Fauna Diversity and Bird Community Structure in the Bissoloro Educational Forest, South Sulawesi

Hendra Kurniawan[*], Sutan Sahala Muda Marpaung, Eva Oktaviani, Firman Syah

Forestry Department, Kupang State Agricultural Polytechnic, Kupang, Indonesia
[*]e-mail: hendra.kurniawan@staff.politanikoe.ac.id

Abstract:. The Bissoloro Educational Forest, covering an area of 75.12 hectares in Gowa Regency, South Sulawesi, serves as a natural research site under the stewardship of Muhammadiyah University of Makassar. Although the forest holds considerable ecological value, comprehensive and systematic data on its faunal diversity are still limited. This study was conducted to explore and evaluate the composition, richness, and community structure of fauna within the area, focusing on three major groups: mammals, reptiles, and birds. Data collection for mammals and reptiles was conducted through both direct sightings and indirect indicators, while avian data were obtained using a 1,700-meter line transect with 17 observation points over a three-day survey period. A total of 39 faunal species were recorded, comprising 4 mammal species, 10 reptile species, and 25 bird species. Among the bird species, *Pycnonotus aurigaster* was identified as the most dominant, with the highest Importance Value Index (INP) of 38.19%, supported by a relative frequency of 19.61% and relative dominance of 18.58%. The overall bird community diversity, as measured by the Shannon-Wiener index (H'), was 2.59, reflecting a moderate level of biodiversity. The occurrence of endemic and protected species, including top predators and nectar-feeding birds, indicates that essential ecological functions such as pollination and food web dynamics are still maintained. These results highlight the ecological importance of the Bissoloro Educational Forest and its role as a vital site for biodiversity conservation, environmental education, and long-term ecological monitoring in alignment with the Merdeka Belajar Kampus Merdeka (MBKM) framework.

Keywords: Bissoloro Educational Forest; Endemic Species; Faunal Diversity; Importance Value Index.

Introduction

Indonesia is recognized as one of the world's megabiodiversity countries, characterized by extremely high levels of biodiversity, particularly within the Wallacea region such as Sulawesi, which is home to numerous endemic species [1], [2]. Sulawesi hosts 127 mammal species, 72 of which are endemic, along with more than 350 bird species, including raptors and various endemics unique to this ecoregion [3], [4]. This rich faunal diversity makes Sulawesi's forest areas crucial for conservation research, ecological studies, and environmental education.

Forests function not only as providers of ecosystem services but also as habitats for a wide range of fauna that play vital roles in maintaining ecosystem balance through processes such as pollination, seed dispersal, natural pest control, and nutrient cycling [5], [6]. The presence of certain animal species can serve as bioindicators of ecosystem health and inform forest management and conservation planning strategies [7].

The Bissoloro Educational Forest, located in Gowa Regency, South Sulawesi, is managed by Universitas Muhammadiyah Makassar as a natural laboratory covering approximately 75 hectares. Its location, adjacent to the Takalar Protected Forest and situated in a transitional highland landscape, makes it a potentially rich habitat for diverse fauna, particularly birds, reptiles, and small mammals. However, data on faunal diversity in this area remain limited and have not been systematically documented. [8], [9] reported the presence of *Macaca maura* and several endemic bird species in the vicinity, but comprehensive quantitative studies on faunal community composition and structure have yet to be conducted.

Previous studies have shown that line transect methods are effective in assessing bird community structure and species dominance, as demonstrated [10] in the Universitas Hasanuddin Educational Forest and [11] in the Mount Nona Nature Reserve. Furthermore, the use of importance value index (INP) and the Shannon-Wiener diversity index is widely applied to evaluate bird species abundance and diversity in various tropical conservation areas [12].

Considering the need for baseline data to support conservation-based area management, as well as the urgency of preserving endemic and protected species, this study aims to identify the species composition of fauna (mammals, reptiles, and birds) in the Bissoloro Educational Forest and to analyze bird community structure based on importance value and diversity indices. The findings are expected to serve as a foundation for developing the area as a center for environmental education and campus-based conservation, in alignment with the implementation of the *Merdeka Belajar Kampus Merdeka* (MBKM) policy, which promotes contextual and field-based learning.

Research Methods

The research was conducted in the Educational Forest of Muhammadiyah University of Makassar, located in Bissoloro Village, Bungaya Subdistrict, Gowa Regency,

South Sulawesi Province, covering an area of 75.12 hectares. To assess the faunal potential, which includes mammals, reptiles, and birds, an exploratory survey (reconnaissance survey) was carried out. Data collection on mammals and reptiles was conducted through species identification. Wildlife observations were based on sightings of individuals, tracks, feces, nests, vocalizations, or other signs, as well as information obtained from local residents, which was validated through photographic documentation.

Bird data were collected by identifying species and counting individuals to determine frequency, dominance, important value index, bird abundance, and species diversity. Bird surveys were conducted using the line transect method, recording all necessary data. In addition, supplementary information such as time of appearance (hour and minute), photographs, GPS coordinates, and a brief description of the habitat where each bird species was found was documented. Observations were conducted along a 1,700-meter transect (17 transect points) over three days, during both morning and late afternoon sessions. The line transect model used for bird data collection is presented in Figure 1.
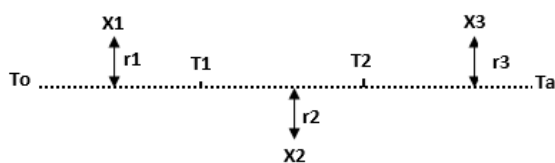

Figure 1. Observation Path Using Line Transect Method

Description:
Xi = Observed bird species
ri = Distance between the bird and the transect line/observer
To = Starting point of observation
Ti = Interval points every 100 meters
Ta = Endpoint of observation

Data analysis for bird species was conducted by calculating frequency, relative frequency, dominance, relative dominance, important value index (INP), abundance, and species diversity index. Frequency (F), relative frequency (FR), dominance (D), relative dominance (DR), and the Important Value Index (INP) were calculated using the formulas adapted as follows:

$$\text{Frequency (F)} = \frac{\sum \text{Number of transect points where a species was found}}{\sum \text{Total number of transect points}}$$

$$\text{Relative Frequency (FR)} = \frac{\text{Frequency of a species}}{\text{Total frequency of all species}} \, x100\%$$

$$\text{Dominance (D)} = \frac{\sum \text{Number of individuals of each species}}{\text{Total sampled transect area}}$$

$$\text{Relative Dominance (DR)} = \frac{\text{Dominance of a species}}{\text{Total dominance of all species}} \, x100\%$$

$$\text{Important Value Index (INP)} = \text{FR} + \text{DR}$$

To calculate species abundance, the following formula from Van Balen [11] was used:

$$\text{Bird Abundance (Pi)} = \frac{\sum \text{Number of individuals of species } i}{\sum \text{Total number of individuals of all species}}$$

According to [5], species diversity can be determined using the Shannon-Wiener diversity index formula:

$$\text{Bird Diversity Index (H')} = - \sum [\text{Pi ln Pi}]$$

Results and Discussion

Faunal Species Identification

Based on field survey results, the Bissoloro Educational Forest has been identified as a natural habitat for 39 species of wildlife, comprising 4 mammal species, 10 reptile species, and 25 bird species. Among these, several species are endemic to Sulawesi, such as *Macaca maura*, *Tyto rosenbergii*, and *Loriculus stigmatus*, which are also listed as nationally protected species. These findings reinforce the argument that this area holds strategic value for biodiversity conservation, as highlighted by those who emphasised the importance of Sulawesi's hilly landscapes and secondary forests as refuges for rare and endemic species.

The presence of *Macaca maura* in this area reflects the ecological function of secondary forests as critical habitats for endemic primates [13], a study indicated that this primate species is more commonly found along forest edges and transitional zone conditions that align with the topography of Bissoloro, which is characterized by hilly terrain adjacent to the Takalar Protected Forest. A list of the recorded fauna species in the Bissoloro Educational Forest is presented in Table 1.

Table 1. Identified Wildlife Species

Indonesian/Local Name	Scientific Name	Observation
A.　Mammals		
Monyet Dare#*	*Macaca maura*	Direct Observation
Kucing Hutan	*Prionailurus sp*	Direct Observation
Babi Hutan	*Sus barbatus*	Direct Observation
Musang	*Viverricula sp*	Nest Evidence
B.　Reptiles		
Kadal Coklat	*Eutropis rudis*	Direct Observation
Kadal Hijau	*Lamprolepis smaragdina*	Direct Observation
Bunglon	*Gonychepalus sp*	Direct Observation
Tokek	*Gekko sp*	Direct Observation
Cicak kayu	*Hemidactylus frenatus*	Direct Observation
Ular Daun	*Trimeresurus albolabris*	Community Info (documented)
Ular Sawah	*Phyton reticulates*	Community Info (documented)
Ular Hitam	*Boiga sp*	Community Info (documented)
Katak Sawah	*Fejervarya cancrivora*	Direct Observation
Katak Terbang	*Rhacophorus edentulus*	Direct Observation
C.　Birds		
Kutilang	*Pycnonotus aurigaster*	Direct Observation
Burung Hantu #	*Tyto rosenbergii*	Direct Observation
Elang Hitam*	*Ictinaetus malaiensis*	Direct Observation
Elang Putih*	*Haliaeetus leucogaster*	Direct Observation
Gagak Hutan	*Corvus enca*	Direct Observation
Burung Gereja	*Passer montanus*	Direct Observation
Semak Loreng	*Turnix suscitator*	Direct Observation
Wiwik kelabu	*Cacomantis merulinus*	Direct Observation
Serindit Sulawesi#*	*Loriculus stigmatus*	Direct Observation
Kuntul Kecil	*Egretta garzetta*	Direct Observation

Srigunting Jambul	*Dicrurus hottentotus*	Direct Observation
Bondol Rawa	*Lanchura malacca*	Direct Observation
Sriti	*Collocalia linchi*	Direct Observation
Layang-layang	*Hirundo rustica*	Direct Observation
Madu Sriganti	*Cinnyris jugularis*	Direct Observation
Burung Kacamata	*Zosterops palpebrosus*	Direct Observation
Kancilan Perut kuning#	*Pachycephala sulfuriventer*	Direct Observation
Tekukur	*Streptopelia chinensis*	Direct Observation
Bangau Besar	*Leptoptilos dubius*	Direct Observation
Walet	*Collocalia esculenta*	Direct Observation
Kepodang Emas	*Oriolus chinensis*	Direct Observation
Raja Perling Sulawesi#	*Basilornis celebensis*	Direct Observation
Burung Madu	*Myzomela sanguinolenta*	Direct Observation
Cekakak Sungai	*Halcyon chloris*	Direct Observation
Ayam Hutan	*Gallus-gallus*	Direct Observation

Note:
*Endemic species
Protected under the Regulation of the Minister of Environment and Forestry No. P.106/MENLHK/SETJEN/KUM.1/12/2018

Importance Value Index of Bird

Based on data analysis, the bird species *Pycnonotus aurigaster* exhibited the highest Importance Value Index (INP) at 38.19%, supported by a relative frequency of 19.61% and a relative dominance of 18.58%. This figure indicates that the species is the most dominant and widely distributed bird at the observation site. According to the classification [14], species with dominance values exceeding 5% can be categorized as dominant species. Thus, *Pycnonotus aurigaster*, along with *Lonchura malacca* and *Hirundo rustica*, forms the core structure of the bird community in this area.

The dominance of *Pycnonotus aurigaster* can be ecologically interpreted as a reflection of its adaptability to habitat changes, characterizing it as a generalist species. It is commonly found in forest edge areas or in lightly modified environments, such as gardens and agricultural lands [15]. This condition suggests that parts of the Bissoloro area may have experienced low-level human intervention. The results of the data analysis on the importance value index of bird species at the study site are presented in Table 2.

Table 2. Importance Value Index of Bird Species

Scientific Name	F	FR (%)	D (ind/ha)	DR (%)	INP (%)
Pycnonotus aurigaster	0.71	19.61	5.88	18.58	38.19
Tyto rosenbergii	0.12	3.32	0.65	2.05	5.37
Passer montanus	0.18	4.97	1.96	6.19	11.16
Turnix suscitator	0.18	4.97	0.98	3.09	8.06
Cacomantis merulinus	0.12	3.32	0.65	2.05	5.37
Loriculus stigmatus	0.06	1.66	0.65	2.05	3.71
Egretta garzetta	0.06	1.66	0.33	1.04	2.70
Dicrurus hottentotus	0.18	4.97	1.63	5.15	10.12
Lanchura malacca	0.29	8.01	4.90	15.47	23.48
Collocalia linchi	0.12	3.32	0.98	3.09	6.41
Hirundo rustica	0.35	9.66	3.59	11.34	21.00
Cinnyris jugularis	0.18	4.97	1.31	4.14	9.11
Zosterops palpebrosus	0.35	9.66	2.94	9.28	18.94
Streptopelia chinensis	0.24	6.63	1.31	4.14	10.77
Leptoptilos dubius	0.06	1.66	0.65	2.05	3.71
Collocalia esculenta	0.24	6.63	1.63	5.15	11.78
Oriolus chinensis	0.12	3.32	0.98	3.09	6.41
Basilornis celebensis	0.06	1.66	0.65	2.05	3.71
Total	3.62	100	31.67	100	200

Abundance and Diversity Index of Bird

The calculation of the Shannon-Wiener diversity index (H') yielded a value of 2.59, which falls within the category of moderate diversity. A value between 2 and 3 indicates that the community possesses a sufficient level of stability to withstand external pressures without experiencing significant functional loss. This result is comparable to findings from studies conducted in the Unhas Tamalanrea Educational Forest and the Gunung Nona Nature Reserve, which recorded H' values of 2.72 and 2.41, respectively [16].

This level of diversity suggests that although Bissoloro is not a primary forest, it is still capable of supporting a balanced bird community. The presence of endemic and protected species further reinforces the notion that the area has not undergone severe ecological degradation. However, the low frequency of species such as *Loriculus stigmatus* and *Tyto rosenbergii* warrants attention, as noted [17], [18] since such patterns may indicate habitat disturbance or pressure from human activities. Detailed results on bird species abundance and diversity are presented in Table 3.

Table 3. Results of Data Analysis on Bird Species Abundance and Diversity

No	Indonesian/ Local Name	Scientific Name	∑	PI	H'
1	Kutilang	*Pycnonotus aurigaster*	18	0.19	0.32
2	Burung Hantu	*Tyto rosenbergii*	2	0.02	0.08
3	Burung Gereja	*Passer montanus*	6	0.06	0.17
4	Semak Loreng	*Turnix suscitator*	3	0.03	0.11
5	Wiwik kelabu	*Cacomantis merulinus*	2	0.02	0.08
6	Serindit Sulawesi	*Loriculus stigmatus*	2	0.02	0.08
7	Kuntul Kecil	*Egretta garzetta*	1	0.01	0.05
8	Srigunting Jambul	*Dicrurus hottentotus*	5	0.05	0.15
9	Bondol Rawa	*Lanchura malacca*	15	0.16	0.29
10	Sriti	*Collocalia linchi*	3	0.03	0.11
11	Layang-layang	*Hirundo rustica*	11	0.11	0.24
12	Madu Sriganti	*Cinnyris jugularis*	4	0.04	0.13
13	B. Kacamata	*Zosterops palpebrosus*	9	0.01	0.23
14	Tekukur	*Streptopelia chinensis*	4	0.04	0.13
15	Bangau Besar	*Leptoptilos dubius*	2	0.02	0.08
16	Walet	*Collocalia esculenta*	5	0.05	0.15
17	Kepodang Emas	*Oriolus chinensis*	3	0.03	0.11
18	Raja Perling Sulawesi	*Basilornis celebensis*	2	0.02	0.08
Total			97	1	2.59

Ecologically, the presence of apex predators such as *Ictinaetus malaiensis* and *Haliaeetus leucogaster*, along with nectarivorous species such as *Cinnyris jugularis* and *Zosterops palpebrosus*, indicates that key ecological processes, including food chain dynamics and pollination of flowering plants, are still functioning properly within the area [19], [20], [21].

From a conservation perspective, the discovery of species protected under the Regulation of the Minister of Environment and Forestry No. P.106/2018 further

strengthens the rationale for protecting this area through a campus-based conservation approach. This approach aligns with landscape-based conservation strategies as outlined in the national biodiversity strategy document, and supports the Merdeka Belajar Kampus Merdeka (MBKM) policy, which promotes experiential research and learning.

Conclusion

This study successfully identified a total of 39 fauna species in the Bissoloro Educational Forest, Gowa Regency, South Sulawesi, consisting of 4 mammals, 10 reptiles, and 25 birds. Several of these are nationally protected and endemic species, such as *Macaca maura*, and *Loriculus stigmatus*. These findings reinforce the ecological significance of the area as an important habitat for Sulawesi's native fauna. The analysis of bird community structure revealed that *Pycnonotus aurigaster* was the most dominant species, with an Importance Value Index (INP) of 38.19%. The Shannon-Wiener diversity index (H') of 2.59 indicates a moderate level of diversity, reflecting a relatively stable ecosystem condition. The presence of indicator species, such as raptors and nectarivorous birds, suggests that key ecosystem functions such as population control and pollination are still operating naturally. These conditions position the Bissoloro Educational Forest as a strategic site for the development of environmental education programs, biodiversity research, and field-based conservation training.

References

[1] M. J. Struebig *et al.*, "Safeguarding imperiled biodiversity and evolutionary processes in the Wallacea center of endemism," *Bioscience*, vol. 72, no. 11, pp. 1118–1130, 2022.https://doi.org/10.1093/biosci/biac085

[2] H. Assidiq, N. H. Al Mukarramah, and S. N. Bachril, "Threats to the sustainability of biodiversity in Indonesia by the utilization of forest areas for national strategic projects: A normative review," in *IOP Conference Series: Earth and Environmental Science*, IOP Publishing, 2021, p. 012071.DOI 10.1088/1755-1315/886/1/012071

[3] M. A. Ridha, M. D. Kusrini, A. Mardiastuti, and N. Karraker, "The amphibians and reptiles of Rawa Aopa Watumohai national park, southeast Sulawesi," *Media Konservasi*, vol. 26, no. 2, pp. 128–138, 2021. https://doi.org/10.29244/medkon.26.2.128-138

[4] A. RIYANTO and C. RAHMADI, "Amphibian and reptile diversity of peleng island, banggai kepulauan, Central Sulawesi, Indonesia," *Biodiversitas*, vol. 22, no. 5, 2021.https://doi.org/10.13057/biodiv/d220558

[5] K. Parajuli and P. Ghimire, "Farmland Birds and their Importance in Agro ecosystem: A Review," *International Research Journal of MMC (IRJMMC)*, vol. 5, no. 4, pp. 158–168, 2024. https://doi.org/10.3126/irjmmc.v5i4.70828

[6] N. G. Raj, "Insect Ecological Interactions: From Trophic Cascades to Ecosystem Services," in *Entomology Redefined*, CRC Press, 2024, pp. 220–232.

[7] D. E. Jacob, I. U. Nelson, S. C. Izah, E. Ukpong, U. U. Akpan, and M. C. Ogwu, "Bioindicators in recreational planning and development: balancing nature and human activities," in *Biomonitoring of pollutants in the global south*, Springer, 2024, pp. 835–878. https://doi.org/10.1007/978-981-97-1658-6_24

[8] A. A. METANANDA *et al.*, "Human-macaque conflicts at a human settlement in Riau Province, Indonesia," *Biodiversitas*, vol. 25, no. 9, 2024.https://doi.org/10.13057/biodiv/d250915

[9] M. T. Zaluar, R. Tardin, D. Llusia, J. Niemeyer, M. C. Ribeiro, and M. M. Vale, "Impact of invasive marmosets (Primates, Callitrichidae) on bird acoustic diversity in a large neotropical urban forest," *Biol Invasions*, vol. 24, no. 6, pp. 1725–1737, 2022.https://doi.org/10.1007/s10530-022-02748-z

[10] G. Gebremichael, K. Hundera, L. De Decker, R. Aerts, L. Lens, and A. Atickem, "Bird community composition and functional guilds response to vegetation structure in Southwest Ethiopia," *Forests*, vol. 13, no. 12, p. 2068, 2022.https://doi.org/10.3390/f13122068

[11] Prajawati, Budimawan, and A. Saru, "Development analysis of mangrove ecotourism land suitability and carrying capacity of the Mangrove area of Bebanga, Mamuju Regency, West Sulawesi Province.," 2021.

[12] S. H. Larekeng *et al.*, "A diversity index model based on spatial analysis to estimate high conservation value in a mining area," *Forest and Society*, vol. 6, no. 1, pp. 142–156, 2022.

[13] E. P. Riley *et al.*, "The potential conservation value of anthropogenically modified habitat for the Endangered moor macaque Macaca maura in Sulawesi, Indonesia," *Oryx*, vol. 57, no. 5, pp. 600–610, 2023.https://doi.org/10.1017/S003060532200151X

[14] G. G. Mangini *et al.*, "A classification scheme for mixed-species bird flocks," *Philosophical Transactions of the Royal Society B*, vol. 378, no.

1878, p. 20220100, 2023.https://doi.org/10.1098/rstb.2022.0100

[15] C. M. A. Franklin, K. A. Harper, and M. J. Clarke, "Trends in studies of edge influence on vegetation at human-created and natural forest edges across time and space," *Canadian Journal of Forest Research*, vol. 51, no. 2, pp. 274–282, 2021.https://doi.org/10.1139/cjfr-2020-0308

[16] A. U. B. Putri, R. I. Maulany, and A. Achmad, "Identifying management strategies for the development of wildlife-based ecotourism: A study case of Sulawesi bear cuscus (Ailurops ursinus) inhabited the Educational Forest of Hasanuddin University, Maros," in *IOP Conference Series: Earth and Environmental Science*, IOP Publishing, 2022, p. 012044.DOI 10.1088/1755-1315/1115/1/012044

[17] D. F. Teixeira *et al.*, "Effect of anthropic disturbances on the activity pattern of two generalist mesocarnivores inhabiting Mediterranean forestry plantations," *Biodivers Conserv*, vol. 32, no. 4, pp. 1251–1270, 2023. https://doi.org/10.1007/s10531-023-02548-4

[18] T. S. Doherty, G. C. Hays, and D. A. Driscoll, "Human disturbance causes widespread disruption of animal movement," *Nat Ecol Evol*, vol. 5, no. 4, pp. 513–519, 2021.https://doi.org/10.1038/s41559-020-01380-1

[19] A. M. Fernandes, O. de Souza Teixeira, E. B. Garcia, M. L. C. Matos, G. B. da Costa Matos, and R. D. Pazdiora, "Biodiversidade na Amazônia Brasileira: Prospecção Científica e Tecnológica," *Fronteira: Journal of Social, Technological and Environmental Science*, vol. 14, no. 2, pp. 225–245, 2025.https://doi.org/10.21664/2238-8869.2025v14i2.p225-245

[20] F. Requier, N. Pérez-Méndez, G. K. S. Andersson, E. Blareau, I. Merle, and L. A. Garibaldi, "Bee and non-bee pollinator importance for local food security," *Trends Ecol Evol*, vol. 38, no. 2, pp. 196–205, 2023.https://doi.org/10.1016/j.tree.2022.10.006

[21] J. Bascompte and M. Scheffer, "The resilience of plant–pollinator networks," *Annu Rev Entomol*, vol. 68, no. 1, pp. 363–380, 2023.https://doi.org/10.1146/annurev-ento-120120-102424