

Analysis of Bird Species Diversity in the Selo Resort Area of Mount Merbabu National Park

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Abstract. Birds play a vital role in ecosystems and represent one of the richest components of wildlife diversity in Indonesia. Bird species diversity is critical for describing the community structure of a given habitat. This study aimed to assess bird species diversity, conservation status, and species composition based on feeding guilds. Data were collected using a combined method of line transect and point count surveys along the Mount Merbabu hiking trails via the Selo and Gancik routes at the Selo Resort Area of Mount Merbabu National Park (TNGMb), located in Dusun I, Suroteleng, Selo, Boyolali Regency, Central Java. Data were analyzed using the Shannon-Wiener diversity index ($\hat{H}$), yielding values of 3.040 for the Selo trail and 2.395 for the Gancik trail. The dominance index (C) was 0.063 for Selo and 0.126 for Gancik, indicating that the Selo trail supports a more diverse, balanced bird community with no dominant species.

1 Introduction

Birds are among the most easily observed wildlife across all habitat types. They play a crucial role in ecosystem functioning and represent one of the most species-rich components of Indonesian wildlife. Each bird species possesses unique aesthetic value, and their survival depends on several conditions, including suitable habitat and protection from disturbances [1]. Mount Merbabu National Park is considered a particularly favorable habitat for birds due to its diverse plant community, which provides breeding grounds for many species [2]. TNGMb encompasses montane tropical rainforest, harboring more than 70 bird species [3].

The diversity of traits and characteristics found among living organisms reflects the diversity of potential benefits they can provide. When scientific data and information on biological resources remain incomplete, the extinction of any organism is equivalent to the permanent loss of an opportunity to harness its ecological and economic potential [4]. Bird species diversity, as an indicator of environmental quality, warrants particular attention, as bird communities are influenced by physical, chemical, and biological factors. Physical factors include temperature, elevation, soil type, humidity, light, and wind; chemical factors include food availability, water, minerals, and vitamins in terms of both quantity and quality; and biological factors include vegetation, wildlife, and human activity [5]. Habitat, broadly defined as the environment in which an organism lives, is fundamental to all species [6]. Bird

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habitat serves as a key element supporting the survival and diversity of bird communities. Critical components include food availability, nesting sites, water sources, and protection from predators. Different habitat types—such as primary forest, secondary forest, mangroves, and wetlands—each exhibit distinct vegetation structures and resource availability, thereby supporting distinct bird assemblages [7].

Bird conservation status is determined based on multiple criteria, including the IUCN Red List, CITES appendices, and national regulations such as the Minister of Environment and Forestry Regulation No. P.20/MENLHK/SETJEN/KUM.1/6/2018 [8]. Conservation efforts within TNGMb include habitat mapping, species monitoring, and community education. Birdwatching and avitourism activities have also been developed to raise awareness of the importance of bird conservation in this area. With a holistic and participatory approach, conservation initiatives at TNGMb are expected to sustain the long-term viability of resident bird species [9]. This study aimed to assess bird species diversity, conservation status, and species composition by feeding guild in the Selo Resort Area of Mount Merbabu National Park (TNGMb).

2 Methods

This study was conducted from June to July 2025 at the Selo Resort Area of Mount Merbabu National Park (TNGMb), along two hiking trails: the Selo trail and the Gancik trail. Bird observations were conducted using a combined point count and line transect method, selected because observation sites were located along established hiking trails. The observation scheme is as follows:

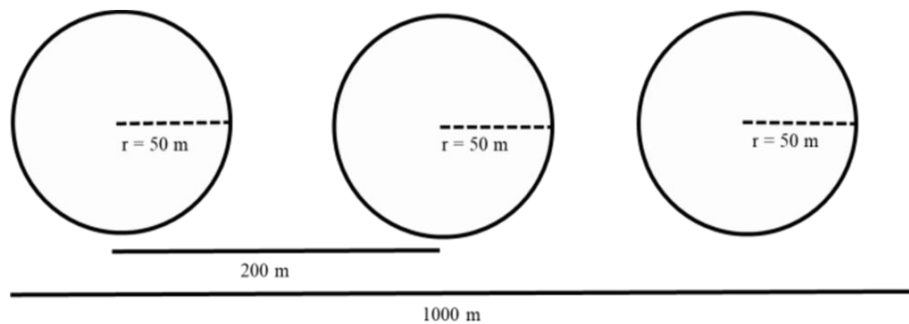


Fig. 1. Schematic diagram of the point count observation method.

Observations were conducted along the hiking trails at predetermined counting points spaced 200 meters apart. Each counting point consisted of a circular plot with a 50-meter radius (Figure 1). Each point was observed for 10 minutes to prevent double counting [10]. Bird observation routes were recorded using the Avenza application and subsequently analyzed to display digitally stored spatial data in map format.

3 Results and discussion

3.1 Results

This study was conducted at two trails within the Selo Resort Area: the Selo hiking trail and the Gancik hiking trail, converging at the intersection near Post 3. The Selo trail is located at an elevation of approximately 1,636 m above sea level (masl), while the Gancik trail is

situated at approximately 1,850 masl. A total of 44 bird species were recorded across both trails.

Table 1. Bird species recorded on the Selo and Gancik trails, TNGMb

No.	Local Name	Scientific Name	Family
1	Mountain Thrush	<i>Turdus poliocephalus</i>	Turdidae
2	Green Junglefowl	<i>Gallus varius</i>	Phasianidae
3	Long-tailed Shrike	<i>Lanius schach</i>	Laniidae
4	Pygmy Wren-Babbler	<i>Pnoepyga pusilla</i>	Pnoepygidae
5	Pygmy Bushtit	<i>Psaltia exilis</i>	Aegithalidae
6	Tawny-breasted Parrotfinch	<i>Erythrura hyperythra</i>	Estrildidae
7	Friendly Bush-warbler	<i>Horornis flavolivaceus</i>	Scotocercidae
8	Javan Bush-warbler	<i>Locustella montis</i>	Locustellidae
9	Javan Scimitar Babbler	<i>Pomatorhinus montanus</i>	Timaliidae
10	Striated Grassbird	<i>Megalurus palustris</i>	Locustellidae
11	Javan Tailorbird	<i>Orthotomus sepium</i>	Cisticolidae
12	White-browed Shrike-babbler	<i>Pteruthius flaviscapis</i>	Vireonidae
13	Javan Whistling Thrush	<i>Myophonus glaucinus</i>	Myophonus
14	Orange-spotted Bulbul	<i>Pycnonotus bimaculatus</i>	Pycnonotidae
15	Sooty-headed Bulbul	<i>Pycnonotus aurigaster</i>	Pycnonotidae
16	Black Eagle	<i>Ictinaetus malaiensis</i>	Accipitridae
17	Oriental Honey-buzzard	<i>Pernis ptilorhyncus</i>	Accipitridae
18	Great Tit	<i>Parus major</i>	Paridae
19	Javan White-eye	<i>Zosterops melanurus</i>	Zosteropidae
20	Pied Triller	<i>Lalage nigra</i>	Campephagidae
21	Black-naped Oriole	<i>Oriolus chinensis</i>	Oriolidae
22	Rufous-tailed Fantail	<i>Rhipidura phoenicura</i>	Rhipiduridae
23	Yellow-vented Bulbul	<i>Pycnonotus goiavier</i>	Pycnonotidae
24	Bar-winged Prinia	<i>Prinia polychroa</i>	Cisticolidae
25	Hill Prinia	<i>Prinia superciliaris</i>	Cisticolidae
26	Sunda Minivet	<i>Pericrocotus miniatus</i>	Campephagidae
27	Scarlet Minivet	<i>Pericrocotus flammeus</i>	Campephagidae
28	Small Minivet	<i>Pericrocotus cinnamomeus</i>	Campephagidae
29	Little Pied Flycatcher	<i>Ficedula westermanni</i>	Muscicapidae
30	Snowy-browed Flycatcher	<i>Ficedula hyperythra</i>	Muscicapidae
31	Indigo Flycatcher	<i>Eumyias indigo</i>	Muscicapidae

No.	Local Name	Scientific Name	Family
32	Ashy Drongo	<i>Dicrurus leucophaeus</i>	Dicruridae
33	Spotted Dove	<i>Spilopelia chinensis</i>	Columbidae
34	Chestnut-capped Babbler	<i>Timalia pileata</i>	Timaliidae
35	Rufous-fronted Babbler	<i>Cyanoderma melanothorax</i>	Timaliidae
36	Spotted Babbler	<i>Stachyris maculata</i>	Timaliidae
37	Little Cuckoo-Dove	<i>Macropygia ruficeps</i>	Columbidae
38	Barred Cuckoo-Dove	<i>Macropygia unchall</i>	Columbidae
39	Mossy-nest Swiftlet	<i>Collocalia hirundinacea</i>	Apodidae
40	Cave Swiftlet	<i>Collocalia linchi</i>	Apodidae
41	Pink-headed Fruit-dove	<i>Ptilinopus porphyreus</i>	Columbidae
42	Javan Fulvetta	<i>Alcippe pyrrhoptera</i>	Alcippeidae
43	Plaintive Cuckoo	<i>Cacomantis merulinus</i>	Cuculidae
44	Banded Bay Cuckoo	<i>Cacomantis variolosus sepulcralis</i>	Cuculidae

3.1.1 Bird Diversity and Species Richness on the Selo Trail

Results indicated that the Selo trail harbored 146 individuals belonging to 39 species. The Shannon-Wiener diversity index ($\hat{H}$) of 3.040 reflects high species diversity along this trail. The evenness index (E) of 0.894 indicates a relatively uniform distribution of individuals across species. The dominance index (C) of 0.063 confirms that no single species substantially dominates the bird community along this trail.

Table 2. Diversity, Evenness, and Dominance Indices for the Selo Trail

Index	Value
Diversity ($\hat{H}$)	3.040
Evenness (E)	0.894
Dominance (C)	0.063

The Selo trail encompasses a diverse assemblage of bird families, including Turdidae, Laniidae, Estrildidae, Pycnonotidae, Campephagidae, Muscicapidae, and Accipitridae. This family-level diversity indicates that the habitat along the Selo trail supports multiple feeding guilds, including insectivores, frugivores, granivores, and carnivores. The high diversity at Selo is attributed to the more complex vegetation structure, which includes a mixture of natural forest and former plantation forest, providing diverse canopy layers and relatively abundant food resources. The multi-layered vegetation facilitates a broader range of ecological niches, enabling more species to coexist.

3.1.2 Bird Diversity and Species Richness on the Gancik Trail

A total of 119 individuals were recorded along the Gancik trail. The Shannon-Wiener diversity index ($\hat{H}$) of 2.395 indicates moderate species diversity. The evenness index (E) of

0.814 suggests a fairly uniform distribution of individuals across species, though lower than that of the Selo trail. The dominance index (C) of 0.126 indicates a tendency for certain species to dominate the community.

Table 3. Diversity, Evenness, and Dominance Indices for the Gancik Trail

Index	Value
Diversity ($\hat{H}$)	2.395
Evenness (E)	0.814
Dominance (C)	0.126

The Pygmy Wren-Babbler (*Pnoepyga pusilla*) and the Striated Grassbird (*Megalurus palustris*) were the dominant species recorded along this trail. Both species are highly adaptable to more open montane environments. It is likely that more habitat-sensitive bird populations have declined due to the greater elevation and higher tourist activity characteristic of the Gancik trail. The lower diversity along Gancik may be attributed to more homogeneous vegetation, limited canopy stratification, and more intensive human disturbance, all of which constrain the number of species able to persist in this environment. Consequently, the diversity index for the Gancik trail is lower than that of the Selo trail.

3.1.3 Comparative Analysis of Bird Diversity Between Trails

Bird diversity was higher along the Selo trail ($\hat{H}$ = 3.040) compared to the Gancik trail ($\hat{H}$ = 2.395), with greater species richness and more individuals recorded. Both trails exhibited high evenness; however, Selo was more stable (E = 0.894) than Gancik (E = 0.814). Dominance was more balanced in Selo (C = 0.063) than in Gancik (C = 0.126). Overall, the Selo trail supports a more diverse, stable, and balanced bird community, whereas the Gancik trail harbors a moderately diverse community with apparent dominant species, influenced by differences in vegetation structure, elevation, and human disturbance.

Table 4. Comparison of Diversity, Evenness, and Dominance Indices: Selo and Gancik Trails

Trail	Diversity Index ($\hat{H}$)	Evenness Index (E)	Dominance Index (C)
Selo	3.040	0.894	0.063
Gancik	2.395	0.814	0.126

3.1.4 Ecological Analysis: Community Balance, Feeding Guilds, and Conservation Status

The results demonstrate that feeding guild diversity was greater along the Selo trail, encompassing insectivores, frugivores, granivores, carnivores, and nectarivores. In contrast, the dominant guilds on the Gancik trail were insectivores and granivores, with few frugivores and carnivores, suggesting a more complex and resource-diverse ecosystem along the Selo trail. From a conservation perspective, several bird species recorded along both trails are listed under national government protection and the IUCN Red List. For example, the Black Eagle (*Ictinaetus malaiensis*) is classified as a nationally protected species, though its global status remains Least Concern. The presence of this apex predator indicates that the Selo trail retains a relatively complete food web.

3.1.5 Implications for Conservation and Management

The findings of this study not only provide an overview of bird diversity and species richness along the Selo and Gancik trails, but also offer a broader perspective for conservation area management, research development, and socioeconomic considerations. Four key implications were identified: ecological, conservation-related, socioeconomic, and policy-related.

Ecological Implications: The high Shannon-Wiener diversity index recorded on the Selo trail indicates a relatively stable bird community with a well-functioning ecological carrying capacity. The trail thus serves as an ecological indicator of habitat health within the Selo Resort Area. The presence of apex predators such as the Black Eagle (*Ictinaetus malaiensis*) confirms the continued functioning of the food chain. Furthermore, the diversity of feeding guilds (insectivores, frugivores, granivores, and carnivores) reflects positive energy flow within the ecosystem. Feeding guilds represent an important ecological characteristic that can be used as an indicator of ecosystem response to environmental disturbances [11]. In contrast, the Gancik trail exhibited a lower diversity index, with several species—notably the Pygmy Wren-Babbler and Striated Grassbird—dominating the community, suggesting greater habitat vulnerability to ecological disturbance. Without intervention, a continued decline in species diversity may ultimately impair ecosystem functioning. These findings can therefore be used to identify priority areas for ecosystem management.

Conservation Implications: The data indicate that the Selo trail holds substantial potential as the most important area for bird conservation prioritization within TNGMb. Its high species richness and diversity index qualify it as a 'core habitat' requiring protection from all forms of degradation. Conservation approaches should include maintaining vegetation quality, preventing illegal activities such as bird poaching, and restricting land-use changes in the surrounding area. For the Gancik trail, conservation implications are primarily related to habitat rehabilitation. Given its proximity to a tourist area, efforts are needed to balance tourism activities with bird conservation, including replanting native vegetation to restore food availability and establishing more protected core areas.

Socioeconomic Implications: Beyond their ecological value, birds hold significant social and economic importance, particularly in the context of birdwatching ecotourism. This study can serve as a foundation for ecotourism development at TNGMb, particularly along the species-rich Selo trail. Local communities could benefit economically through guiding services, homestays, and local product sales. However, realizing this potential requires training in bird identification, responsible tourism ethics, and marketing strategies. Additionally, certain bird species—such as the Sooty-headed Bulbul (*kutilang*) and Spotted Dove (*tekukur*)—hold cultural significance in Javanese tradition, reinforcing the importance of bird conservation for the preservation of local cultural heritage.

Policy Implications: From a policy perspective, the findings of this study can inform the management strategy and zoning process of Mount Merbabu National Park. The Selo trail may be designated as a core conservation zone, while the Gancik trail can be regulated for limited tourist activities and utilization. Additionally, information on bird conservation status can be used to support the implementation of Minister of Environment and Forestry Regulation (Permen LHK) No. P.106 of 2018 on the protection of flora and fauna.

3.2 Discussion

The results of bird diversity and species richness surveys conducted along the Selo and Gancik trails contribute to a more comprehensive understanding of the avian community structure in the montane ecosystem of Mount Merbabu. Differences between the two trails in

terms of species richness, individual abundance, and diversity indices are generally pronounced.

Overall, the Selo trail exhibited greater bird diversity than the Gancik trail, as evidenced by a higher $\hat{H}$ value, greater species richness, and a more even distribution of individuals. These differences are strongly influenced by environmental factors, including elevation, vegetation structure, and the degree of human disturbance.

The Selo Resort Area represents an important bird conservation zone within Mount Merbabu National Park, given its high abundance of protected species and diverse feeding guilds. Therefore, the management and conservation of both the Selo and Gancik trails should be implemented in a balanced manner, taking into account ecological functions alongside the potential for sustainable ecotourism development.

On the Selo trail, 39 bird species were recorded with 146 individuals, yielding a diversity index ($\hat{H}$) of 3.040, an evenness index (E) of 0.894, and a dominance index (C) of 0.063. These values indicate a diverse, balanced bird community with no dominant species.

On the Gancik trail, 31 bird species were recorded with 119 individuals, yielding an $\hat{H}$ of 2.395, an evenness index (E) of 0.814, and a dominance index (C) of 0.126. These values indicate moderate diversity with a tendency toward species dominance.

Key ecological factors—including elevation, vegetation structure, level of human activity, and food resource availability—drive the observed differences. The more complex vegetation of the Selo trail supports a greater diversity of feeding guilds, whereas the more homogeneous vegetation and lower tourism disturbance on the Gancik trail constrain the community to species with specific ecological adaptations.

Furthermore, the presence of protected species such as the Black Eagle confirms that the Selo trail continues to function as an important habitat for apex predators, underscoring the ecological significance of this core area. As demonstrated by this study, the Selo trail represents the most biodiversity-important habitat in the resort. In contrast, the Gancik trail is better suited for limited use, with a focus on environmentally responsible nature tourism. It is recommended that bird conservation efforts in the Selo and Gancik zones be differentiated, with emphasis on management and rehabilitation in Gancik and strict protection in Selo.

In summary, the Selo trail supports a higher bird diversity and a more stable community than the Gancik trail. Therefore, the Selo trail should be prioritized for conservation, while the Gancik trail requires targeted management to maintain its ecological functions while accommodating visitor activities.

Collectively, these findings affirm that ecology-based management and conservation at Mount Merbabu National Park are essential for sustaining bird diversity and delivering long-term social, cultural, ecological, and economic benefits.

4 Conclusion

Based on the results of the study entitled “Analysis of Bird Species Diversity in the Selo Resort Area of Mount Merbabu National Park,” the following conclusions are drawn:

1. The Selo trail harbors a greater number of bird species than the Gancik trail. A total of 39 bird species with 146 individuals were recorded along the Selo trail, with a Shannon-Wiener diversity index ($\hat{H}$) of 3.040, indicating high diversity, an evenness index (E) of 0.894, and a dominance index (C) of 0.063—values collectively indicating a stable community with no dominant species. On the Gancik trail, 31 species were recorded with 119 individuals and an $\hat{H}$ of 2.395, indicating moderate diversity. The evenness index (E) of 0.814 reflects a relatively uniform distribution of individuals, though the dominance index (C) of 0.126 indicates that certain species—notably the Pygmy Wren-

Babbler (*Pnoepyga pusilla*) and Striated Grassbird (*Megalurus palustris*)—tend to dominate the community.

2. The Selo trail ($\pm 1,636$ masl), situated at a lower elevation, is characterized by a mixture of natural and ex-Perhutani plantation forest, providing a more complex, multi-layered habitat that supports a greater diversity of feeding guilds (insectivores, frugivores, granivores, and carnivores). The Gancik trail ($\pm 1,850$ masl), by contrast, features more homogeneous and open vegetation with higher levels of tourism disturbance, thereby supporting only bird communities with specific ecological adaptations.

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