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Bird Diversity and Existence at Pringtali Block: Implications for Conservation in Meru Betiri National Park, Indonesia

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ABSTRACT

Meru Betiri National Park (MBNP) is one of the conservation areas with an essential bird habitat in East Java. In the conservation monitoring and evaluation framework, we studied the diversity and existence of birds in the bird hotspot (Pringtali Block) as an implication for bird conservation in the MBNP. Bird observations were collected during January-February 2023 at the Pringtali Block using the point count method at six representative sites. The primary data recorded included bird species, abundance of each species, and frequency of encounters. Meanwhile, the secondary data were obtained from web queries covering bird conservation status and distribution through https://www.iucnredlist.org/. Data analysis was conducted in three stages: determining species composition, species diversity index (H'), and species existence value (Ef). The results recorded 70 bird species, consisting of 57 genera and 33 families, in the Pringtali Block of MBNP. The diversity index of birds was included in the high category (H' = 3.31). The average existence value (Ef) of the bird is 48.57 or $\bar{x}$=3 s, which are included in the medium category. This reveals that birds in the Pringtali block have important structural and functional values in the MBNP ecosystem. This value also illustrates the importance of the presence of a bird species in the ecosystem and represents the uniqueness of the bird species. The birds with the highest Ef values were the Javan Hawk-eagle *Nisaetus bartelsi* (86.67) and White-rumped Woodpecker *Meiglyptes tristis* (86.67). Both species have low frequencies, are an endangered category, and are endemic to Java. Therefore, conservation efforts associated with MBNP have been successful.

1. Introduction

Meru Betiri National Park (MBNP) is a conservation area with an essential habitat for bird communities in the East Java region. A previous report has revealed that approximately 215 bird species occupy the MBNP area (Kurnianto *et al*. 2014; Kurnianto *et al*. 2016), and the government protected 68 species through Peraturan Menteri Lingkungan Hidup dan Kehutanan (Regulation of the Minister of Environment and Forestry) No. P.106, 2018. As a part of this ministry, the MBNP plays a crucial role in protecting these birds from their natural habitats. According to the International Union for Conservation of Nature's (IUCN) Red List, several bird species in MBNP also have threatened categories, including Near Threatened (NT), Vulnerable (VU), and Endangered (EN) on the International Union for Conservation of Nature's (IUCN) Red List. These birds occupy several habitats in the MBNP, including coastal areas, mangroves, swamps, rheophytes, and lowland rainforests (Syarief *et al*. 2018). Kurnianto *et al*. (2014) revealed that one

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of the areas with high bird diversity in the MBNP is the Pringtali Block. This block represents various bird habitat types, such as primary lowland forests, secondary forests, rheophytes, and plantations.

Pringtali Block is an ecosystem in the jungle zone of Bandealit Resort. Separate from this area was formerly an artificial feeding ground for wildlife, such as banteng (*Bos javanicus*), Javan deer (*Cervus timorensis*), and southern red muntjac (*Muntiacus muntjak*) for grazing (Syarief *et al*. 2018). However, over the past five years, the Pringtali Block has been covered by high herbaceous and shrub vegetation with several exotic species, particularly *Lantana camara* (Sulistiyowati *et al*. 2021). The dominance of this species causes feeding ground conditions to become more closed, leading to succession towards secondary forests. Changes in vegetation make it possible for herbivores or consumers, such as insects and birds, to occupy. Vegetation cover provides an appropriate bird habitat, especially for foraging, socializing, and nesting (Stratford and Sekercioglu 2015).

The presence of birds can be a bioindicator of vegetation changes in the Pringtali Block. According to Sulistiyowati and Buot (2016), the existence of an organism in an ecosystem can be evaluated by assessing the species existence factor (Ef). It is determined by three main factors: frequency of encounter (Fr), conservation status (Cs), and geographical distribution (Gd). Ef refers to the importance of each species in the ecosystem. In addition, it also revealed a unique level of birds (Siddiq *et al*. 2023a), making bird conservation a priority.

Furthermore, this value can be the basis for making policies to conserve birds in the MBNP. The MBNP requires bird existence value data to map bird hotspots as conservation areas. Therefore, it can carry out sustainable bird monitoring, especially for protected, endangered, and prioritized birds for conservation purposes.

The Pringtali Block is located between plantations and primary forests, making this area a suitable bird habitat. Apart from being used as the primary habitat, this area is also a bird-crossing route from plantation to primary forest, or vice versa. This activity supports ecological resources, especially foraging. In addition, bird communities play an essential role in the ecosystem, including primary, secondary, and tertiary consumers, such as a prominent part of the energy flow (Stratford and Sekercioglu 2015). According to Kurnianto *et al*. (2014), granivorous, frugivorous, insectivorous, nectarivorous, and carnivorous bird groups can be found in the Pringtali Block. Therefore, this area is considered a biodiversity hotspot with a high value for bird presence in the MBNP. An ecological appraisal can measure existence value (Sulistiyowati and Buot 2016; Siddiq *et al.* 2023a). Therefore, given the potential of the Pringtali Block as a biodiversity hotspot, this study aimed to assess the existence values of bird species to inform targeted conservation efforts in MBNP.

2. Materials and Methods

2.1. Study Area

This study was conducted in the Pringtali Block, Bandealit Resort, Meru Betiri National Park, East Java, Indonesia (Figure 1). Bandealit Resort is located on the south-central side of the MBNP. Geographically, the resort

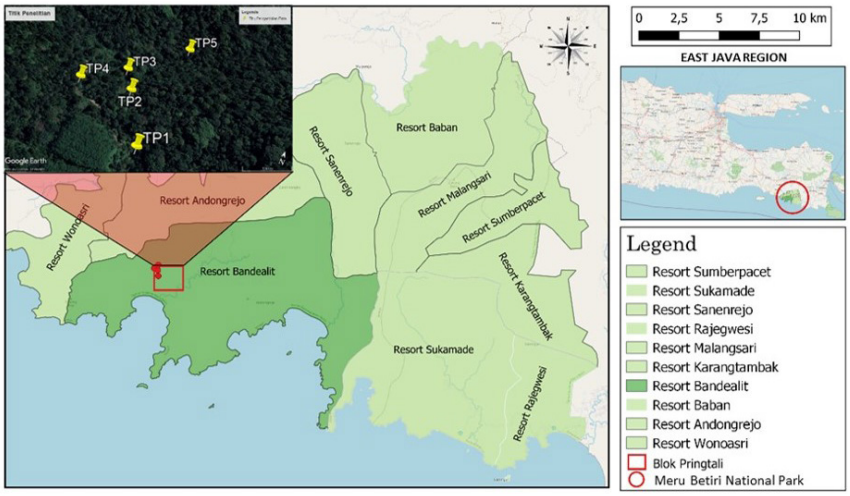

Figure 1. Study sites at Pringtali Block, Bandealit Resort, Meru Betiri National Park, East Java

is located at 8°28'52″ " S and 113°42'41"″ E, with several ecosystem types, including tropical lowland forests, plantations, coastal forests, and estuaries. The research area at Pringtali Block consists of five representative sites (TP), i.e., TP 1 (8°27'56.53"S and 113°42'47.16"E), TP 2 (8°27'54.33"S and 113°42'48.01"E), TP 3 (8°27'53.49"S and 113°42'50.87"E), TP 4 (8°27'56.98"S and 113°42'51.09"E), and TP 5 (8°28'0.25"S and 113°42'51.15"E).

2.2. Bird observation

Bird observations were conducted from January to February 2023 using the point count method (Bibby *et al*. 2000; Thunhikorn *et al*. 2016) at five representative sites on (TP). The presence of birds was observed in the morning (06.00-08.30) and afternoon (15.00-17.30), with an observation duration of 30 min for each TP for seven days. Both times are effective for bird observations because their daily rhythms are influenced by biological and environmental factors such as feeding behavior, temperature, predator avoidance, and social interactions (MacKinnon *et al*. 2010; Siddiq *et al*. 2023a). Three observers conducted observations within an observation range (r) of 20-50 meters for each TP. These observations were carried out using two approaches, namely, physical sightings using binoculars Aculon Powerview 10 × 50, a Canon PowerShot SX540 HS DSLR camera, a Canon EOS 60D DSLR camera, a telephoto lens 75-300 mm, and sound recording using a Sony ICD-PX240. Furthermore, identification and verification of physical sightings use the morphological characteristics referred to by MacKinnon *et al*. (2010) and Taufiqurrahman *et al*. (2022), while the bird sound-recorded confirmation uses https://xeno-canto.org/. Furthermore, the secondary data were obtained from web queries covering bird conservation status and distribution through https://www.iucnredlist.org/.

2.3. Data Analysis

Data analysis was conducted in three stages: determining species composition, species diversity index, and species existence value. Species composition was analyzed based on family, species names, and local taxonomies. Bird diversity was analyzed using the Shannon-Wiener index (H') (Oksanen *et al*. 2018), performed using the R studio program (R Core Team 2021) with the following formula:

$$H' = -\Sigma\ (pi \ln pi)$$

Where:
H' : species diversity index
Pi : ni/N
N : the total individual number of all species
ni : the total individual number of species-i

Furthermore, the existence value (Ef) was analyzed according to Sulistiyowati and Buot (2016) and Siddiq *et al*. (2023a) using the following formula:

$$Ef = \frac{\text{Value Fr} + \text{Value Cs} + \text{Value Gd}}{3 \times 5} \times 100\%$$

Where:
Ef : existence value
Fr : frequency encounter
Cs : conservation statuses
Gd : geographic distribution
3 : total of variable
5 : total of scale in each variable

Frequency encounters (Fr) were analyzed using the following formula:

$$\text{Fr} = \frac{\text{Frequency of species}}{\text{Frequency of all sites}} \times 100\%$$

The frequency status then determines the Fr scale obtained from the calculation according to the provisions in Table 1.

The conservation status then determines the Cs scale obtained from the calculation, according to the provisions in Table 2.

Table 1. Scale of frequency

Percentage	Scale of Fr
81-100	1 (Very Common)
61-80	2 (Common)
41-60	3 (Uncommon)
21-40	4 (Occasional)
0-20	5 (Rare)

Table 2. The scale of conservation statuses

Conservation status	Scale of Cs
CR = Critically Endangered*	5
EN = Endangered	4
VU = Vulnerable	3
NT = Near Threatened	2
LC = Least Concern**	1

The geographical distribution then determines the Gd scale obtained from the calculation, according to the provisions in Table 3.

The existence value of the bird species was converted to a level of uniqueness based on Siddiq *et al*. (2023a), as shown in Table 4.

Table 3. Scale of geographical distribution

Area distribution	Scale of Gd
Local in Indonesia	5
Island in Indonesia	4
Indonesia Archipelago	3
Continent	2
World	1

Table 4. Existence value

Ef (%)	Ef (scale)	Uniqueness category
81-100	5	Very High
61-80	4	High
41-60	3	Medium
21-40	2	Low
0-20	1	Very Low

3. Results

We recorded 70 bird species belonging to 57 genera and 33 families in the Pringtali Block of the MBNP (Table 5). According to three conservation statuses, firstly related to the IUCN Red List, we recorded 60 species are least concern, three species (*Lophotriorchis kienerii*, *Chrysophlegma mentale*, *Loriculus pusillus*) are near threatened, two species (*Buceros rhinoceros* and *Rhyticeros undulatus*) are vulnerable, and three species (*Nisaetus bartelsi*, *Meiglyptes tristis*, and *Alophoixus bres*) are endangered. Second, concerning CITES, we recorded 61 species not in the Appendix and nine species (in Appendix II). Lastly, related to the Indonesia Regulation, we recorded that 59 species were not protected, and 11 were protected.

Eleven bird endemics were occupying in this block, including five endemics to Java (*N. bartelsi*, *P. javensis*, *C. mentale*, *M. tristis*, and *Mi. flavicollis*) and five endemics to Java and Bali (*H. cyanoventris, Co. javensis*, *P. australis*, *L. pusillus*, and *A. bres*). The bird documentation is as follows (Figure 2):

Table 5. Species composition of birds in the pringtali block of MBNP. Abbreviations: Least concern (LC), near threatened (NT), vulnerable (VU), endangered (En), appendix II (A.II), not appendix (NA), indonesian regulation (IR), protected (PR), not protected (NP)

Family	Spesies	Local name	Conservation status		
			IUCN	CITES	IR
Acciptridae	*Accipiter trivirgatus*	Crested Goshawk	LC	A.II	PR
	Ictinaetus malaiensis	Black Eagle	LC	A.II	PR
	Lophotriorchis kienerii	Rufous-bellied Eagle	NT	A.II	PR
	*Nisaetus bartelsi***	Javan Hawk-eagle	EN	A.II	PR
	Pernis ptilorhynchus	Crested Honey-buzzard	LC	A.II	PR
	Spilornis cheela	Crested Serpent-eagle	LC	A.II	PR
Aegithinidae	*Aegithina tiphia*	Common lora	LC	NA	NP
Alcedinidae	*Ceyx erithaca*	Oriental Dwarf-kingfisher	LC	NA	NP
	*Halcyon cyanoventris**	Javan Kingfisher	LC	NA	NP
	Todiramphus chloris	Collared Kingfisher	LC	NA	NP
	Todiramphus sanctus	Sacred Kingfisher	LC	NA	NP
Apodidae	*Apus nipalensis*	House Swift	LC	NA	NP
	Collocalia linchi	Cave Swift	LC	NA	NP
Artamidae	*Artamus leucoryn*	White-breasted Woodswallow	LC	NA	NP
Bucerotidae	*Buceros rhinoceros*	Rhinoceros Hornbill	VU	A.II	PR
	Rhyticeros undulatus	Wreathed Hornbill	VU	A.II	PR
Campephagidae	*Coracina javensis**	Large Cuckooshrike	LC	NA	NP
	Lalage fimbriata	Lesser Cuckooshrike	LC	NA	NP
	Lalage nigra	Pied Triller	LC	NA	NP
	Pericrocotus cinnamomeus	Small Minivet	LC	NA	NP
	Pericrocotus flammeus	Scarlet Minivet	LC	NA	NP
Cisticolidae	*Orthotomus ruficeps*	Ashy Tailorbird	LC	NA	NP
	Orthotomus sutorius	Common Tailorbird	LC	NA	NP

Table 5. Continued

Family	Spesies	Local name	Conservation status		
			IUCN	CITES	IR
Columbidae	*Geopelia striata*	Zebra Dove	LC	NA	NP
	Macropygia ruficeps	Little Cuckoo-Dove	LC	NA	NP
	Ptilinopus melanospilus	Black-naped Fruit-dove	LC	NA	NP
	Spilopelia chinensis	Eastern Spotted Dove	LC	NA	NP
	Treron griseicauda	Grey-cheeked Green-pigeon	LC	NA	NP
Corvidae	*Corvus enca*	Slender-billed Crow	LC	NA	NP
	Crypsirina temia	Racket-tailed Treepie	LC	NA	PR
Cuculidae	*Cacomantis merulinus*	Plaintive Cuckoo	LC	NA	NP
	Cacomantis sonneratii	Banded Bay Cuckoo	LC	NA	NP
	Centropus bengalensis	Lesser Coucal	LC	NA	NP
	Surniculus lugubris	Square-tailed Drongo-Cuckoo	LC	NA	NP
Dicaeidae	*Dicaeum trigonostigma*	Orange-bellied Flowerpecker	LC	NA	NP
Dicruridae	*Dicrurus paradiseus*	Greater Racquet-tailed Drongo	LC	NA	NP
Estrildidae	*Lonchura punctulata*	Scaly-breasted Munia	LC	NA	NP
Eurylaimidae	*Eurylaimus javanicus*	Javan Broadbill	LC	NA	NP
Falconidae	*Microhierax fringillarius*	Black-thighed Falconet	LC	A.II	PR
Hirudinidae	*Cecropis daurica*	Red-rumped Swallow	LC	NA	NP
Laniidae	*Lanius schach*	Long-tailed Shrike	LC	NA	NP
Megalaimidae	*Psilopogon australis**	Yellow-eared Barbet	LC	NA	NP
	Psilopogon haemacephalus	Coppersmith Barbet	LC	NA	NP
	*Psilopogon javensis***	Black-banded Barbet	LC	NA	PR
Meropidae	*Merops leschenaulti*	Chesnut-headed Bee-eater	LC	NA	NP
Monarchidae	*Hypothymis azurea*	Black-naped Monarch	LC	NA	NP
Nectariniidae	*Cinnyris jugularis*	Olive-backed Sunbird	LC	NA	NP
Oriolidae	*Oriolus chinensis*	Black-naped Oriole	LC	NA	NP
	Oriolus xanthonotus	Dark-throated Oriole	LC	NA	NP
Pellorneidae	*Malacocincla sepiaria*	Horsfield's Babbler	LC	NA	NP
	Pellorneum capistratum	Rufous-browed Babbler	LC	NA	NP
Phasianidae	*Gallus varius*	Green Junglefowl	LC	NA	NP
Picidae	*Chrysophlegma mentale***	Checker-throated Woodpecker	NT	NA	NP
	Dendrocopos analis	Freckle-breasted Woodpecker	LC	NA	NP
	Dinopium javanense	Common Flameback	LC	NA	NP
	*Meiglyptes tristis***	White-rumped Woodpecker	EN	NA	NP
	Picoides moluccensis	Sunda Pygmy Woodpecker	LC	NA	NP
Psittacidae	*Loriculus pusillus**	Yellow-throated Hanging-parrot	NT	NA	NP
Pycnonotidae	*Alophoixus bres**	Brown-cheeked Bulbul	EN	NA	NP
	Pycnonotus aurigaster	Sooty-headed Bulbul	LC	NA	NP
	Pycnonotus goiavier	Yellow-vented Bulbul	LC	NA	NP
	Pycnonotus plumosus	Olive-winged Bulbul	LC	NA	NP
	Pycnonotus simplex	Cream-vented Bulbul	LC	NA	NP
Rallidae	*Amaurornis phoenicurus*	White-breasted Waterhen	LC	NA	NP
Sturnidae	*Aplonis minor*	Short-tailed Starling	LC	NA	NP
	Aplonis panayensis	Asian Glossy Starling	LC	NA	NP
Timaliidae	*Mixornis flavicollis***	Grey-cheeked Tit-Babbler	LC	NA	NP
Turnicidae	*Turnix suscitator*	Barred Buttonquail	LC	NA	NP
Vangidae	*Hemipus hirundinaceus*	Black-winged Flycathcer-shrike	LC	NA	NP
	Tephrodornis virgatus	Large Woodshrike	LC	NA	NP

The diversity of birds in the Pringtali Block was high (H'=3.31). Meanwhile, the average existence value of the birds was in the medium category (Ef = 48.57). An Ef diagram is shown below (Figure 3).

It reveals that the bird in the Pringtali block has an important structural and functional value in the MBNP ecosystem. The existence of these bird species could indicate that the Pringtali block, especially the feeding ground area, is thought to have undergone succession to secondary forests. This alleged change in vegetation cover in the Pringtali Block can create a suitable bird habitat. The Ef value also illustrates the importance

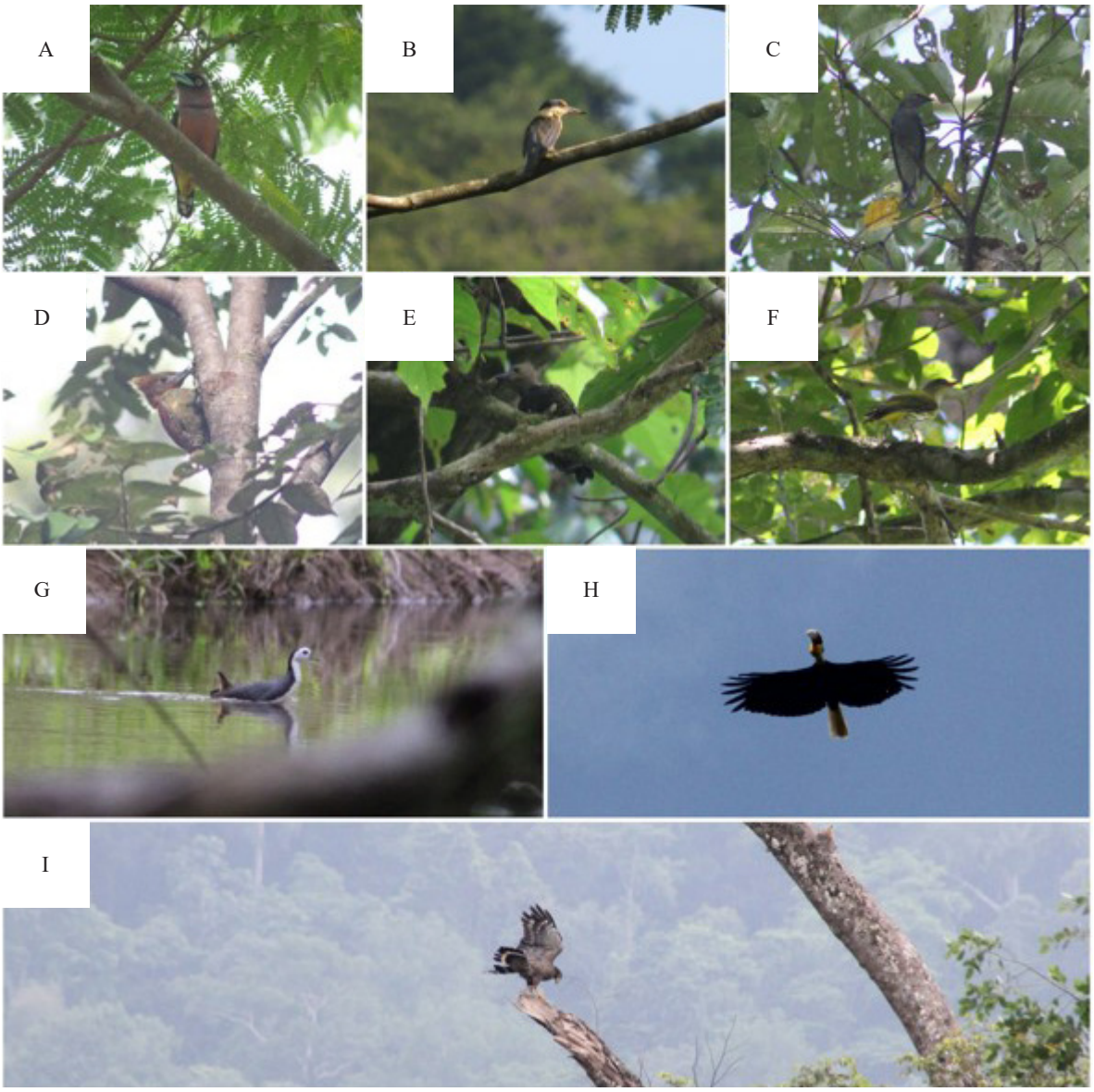

Figure 2. Birds documentation in pringtali block, bandealit resort, Meru Betiri National Park: Javan broadbill (A),sacred kingfisher (B), lesser cuckooshrike (C), checker-throated woodpecker (D), white-rumped woodpecker (E), dark-throated oriole (F), white-breasted waterhen (G), wreathed hornbill (H), crested serpent-eagle (I)

of the presence of a bird species in the ecosystem and represents the uniqueness of the bird species. The birds with the highest Ef values were the Javan Hawk-eagle *N. bartelsi* (86.67) and the White-rumped Woodpecker *M. tristis* (86.67) (Figure 3). Both species have low frequencies (5 score), an endangered category (4 score), and are endemic to Java Island (4 score).

4. Discussion

We recorded 70 bird species in the Pringtali Block and 32% of all birds in MBNP (215 species). The two bird species had the highest existence values that is, Javan Hawk-eagle *N. bartelsi* (Ef=86.67) and White-rumped Woodpecker *M. tristis* (Ef=86.67) had the highest values (Figure 3). *N. bartelsi* was rarely encountered (20%). However, this species has a reasonably high frequency compared to the other nine diurnal raptors in Bandealit (Siddiq *et al*. 2023b). It is suspected that the Pringtali Block and its surroundings are the home range for this rare species. Nursamsi *et al.* (2018) stated that *N. bartelsi* tends to occupy forested areas with dense cover. This species is endemic to Java Island and has been endangered since 1994, with

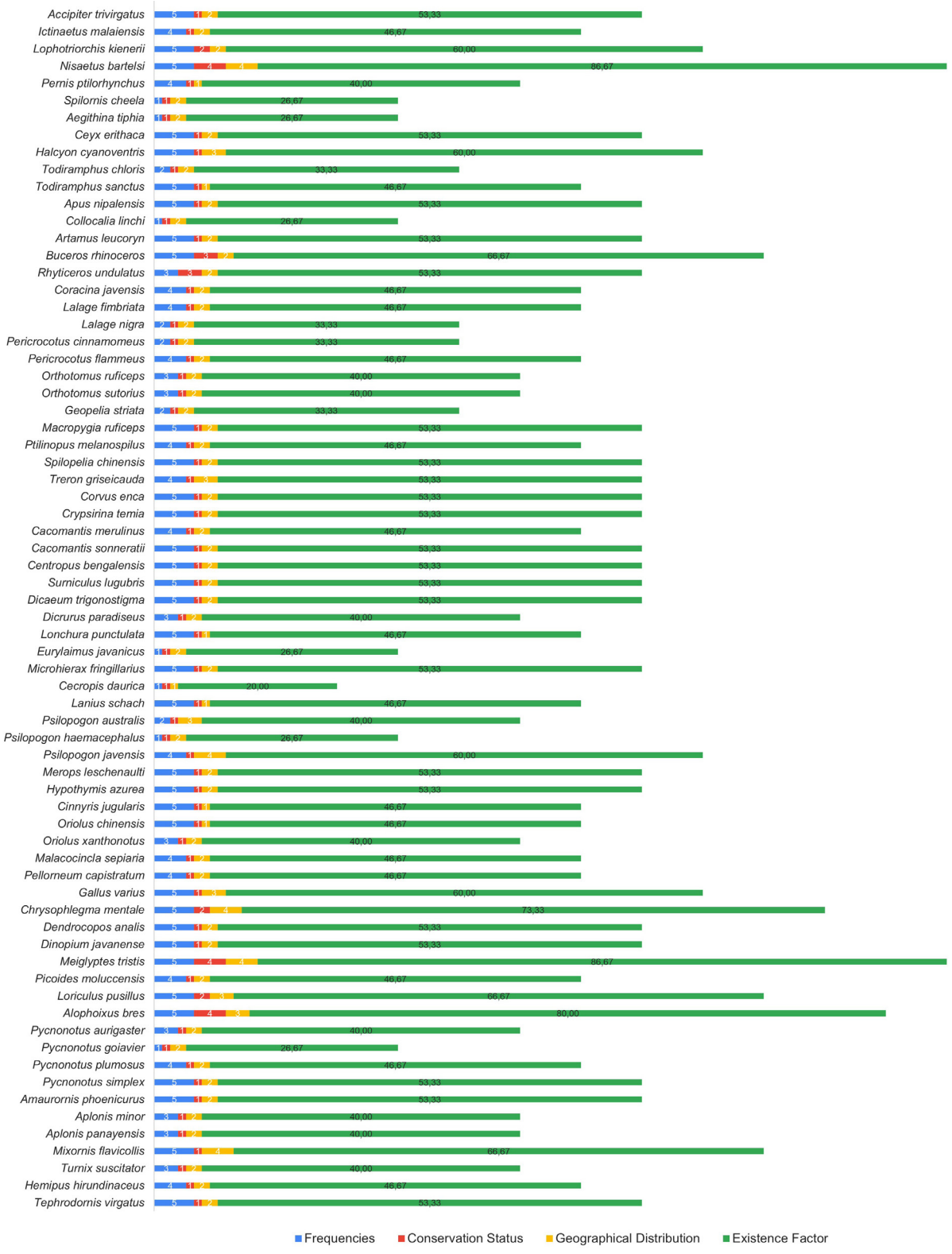

Figure 3. The existence of birds at the Pringtali Block and Meru Betiri National Park

a declining population trend (Birdlife International 2017). The slow population growth rate is caused by deforestation, degradation, and habitat disturbance (Balen *et al.* 2000; Prawiradilaga 2006). Based on this, the Javan Hawk-eagle is a priority animal for protection, especially in Meru Betiri National Park (Kurnianto *et al*. 2014; Syarief *et al*. 2018).

Due to its high Ef value, *M. tristis* (Figure 2E) is an important bird species. The number of encounters (20%) was low during the observation period. This species is endemic to Java and inhabits plantations as well as secondary and primary forests (Taufiqurrahman *et al*. 2022). Referring to the IUCN Red List assessment, *M. tristis* is an endangered category with a decreasing population trend (Birdlife International 2016). It was due to anthropogenic factors, such as habitat conversion and illegal poaching (Lammertink 2014; Birdlife International 2016). Kurnianto *et al*. (2023) reported that *M. tristis* was recorded at seven sites in the MBNP, including plantations (coconut, Albizia, and rubber), secondary forests bordering villages, mangroves, and polycultures. This existence in the Pringtali Block is a new site for local distribution in the MBNP. We observed this species in a primary forest with heterogeneous tree vegetation. Therefore, we suggest that the essential habitat for *M. tristis* is a heterogeneous forest, whereas *N. bartelsi* prefers dense forests with complex stratification.

Based on the existence factor (Ef) approach of a bird in the Pringtali Block, the average value was in the medium category (Ef=48.57 or $\bar{x}$=3 s I), which was unique in terms of the constituent factors: frequency status ($\bar{x}$=3.93), conservation status ($\bar{x}$=1.23), and geographical distribution status ($\bar{x}$=2.13). This is also similar to Siddiq *et al*. (2023a), who revealed the Ef value of birds in the Erek-Erek Geoforest Ijen Geopark in the medium category (Ef=51.35 or $\bar{x}$=3 score). Conservation status is an important factor that significantly affects the value of first bird species. Based on the results of this study, birds found in the Pringtali block of Bandealit NPMB Resort have four conservation status categories based on the IUCN Red List, including the least concern 60 species (86%), followed by five near-threatened species (7%), two vulnerable species (3%), and three endangered species (4%). This shows that the Pringtali block is an essential habitat for threatened endangered birds at MBNP precisely and in East Java.

Another crucial constituent factor is the distribution status and frequency of birds. This distribution status refers to bird endemicity. Five bird species are endemic to Java, including Javan Hawk-eagle (*N. bartelsi*), Black-banded Barbet (*P. javensis*), Checker-throated Woodpecker (*C. mentale*), White-rumped Woodpecker (*M. tristis*), and Grey-cheeked Tit-Babbler (*Mi. flavicollis*). These endemicity statuses refer to the current distribution of birds on Greater Sunda (Taufiqurrahman *et al*. 2022) and the IUCN Red List. Bird endemics often occupy small areas and are notably higher in rainforests (Sreekar *et al*. 2021). Furthermore, according to the frequency status, it is dominated by low encounter rates (<20%), which are 32 species. Birds with such low encounter rates may have limited populations and specific habitats. This aligns with the findings of Loiseau *et al*. (2020), who revealed that rare birds can be caused by habitat conditions and population size.

On the other hand, the Pringtali block represents the bird conservation implication at MBNP because it has the highest species richness (70 species) in comparison with the other blocks, such as rehabilitation zones, including Donglo, Pletes, and Kandangmotor blocks at Wonoasri-Andongrejo Resort with a total of 22 bird species (Kurnianto *et al*. 2022), and the Bonangan block at Wonoasri Resort with a total of 38 bird species (Siddiq *et al*. 2024). The diversity of birds in the Pringtali Block was high (H'=3.31). This block had heterogeneous vegetation and complex stratification. This is provided to primary resources for birds, such as food variety, resting and perching areas, sheltering areas, and probably nesting areas. According to Alexandrino *et al*. (2016), bird abundance and diversity are high in nondegraded forests. Furthermore, this block is suspected to represent a suitable bird habitat, particularly in dense and heterogeneous forests. Despite this, curious observations are still needed to obtain primary resources and measure the habitat preferences of birds in this block.

According to these results, it is appropriate to maintain the habitat in the Pringtali Block. Focusing on both species with the highest Ef, *N. bartelsi*, and *M. tristis*. These species are endemic and more sensitive to disturbances; therefore, they must be prioritized in the Pringtali Block. Conservation acts, such as monitoring the population, distribution, and nesting areas, are crucial for immediate implementation. Geographically, this block bordered by a plantation is also suggested to pose serious threats because, unintentionally, human activities in the plantation can become a disturbance. The periodic monitoring could involve researchers

who can analyze the data and society surrounding the MBNP, particularly inside the Bandealit Resort. Another in situ conservation act has been implemented for *N. bartelsi*, such as Gunung Picis Ponorogo Nature Reserve (Yuliamalia *et al*. 2021) and Gunung Ciremai National Park (Adu *et al*. 2023).

Ultimately, these research results show the immense conservation implications of MBNP, particularly for birds. This was proven by 70 birds in the Pringtali Block of the MBNP. It has earned crucial notes, particularly for several endemic and threatened species. However, it still has limitations, such as short survey periods, and requires refinement to obtain year-round data. Further research is also needed to complete the bird database in the Pringtali Block, such as by employing advanced monitoring techniques that use bioacoustics (Vu *et al*. 2023). Another ecological component, behavior and habitat preferences, is also essential. Meanwhile, according to the results in the Pringtali Block, it could be implemented in another terrain that is an essential habitat for birds, thus gaining the species priority to conserve.

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