



Diversity and Abundance of Mammals and Aves in the Gunung Leuser National Park Area, Bukit Lawang, Bahorok District, Langkat Regency, North Sumatra

Kaniwa Berliani* , Ahmad Luthfi Abdillah Nasution , Hermansyah, Oky Kusuma Atni , Siti Mardhatillah, Putri Amelia Lubis, Sinta R Pardosi, Safira Mustaqilla.

Department of Biology, Faculty of Mathematics and Natural Sciences, Universitas Sumatera Utara, Medan 20155, Indonesia

*Corresponding Author: kaniwa.berliani@usu.ac.id

ARTICLE INFO

Article history:

Received 9 August 2024

Revised 29 August 2024

Accepted 20 September 2024

E-ISSN: 2656-0674

How to cite:

Kaniwa Berliani, Ahmad Luthfi Abdillah Nasution, Hermansyah, Oky Kusuma Atni, Siti Mardhatillah, Putri Amelia Lubis, Sinta R Pardosi, and Safira Mustaqilla, "Diversity and abundance of mammals and birds in the Gunung Leuser National Park area, Bukit Lawang, Bahorok District, Langkat Regency, North Sumatra," *International Journal of Ecophysiology*, 6(2), 159-166.

ABSTRACT

Gunung Leuser National Park, located in Bukit Lawang, Langkat Regency, is renowned for its rich biodiversity, hosting a significant number of bird and mammal species. This study aimed to assess the diversity and abundance of mammals and birds in the park. Conducted from May 23 to 25, 2024, using Visual Encounter Surveys (VES) along a 1,000-meter transect, the research identified 8 mammal species with a total of 84 individuals, including *Presbytis thomasi* and *Macaca fascicularis* as the most prevalent. Additionally, 12 bird species with 87 individuals were recorded, dominated by the Hirundinidae family, notably *Hirundo rustica* and *Hirundo tahitica*. Diversity indices indicated moderate species diversity for both mammals ($H' = 1.58$) and birds ($H' = 2.02$), with high evenness ($E = 0.78$) in both groups, suggesting stable communities. The results highlight the park's significant biodiversity and the need for repeated surveys to refine data accuracy and enhance conservation efforts.

Keyword: Abundance, Diversity, aves, mammals

ABSTRAK

Taman Nasional Gunung Leuser, yang terletak di Bukit Lawang, Kabupaten Langkat, terkenal karena keanekaragaman hayatinya yang kaya, dengan banyak spesies burung dan mamalia. Penelitian ini bertujuan untuk menilai keanekaragaman dan kelimpahan mamalia serta burung di taman tersebut. Dilakukan dari 23 hingga 25 Mei 2024, menggunakan Survei Penampakan Visual (VES) sepanjang transek 1.000 meter, penelitian ini mengidentifikasi 8 spesies mamalia dengan total 84 individu, termasuk *Presbytis thomasi* dan *Macaca fascicularis* sebagai yang paling umum. Selain itu, tercatat 12 spesies burung dengan 87 individu, didominasi oleh keluarga Hirundinidae, terutama *Hirundo rustica* dan *Hirundo tahitica*. Indeks keanekaragaman menunjukkan keanekaragaman spesies yang moderat untuk mamalia ($H' = 1,58$) dan burung ($H' = 2,02$), dengan keseragaman yang tinggi ($E = 0,78$) di kedua kelompok, menunjukkan komunitas yang stabil. Hasil ini menyoroti keanekaragaman hayati penting di taman tersebut dan perlunya survei berulang untuk meningkatkan akurasi data dan memperkuat upaya konservasi.

Kata Kunci: Kelimpahan, Keanekaragaman, burung, mamalia



This work is licensed under a Creative Commons Attribution-ShareAlike 4.0 International.
<http://doi.org/10.32734/ijoeip.v6i2.18060>

1. Introduction

Gunung Leuser is a conservation area that hosts 380 bird species, making it one of the locations with the highest number of bird species in the world. Among these, several bird species have their native habitat in the Gunung Leuser area. A total of 50 endemic bird species are found in Gunung Leuser, and 36 of them have their natural habitat in this region. Additionally, 65% of Sumatra's mammal species, both large and small, are recorded in Gunung Leuser [1]. Some important mammal species (key species) in Gunung Leuser National Park include the Sumatran Orangutan (*Pongo abelii*), Lar Gibbon (*Hylobates lar*), Siamang (*Hylobates syndactylus*), Long-tailed Macaque (*Macaca fascicularis*), Pig-tailed Macaque (*Macaca nemestrina*), Thomas's Langur (*Presbytis thomasi*), Clouded Leopard (*Neofelis nebulosa*), Sun Bear (*Helarctos malayanus*), Sumatran Tiger (*Panthera tigris sumatrae*), Asian Elephant (*Elephas maximus*), Sumatran Rhinoceros (*Dicerorhinus sumatrensis*), Saltwater Crocodile (*Crocodylus porosus*), and the Sumatran Serow (*Capricornis sumatraensis*) [2].

Gunung Leuser National Park is a conservation area and tourist destination in North Sumatra, with Bukit Lawang and Tangkahan as key attractions. Recognized by UNESCO as part of the Tropical Rainforest Heritage of Sumatra, Gunung Leuser National Park plays a crucial role in preserving biodiversity and natural habitats for important species. However, Gunung Leuser National Park faces threats from human activities such as illegal logging, land encroachment, fires, and vandalism. The management of Gunung Leuser National Park is designed to provide economic, ecological, social, and cultural benefits in a sustainable manner [3]. There are two factors that influence animal population dynamics: density-dependent and density-independent. Density-dependent factors are influenced by population density and include accidents, disease, predation, and competition, while density-independent factors include natural disasters, weather, and climate. Animal populations that are undisturbed tend to reach equilibrium, although migration, death, and birth continue to affect individual composition [4]. Deforestation for palm oil plantations through the land clearing system threatens wildlife ecology, causing habitat loss and a decrease in both species diversity and fauna abundance. Wildlife is pushed into the remaining habitats, such as riverbanks and steep hills. Forest degradation continues to reduce fauna populations due to the expansion of palm oil plantations [5].

Exploration is the activity of tracking, surveying, and collecting specific genetic resources for utilization and protection from extinction. The objectives of exploration include two main aspects. First, identifying species that are unknown or not yet recorded in taxonomy, which hold significant scientific and conservation value. Second, gathering data and information on dominant animals in a particular region, which may have potential for further development [6]. Therefore, further research on the species richness in Gunung Leuser National Park, particularly in Bukit Lawang, is urgently needed, given the rapid population growth and increasing pressure on the ecosystem in the area.

2. Method

2.1 Field collection

This research was conducted from May 23 to 25, 2024, in Bukit Lawang, Bahorok District, Langkat Regency, North Sumatra Province. The identification process was carried out in the Animal Systematics Laboratory, Department of Biology, Faculty of Mathematics and Natural Sciences, Universitas Sumatera Utara, Medan. The method used in the field was VES (Visual Encounter Survey), by exploring the trekking path in Gunung Leuser National Park with a total observation track length of 1000 meters. At every 200-meter interval, Point Count observations were made by stopping at predetermined 200-meter interval points for 15 minutes, observing each wildlife encounter directly, or through signs of presence such as tracks, droppings, nests, soil diggings, scratches, etc. Each wildlife encounter was marked with coordinates using GPS and recorded in Tallysheets.

2.2 Data analysis

The identification of wildlife was conducted using guidebooks such as Birds of Sumatra, Java, Kalimantan, and Bali for birds [7], Mammals of Kalimantan, Sabah, Sarawak, and Brunei Darussalam [8], and Mammals of South-East Asia for mammals [9]. The identified species were counted and analyzed using diversity and evenness indices. Species abundance (π) was calculated by comparing the number of individuals of a species with the total number of individuals of all species, while species diversity was analyzed using the Shannon index (H') and Uniformity index (E) was calculated using the Shannon-Wiener formula.

3. Results and discussion

Based on the research that has been done, mammals and birds were obtained. all encounters of mammals and birds were recorded with their coordinates which were then mapped on a map. the presentation on the map uses the local names of the animals found such as Bajing/Plantain Squirrel (*Callosciurus notatus*), Monkey/Long-Tailed Macaque (*Macaca fascicularis*), Beruk/Pig-Tailed Macaque (*Macaca Nemestrina*), Argus King/Great Argus (*Argusianus argus*) as can be seen in table 1. The location of the encounter of each type mapped on the map can be seen in figure 1.

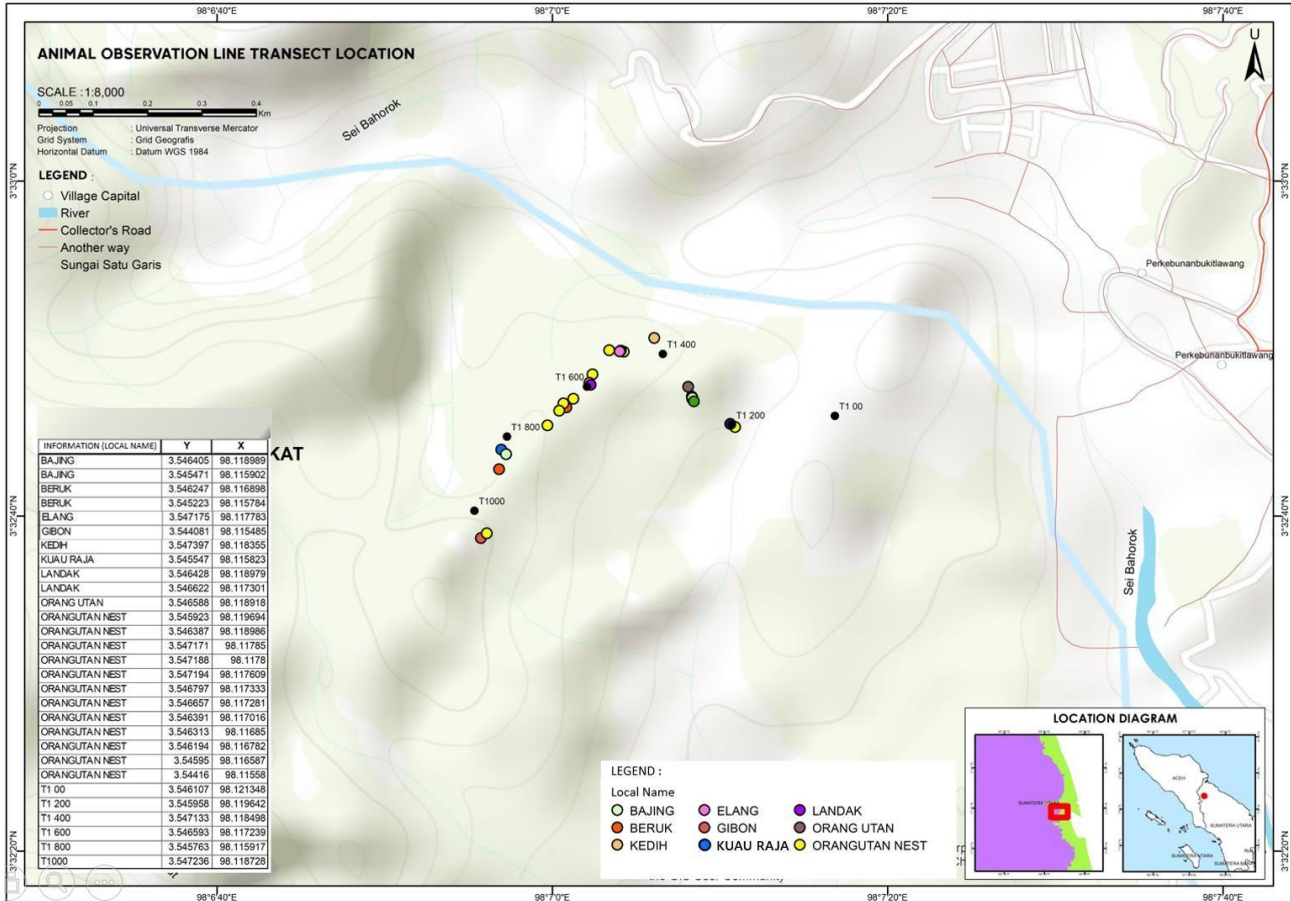


Figure 1. Map of observation points in the Gunung Leuser National Park Bukit Lawang Area, Langkat Regency

3.1 Mammals and birds diversity

In the Gunung Leuser National Park, Bukit Lawang Area, Langkat Regency, a total of 8 mammal species were identified, with 84 individuals from 4 families and 2 orders. The most numerous species was the Thomas's Leaf Monkey (*Presbytis thomasi*) with 29 individuals, followed by the Long-tailed Macaque (*Macaca fascicularis*). The least common species were the Siamang (*Hylobates lar*) and the Tree Squirrel (*Callosciurus notatus*), each with only 1 individual. For birds, 12 species were recorded, totaling 87 individuals from 7 families and 4 orders. The most abundant species were the Hirundinidae family, with the Asian Swallow (*Hirundo rustica*) having 24 individuals and the Rock Swallow (*Hirundo tahitica*) with 12 individuals.

Table 1. Mammals and birds diversity in the Gunung Leuser National Park Bukit Lawang Area, Langkat Regency

Ordo	Family	Species	Local Name	English Name	Conservation status
Mammals					
Primata	Cercopithecidae		Monyet ekor panjang	Long-Tailed Macaque	Endangered
			Beruk	Pig-Tailed Macaque	Endangered
		<i>Macaca nemestrina</i>	Kedih	Thomas Langur	Vulnerable

		<i>Trachypithecus cristatus</i>	Lutung	Monkey Gray Langurs	Vulnerable
	Hominidae	<i>Pongo abelii</i>	Orang utan	Orangutan	Critically endangered
	Hylobatidae	<i>Hylobates lar</i>	Owa sarudung	Lar Gibbon	Endangered
Rodentia	Sciuridae	<i>Callosciurus notatus</i>	Bajing kelapa	Plantain Squirrel	Least concern
		<i>Callosciurus prevostii</i>	Tupai tiga warna	Prevost's Squirrel	Least concern

Birds

Accipitriformes	Accipitridae	<i>Nisaetus cirrhatus</i>	Elang brontok	Changeable Hawk-Eagle	Least concern
		<i>Phaenicophaeus diardi</i>	Kadalan beruang	Black-bellied Malkoha	Near threatened
Cuculiformes	Cuculidae	<i>Argusianus argus</i>	Kuau raja	Great Argus	Vulnerable
Galliformes	Phasianidae		Layang-layang asia	Barn Swallow	Least concern
Passeriformes	Hirundinidae	<i>Hirundo rustica</i>	Layang layang batu	Pacific Swallow	Least concern
		<i>Hirundo tahitica</i>			
	Nectariniidae	<i>Anthreptes malacensis</i>	Madu kelapa	Brown-throated Subbird	Least concern
		<i>Anthreptes simplex</i>	Madu polos	Plain Sunbird	Least concern
		<i>Cinnyris jugularis</i>	Madu sriganti	Olive-backed sunbird	Least concern
	Pycnonotidae	<i>Pycnonotus aurigaster</i>	Kutilang	Sooty-headed Bulbul	Least concern
		<i>Pycnonotus goiavier</i>	Cerocok	Yellow-vented Bulbul	Least concern
	Zosteropidae	<i>Zosterops melanurus</i>	Kacamata biasa	Sangkar White-eye	Vulnerable
		<i>Zosterops montanus</i>	Kacamata gunung	Mountain White-eye	Least concern

Table 1. presents the diversity of mammals and birds in Gunung Leuser National Park, Bukit Lawang, Langkat, along with their conservation status. Among mammals, primate species such as *Macaca fascicularis* and *Macaca nemestrina* are classified as Endangered, while *Presbytis thomasi* and *Trachypithecus cristatus* are listed as Vulnerable. *Pongo abelii* is noted as the most critically threatened species with a Critically Endangered status, while *Hylobates lar* is also classified as Endangered (Figure 2.). Small mammals such as *Callosciurus notatus* and *Callosciurus prevostii* are listed as Least Concern, indicating more stable populations. Among birds, several species like *Hirundo rustica* and *Hirundo tahitica* are categorized as Least Concern, with exceptions for *Phaenicophaeus diardi*, which is Near Threatened, and *Argusianus argus*, which is Vulnerable. *Zosterops melanurus* is also classified as Vulnerable, indicating that some bird species are under threat, while most others maintain relatively stable populations.

Mammals play a crucial role in ecosystems, both as prey and predators, occupying various trophic levels such as herbivores, insectivores, carnivores, and omnivores. Groups such as primates and bats are important for seed dispersal and pollination, which are vital for forest regeneration and insect population control [10]. Meanwhile, birds serve as seed dispersers, natural pollinators, and predators, and they also aid in the decomposition of dead wood. Bird diversity often reflects ecosystem balance. However, species decline due to hunting threatens ecological balance, making conservation efforts necessary [11].

Table 2. Coordinate points of distribution Mammals and birds in the Gunung Leuser National Park Bukit Lawang Area, Langkat Regency

Sampling Points	Coordinate Points (Latitude, Longitude)
0-200 <i>Presbytis thomasi</i>	Northern: 3.546107-3.45958, Eastern: 98.121348-98.119642 3.544768, 98.118856

200-400	Northern: 3.545958-3.547133, Eastern: 98.119642-98.118498
<i>Hylobates lar</i> Call	3.545923, 98.119694
<i>Pongo abelii</i> Nest	3.546387, 98.118986
<i>Callosciurus notatus</i>	3.546405, 98.118989
<i>Pongo abelii</i>	3.546588, 98.118918
400-600	Northern: 3,547133-3,546593, Eastern: 98,118498-98,117239
<i>Presbytis thomasi</i>	3.547397, 98.118355
<i>Pongo abelii</i> Nest	3.547171, 98.11785
<i>Pongo abelii</i> Nest	3.547188, 98.1178
<i>Nisaetus cirrhatus</i>	3.547175, 98.117783
<i>Pongo abelii</i> Nest	3.547194, 98.117609
<i>Pongo abelii</i> Nest	3.546797, 98.117333
<i>Pongo abelii</i> Nest	3.546657, 98.117281
600-800	Northern: 3,546593-3,545763, Eastern: 98,117239-98,115917
<i>Pongo abelii</i> Nest	3.546391, 98.117016
<i>Macaca nemestrina</i>	3.546247, 98.116898
<i>Pongo abelii</i> Nest	3.546313, 98.11685
<i>Pongo abelii</i> Nest	3.546194, 98.116782
<i>Pongo abelii</i> Nest	3.54595, 98.116587
800-1000	Northern: 3,545763-3,547236, Eastern: 98,115917-98,118728
<i>Argusianus argus</i>	3.545547, 98.115823
<i>Callosciurus prevostii</i>	3.545471, 98.115902
<i>Macaca nemestrina</i>	3.545223, 98.115784
<i>Hylobates lar</i>	3.544081, 98.115485
<i>Pongo abelii</i> Nest	3.54416, 98.11558

Table 2. shows the mammal and bird species found within a transect distance of 0 to 1,000 meters. The most frequently encountered species was the *Presbytis thomasi*. This is due to the fact that the growth and reproduction of the Thomas's Leaf Monkey are closely linked to the dynamics of its habitat. Better habitat conditions lead to better population growth. As an arboreal species, the Thomas's Leaf Monkey relies heavily on trees, as tree branches serve as bridges connecting different canopies during movement [12]. According to Ruskhanidar *et al.*, [13], the survival of the Thomas's Leaf Monkey is influenced by the presence of other primate species such as the *Symphalangus syndactylus*, *Macaca fascicularis*, and *Macaca nemestrina*. These species create competition for space and food resources, especially for food and sleeping trees. The daily movement of the Thomas's Leaf Monkey, known as daily travel, is essential for finding food. As noted by Alikodra [12], all wildlife, including primates, engages in daily movement to obtain food. These movements can be both vertical and horizontal. Vertically, the Thomas's Leaf Monkey moves within specific vegetation heights for safety and food. Horizontally, it moves between trees in search of food, sometimes traveling hundreds of meters from its sleeping tree.



Figure 2. Types of primates in Gunung Leuser National Park Bukit Lawang Area, Langkat Regency, (A) *Macaca fascicularis*; (B) *Macaca nemestrina*; (C) *Presbytis thomasi*; (D) *Trachypithecus cristatus*; (E) *Pongo abelii*; (F) *Hylobates lar*.

3.1 Mammals and birds abundance

Table 3. Species abundances of Mammals and birds in the Gunung Leuser National Park Bukit Lawang Area, Langkat Regency

Species	Number of individuals	Abundance (%)
Mammals		
<i>Macaca fascicularis</i>	23	27.4
<i>Macaca nemestrina</i>	12	14.3
<i>Presbytis thomasi</i>	29	34.5
<i>Trachypithecus cristatus</i>	14	16.7
<i>Pongo abelii</i>	2	2.4
<i>Hylobates lar</i>	1	1.2
<i>Callosciurus notatus</i>	1	1.2
<i>Callosciurus prevostii</i>	2	2.4
Total	84	100
Birds		
<i>Nisaetus cirrhatus</i>	1	1.1
<i>Phaenicophaeus diardi</i>	1	1.1
<i>Argusianus argus</i>	12	13.8
<i>Hirundo rustica</i>	24	27.6
<i>Hirundo tahitica</i>	18	20.7
<i>Anthreptes malacensis</i>	3	3.4
<i>Anthreptes simplex</i>	8	9.2
<i>Cinnyris jugularis</i>	2	2.3
<i>Pycnonotus aurigaster</i>	4	4.6
<i>Pycnonotus goiavier</i>	11	12.6
<i>Zosterops melanurus</i>	2	2.3
<i>Zosterops montanus</i>	1	1.1
Total	87	100

Table 3 presents species abundance data for mammals and birds in Gunung Leuser National Park, Bukit Lawang, Langkat Regency. Among the 8 mammal species, with a total of 84 individuals, *Presbytis thomasi* (34.5%) and *Macaca fascicularis* (27.4%) are the most dominant, while other species, such as *Pongo abelii* and *Hylobates lar*, were recorded with only a few individuals. For birds, 12 species were documented, totaling 87 individuals, with *Hirundo rustica* (27.6%) and *Hirundo tahitica* (20.7%) being the most abundant. Other bird species, such as *Argusianus argus* and *Pycnonotus goiavier*, were also relatively numerous, while some were observed in smaller numbers. *Presbytis thomasi*, also known as Thomas's Leaf Monkey, was the most frequently observed species, with 29 individuals recorded. This species typically lives in groups of 7 to 10 individuals, led by a single adult male along with females and their offspring [14] [15]. Mammal inventories, conducted using line transect methods, gather data through direct and indirect observations of animals and their signs (Junaidi *et al.*, 2012). These inventories are essential for monitoring species and their habitats. *Callosciurus notatus*, a diurnal species commonly found in secondary forests and plantations, is frequently observed in direct surveys [16].

The most frequently observed birds belong to the Hirundinidae family, specifically *Hirundo rustica* and *Hirundo tahitica*, with 24 and 18 individuals, respectively. These birds are commonly found in open areas near the observation points and are frequently seen flying and perching on roofs, power lines, and tree branches. According to Ginting *et al.*, [17], swallows, which often perch on buildings and power lines, prefer to land on roofs due to their small size and strong toe claws that grip tightly to cables. They fly quickly to catch insects and are typically found in dry habitats above trees and grass. A notable observation was of the *Argusianus argus* (Kaua Raja), where both males, females, and juveniles were seen in a mating ring area. This behavior is rare, as only about 1% of bird species exhibit such behavior during mating [18]. The Great Argus is a shy bird that avoids close encounters but has a loud and powerful call that resonates clearly across the forest.

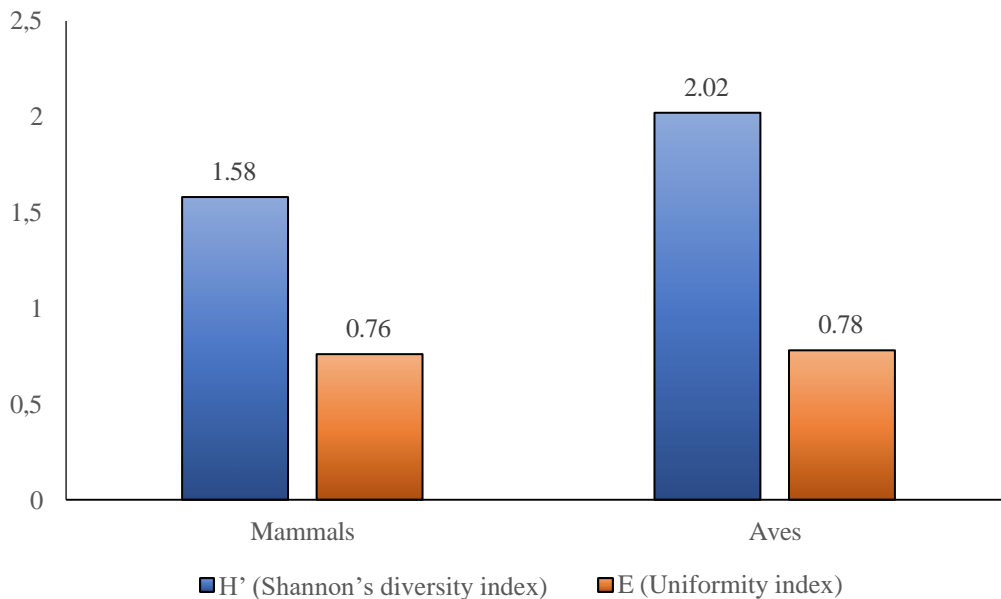


Figure 3. Bar plot of the Shannon's diversity index (H') and uniformity index (E) of Mammals and Birds in Gunung Leuser National Park Bukit Lawang Area, Langkat Regency.

Figure 3. shows the diversity index (H') for mammals indicates a moderate level of diversity, while the evenness index (E) for mammals is high. According to Paulangan *et al.*, [19], moderate diversity suggests a moderate distribution of individuals among species, moderate community stability, and a community that is prone to change. A high evenness index indicates a stable community. Similarly, the diversity index (H') for birds also falls into the moderate category, while the evenness index (E) for birds is high. The conclusions drawn are based on a single survey, so further observations are needed to achieve more accurate results.

4. Conclusion

In the Gunung Leuser National Park, Bukit Lawang Area, Langkat Regency, 8 mammal species were identified with a total of 84 individuals across 4 families and 2 orders. The most numerous species was the *Presbytis thomasi* with 29 individuals, followed by the *Macaca fascicularis*. The least common species were the *Hylobates lar* and *Callosciurus notatus*, each with only 1 individual. The mammal diversity index (H') was 1.58, indicating moderate diversity, while the evenness index (E) was 0.78, indicating high evenness. For birds, 12 species were recorded with a total of 87 individuals across 7 families and 4 orders. The most abundant were the Hirundinidae family, including *Hirundo rustica* with 24 individuals and *Hirundo tahitica* with 12 individuals. The bird diversity index (H') was 2.02, indicating moderate diversity, and the evenness index (E) was 0.78, indicating high evenness. The findings suggest that while the diversity is moderate, the community stability is high. Future surveys should involve multiple repetitions to ensure more accurate results.

References

- [1] Djufri, "Ekosistem Leuser Di Provinsi Aceh Sebagai Laboratorium Alam Yang Menyimpan Kekayaan Biodiversitas Untuk Diteliti Dalam Rangka Pencarian Bahan Baku Obat-Obatan," *Pros Sem Nas Masy Biodiv Indon*, 1 (7): 1543-1552, 2015.
- [2] A. Syatriandi, "Estimasi Populasi Kedih (*Presbytis thomasi*) di Stasiun Penelitian Soraya Kawasan Ekosistem Leuser Kecamatan Sultan Daulat Kota Subulussalam," Thesis. Banda Aceh: Universitas Islam Negeri Ar-Raniry Darussalam, 2022.
- [3] Alamsah, Subhan, Martunis, "Identifikasi Jenis-Jenis Ficus (Moraceae) Pada Kawasan Jamur Gele Taman Nasional Gunung Leuser," *Jurnal Ilmiah Mahasiswa Pertanian*, 8 (3): 607-616, 2023.
- [4] D.S. Sumarto, D.R. Koneri, *Ekologi Hewan*. Bandung: CV. Patra Media Grafindo Bandung. Hal: 64, 2016.
- [5] H. Arief, Y. Wicaksono, D. Suryadi, "Keanekaragaman Jenis Satwa Liar di Kawasan Perkebunan Kelapa Sawit dan Status Perlindungannya: Studi Kasus di Kawasan Unit Pengelolaan PT. Agro Karya Prima Lestari," *Jurnal Media Konservasi*, 15 (3): 152-158, 2010.
- [6] L. Dahamarudin, M. Nurdin, "Eksplorasi Dan Konservasi Ex-Situ Plasma Nutfah Ubi Kayu Sebagai Upaya Mewujudkan Ketahanan Pangan Di Maluku," *Jurnal Agrotropika*, 14 (2): 73-80, 2009.
- [7] J.M. Mackinnon, and W. Rahardjaningtrah, *Burung-burung di Sumatera, Jawa, Bali dan Kalimantan: termasuk Sabah, Sarawak dan Brunei Darussalam*, 2010.
- [8] J. Payne, C.M. Francis, K. Phillipps, and S.N. Kartikasari, *Mamalia di Kalimantan, Sabah, Sarawak, dan Brunei Darussalam*. Sabah Society dan Wild Life Conservation Society. Jakarta, 2000.
- [9] C. Francis, *Mammals of South-East Asia*. Bloomsbury Publishing, 2017.
- [10] E. Sulistyadi, "Karakteristik Komunitas Mamalia Besar di Taman Nasional Bali Barat (TNBB)," *Zoo Indonesia*, 25 (2): 142-159, 2016.
- [11] [11] J. Mackinnon, P. Karen, B. Balen, *Seri Panduan Lapangan Burung-Burung Di Sumatera, Jawa, Bali, dan Kalimantan*. Bogor: Puslitbang Biologi-LIPI, 2010.
- [12] H.S. Alikodra, *Ekologi Konservasi Satwaluar Hidup Harmoni Dengan Alam*. Bogor: IPB Press, 2019.
- [13] Ruskhanidar, Rosmalia, S. Iskandar, 2023. "Thomas Langur (*Presbytis Thomasi*) Daily Movement in Jantho Natural Reserve, Aceh Province," *Jurnal Sains Natural Universitas Nusa Bangsa*, 13 (2): 81-91, 2023.
- [14] J. Supriatna, R. Ramadhan, *Pariwisata Primata Indonesia*. Jakarta: Yayasan Pustaka Obor Indonesia, 2016.
- [15] T. Nando, "Hutan dan Perubahan Iklim "Kedih" dalam Biöetin Ulu MasenUteun Tajaga Rakyat Aceh Makmu Beusare Edisi 3 oleh FFI (Faunadan Flora Internasional) Aceh," Banda Aceh, 2008.
- [16] Junaidi, Rizaldi, W. Novarino, "Inventarisasi Jenis-Jenis Mamalia di Hutan Pendidikan dan Penelitian Biologi (HPPB) Universitas Andalas dengan Menggunakan Camera Trap," *Jurnal Biologi UNAND*, 1: 27-34, 2012.
- [17] S.B. Ginting, C.K. Pattinasarany, L. Latupapua, "Kajian Habitat dan Kelimpahan Jenis Burung pada Lingkungan Kampus Universitas Pattimura Poka Ambon," *Jurnal Sylva Scientiae*, 6(5), 798-808, 2023.
- [18] M. Rafi, W. Novarino, Rizaldi, A. Ardiyanto, "Aktivitas Kuau Raja (*Argusianus argus linnaeus*, 1766) Pada Mating Ring Di Hutan Konservasi Kalaweit Supayang, Solok, Sumatera Barat," *Jurnal Metamorfosa* 4(1) : 58-64, 2017.
- [19] Y.P. Paulangan, B. Barapadang, M.A. Amin, and H. Tangkelayuk, "Social-ecological system in Depapre Bay Area of Jayapura Papua Indonesia," In *IOP Conference Series: Earth and Environmental Science* (Vol. 890, No. 1, p. 012070). IOP Publishing, 2021.