—Endemic. Dark-colored areas indicate a higher individual count per species.

in various urban green spaces in this study conforms with the findings of avifaunal surveys conducted in other urban green spaces of the country. In Davao City, Banzon et al. (2022) documented five species of the family Columbidae in 15 urban green spaces. In Metro Manila, Vallejo et al. (2008), also documented several species of the family Columbidae in the city's last green spaces. In terms of frequency, the *Aplonis panayensis* (n = 120) and *Passer montanus* (n = 106) were commonly encountered among the species accounted for in the urban green spaces surveyed. These findings are also similar to the observations of Banzon et al. (2022) in Davao City and Aida et al. (2016) in urban landscapes of Malaysia. The abundance of *Aplonis panayensis* in urban areas was attributed to its ability to utilize available food resources (Shazali et al. 2016).

Nineteen percent of the avifauna species accounted for are endemic, while 81% are non-endemic (Figure 1). Three of the four (75%) endemic species were documented only in NDU while one species—*Rhipidura nigritorquis* was recorded in PC Hill and NDU. The observed low endemism of avifauna in the present survey conforms with previous avifaunal surveys in urban green spaces in the Philippines (Banzon et al. 2022; de Vera et al. 2023). The vegetation type may play a factor in the low number of endemic birds in urban green spaces (Tanalgo et al. 2015, 2019). Since urban green spaces surveyed in this study lack native habitats, this may explain the low degree of endemic birds being documented.

Nineteen percent of the bird species that were recorded in the urban green spaces of Cotabato City were introduced. Little is known about the possible effects of introduced bird species on native bird species in the country (Gonzales 2006), but introduced birds can be a threat to native birds through the competition for nesting sites, and food (Baker et al. 2014). In addition, based on the DENR-BMP (2019), one Critically Endangered species of bird was spotted in NDU, the Philippine Hanging-Parrot *Loriculus philippensis*.

Table 2. Avian diversity in urban green spaces surveyed within Cotabato City.

Urban green space site	Coordinates	Elevation (m)	Area (m²)	Species richness	Simpson's reciprocal diversity index
NDU	7.2172, 124.2438	6	101, 855.52	20	0.903
PC Hill	7.2198, 124.2445	59	94, 599.97	14	0.9106
MBRH	7.2116, 124.2438	13	95, 723.85	9	0.8601

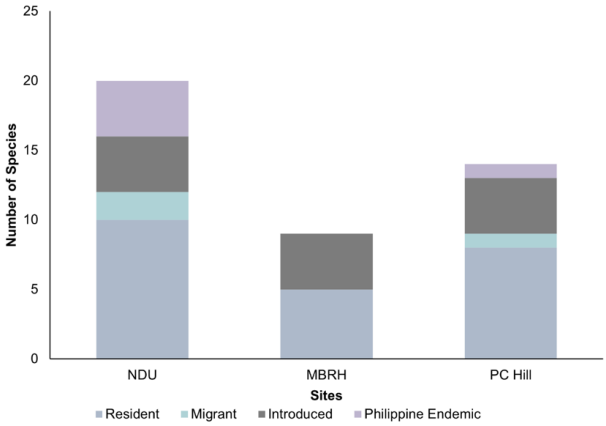

Figure 1. Distribution of endemic and non-endemic bird species in the select urban spaces within Cotabato City.

This species also occurs in other urban areas in the country (Senarillos et al. 2020) and was reported to be threatened due to the unregulated hunting in some areas of the country for the pet trade (Panopio & Pajaro 2014).

Table 2 shows that among the urban green spaces surveyed, PC Hill has the highest diversity (0.9106), followed by NDU (0.903), and the MBRH (0.8601). PC Hill has less vegetation and more residential buildings compared to NDU, however, results showed that it has the highest bird diversity among the urban green spaces surveyed. The results differ to the study conducted in southern Mindanao that reports the positive association of vegetation to avifaunal diversity (see Tanalgo et al. 2015; Gracia et al. 2021). Such observation might be due to limitations of the study such as the time of the day the bird surveys were conducted (0500–0900 h) and the limited number of study sites. Future studies in avifaunal diversity in Cotabato City should consider other urban green spaces and temporal variations.

CONCLUSION

The results of our study showed that most of the birds documented in urban green spaces surveyed in Cotabato City are of Least Concern and non-endemic and few species were recorded as endemic and Critically Endangered. This adds to the existing literature regarding the importance of habitat heterogeneity and restored sites in promoting conservation measures for avifauna diversity in urban green spaces. However, there are still limitations in this study. Several factors may influence bird diversity in urban green spaces. Future studies should consider bird surveys of other urban green spaces outside and within the commercial center of the city. Moreover, other factors such as noise, buildings, and the number of vehicles should also be investigated and determine how these may affect avifauna diversity in urban green spaces of Cotabato City.

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