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DIVERSITY OF BATS IN HALABAN MONITORING POST AREA SEI BETUNG GUNUNG LEUSER NATIONAL PARK

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ABSTRACT

Halaban Monitoring Post, Sei Betung Resort, Gunung Leuser National Park is a rehabilitated forest restoration location since 2017 after previously being diversified from oil palm land. The location has currently become a habitat for various types of animals, including bats. The identification of bat species at the Halaban Monitoring Post is conducted to assess the presence of fauna, with important ecological roles in pollination. Identification was conducted using mist nets installed at five observation points. Our observations showed that 87 individuals of Microchiroptera family bats were found, belonging to 4 species: Cynopterus brachyotis (38 individuals), Cynopterus minutus (15 individuals), Glischropus tylopus (1 individual), Hipposideros cervinus (33 individuals). Further analysis showed Shannon-Wiener diversity index ranges from 0.0 to 0.94 and Margalef species richness index ranges from 0.0 to 0.69. Bat abundance tends to be evenly distributed with an evenness index of 0.0 to 1.35. There is a dominant species at one of the locations with a dominance index value of 0.85.

Keywords: *bats, diversity, Sei Betung, Gunung Leuser National Park, Chiroptera*

INTRODUCTION

Restoration of the 500-hectare Sei Betung Sub-region has been successfully rehabilitated since 2007 by the Gunung Leuser National Park (GLNP) authorities after being an oil palm plantation for over 15 years. Land cover changes from 2008 to 2016 in the SPTN Region VI Besitang TNGL area show significant shifts, with forested areas increasing from 104,741.15 to 107,336.03 hectares (Sulistyono dkk., 2019). The percentage change in canopy density from 2016 to 2022 indicates that low-density canopy decreased by 49.75%, medium-density also decreased by 19.64%, and high-density canopy increased by 23.37% (Daulay, 2023). This indicates the success of the restoration, as the area now provides ideal habitat support for wildlife.

Currently, efforts to restore the conservation area to its original function as a forest have become a priority, given the importance of ecosystem recovery. Several studies on biodiversity in the Halaban Monitoring Post area of the Sei Betung Sub-region have been conducted, such as bird species diversity (Sihotang et al., 2013) and umbrella species diversity (Kuswanda, 2017). Understanding the presence of bats as pollinators and seed dispersers is crucial for recognizing one of the supporting resources for the sustainability of restoration and ecosystem stability in GLNP. The effectiveness of bats in seed dispersal is considered high due to their abundant species variation and diverse feeding behaviors. The absence of bats could be disastrous due to the loss of the ecological services they provide

(Bates et al., 2022).This study aims to provide information by examining bat diversity in the restoration area of Resort Sei Betung, GLNP, and its implications for forest restoration efforts and the return of various wildlife species. Through a comprehensive scientific approach, this research is expected to provide reference for GLNP management in preserving the forest ecosystem and biodiversity in the area.

METHOD

Study sites

This research was conducted starting from November 2023 in the Halaban Monitoring Post area in the Sei Betung Resort, Gunung Leuser National Park (GLNP), Langkat, North Sumatra. The trap installation locations for mist nets (Figure 1) were determined based on existing grids. The environmental descriptions for each point are listed in Table 1. The selection of these locations was based on areas suspected to be bat flight paths such as forest edges or forest gates, across rivers, hillsides, and open areas.

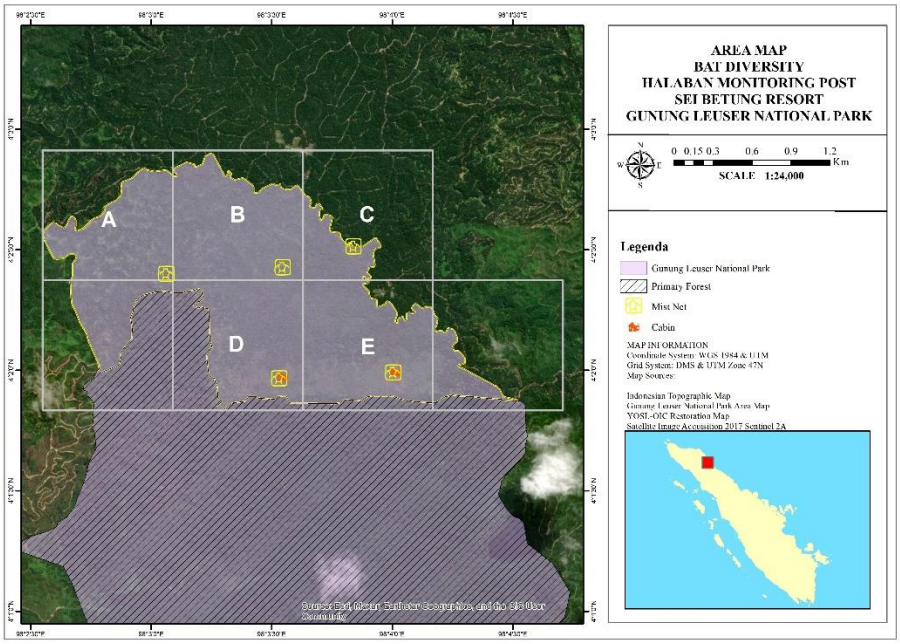

Figure 1. Research Location and Mist Net Installation

Mist net was installed considering several factors including animal trail or near fruiting and flowering trees, while considering canopy cover, over rivers or ecotone areas (Prasetyo dkk., 2011)

Trap Installation

Bat data is obtained using mist nets, which are often used to target fruit-eating bat groups. Mist nets are installed from 6:00 PM to 7:00 AM local time, for 5 nights at each observation grid along bat flight paths, near fruit trees, rows of trees forming corridors, and areas around water bodies. The nets installed 3 meters above ground level with a net height of 2.5 meters, net span length 12 meters.

Table 1. Description of mist net installation locations

Grid	Coordinates	Description
A	4º 1' 59.436" N 98º 4' 0.267" E	Dense understory vegetation, dominated by ferns, no wildlife trails, minimal canopy cover
B	4º 1' 57.98" N 98º 3' 31.871" E	Open area with active elephant trails on the both sides, dense canopy cover.

C	4º 2' 30.787" N 98º 3' 50.378" E	Characteristics of young forest vegetation, approximately 50 meters from elephant ditch fed by water and bordering on open oil palm land.
D	4º 2' 23.969" N 98º 3' 3.774" E	Open area with active elephant trails on the left side, dense canopy cover.
E	4º 2' 25.597" N 98º 3' 32.684" E	Characteristics of young forest vegetation, with active human trails.

Bat Identification

Bats caught in the nets were measured, weighed, and released after documentation. Bat identification was carried out directly on-site using identification references such as “A Field Guide to the Mammals Borneo” (Payne, 1985), “Identification Keys of the Mammals of Borneo: Insectivora, Scandentia, Rodenta and Chiroptera” (Yasuma, 2003) and other supporting journals.

Data Analysis

Data analysis of captured bat from all traps was analyzed using RStudio, BiodiversityR Package, software version 2022.12.0+353 to determine species richness, abundance, diversity index, evenness index, species richness index, species dominance, and similarity index.

RESULTS and DISCUSSION

From five observation points, a total of 87 individual bats belonging to four different species were recorded (Figure 2). Table 2 explains the number of individuals captured. These individuals consist of 2 species from the Pteropodidae family, 1 species from the Hipposideridae family, and 1 species from the Vespertilionidae family. The identification results of each individual show that 3 species are commonly found in residential areas and forests, while 1 species of bat found is a species that is near threatened. The location where the highest number of bats was found is in grid C. This is be affected by the high activity of bat feeding in young forests with relatively low fruit positions. For example, the Pteropodidae family is a fruit-eating bat family (Frugivora) with the most species and commonly found in various habitats (Suripto, 2021).

Table 2. Species and number of individuals trapped in the Halaban Monitoring Post area

Family	Species	Grid					Total
		A	B	C	D	E	
Pteropodidae							
	Cynopterus brachyotis	-	1	12	4	21	38
	Cynopterus minutus	-	7	-	8	-	15
Hipposideridae							
	Hipposideros cervinus	-	-	33	-	-	33
Vespertilionidae							
	Glischropus tylopus	-	-	-	-	1	1
Number of individuals (N)		0	8	45	12	22	87
Number of species (S)		0	2	2	2	2	4

Cynopterus brachyotis, from the Pteropodidae family, is the species with the highest number of individuals, totaling 38 individuals (Table 2), accounting for 44% of the total captured individuals (Figure 3). This species was found at 4 out of 5 observation points. Additionally, *C. brachyotis* is the most commonly encountered species in various types of forest habitats and human settlements. The presence of this species is crucial because few

seed-dispersing animals are found in urban areas. This species has highly diverse feeding preferences and ecologically aids in the dispersal of seeds in urban areas (Chan et al., 2021). The morphological characteristics of *C. brachyotis* include a skull length of 27–30.7 mm; forearm length of 54.7–66.7 mm; tibia length of 18.7–26.3 mm; ear length of 15–17 mm; hindfoot length of 13.5–15.5 mm, with white ear edges and a dental formula of I1I2CP1P3P4M1/I1I2CP1P3P4M1M2. P4 and M1 do not have prominences in the middle of the chewing surface (Yasuma et al., 2003).

Hipposideros cervinus (Synonyms: *H. celebensis, H. schneidersi*) is the species with the second-highest number of individuals after *C. brachyotis*. This species was found in 33 individuals (Table 2), accounting for 38% of the total captured individuals (Figure 3). It was found only at one observation point. This species has morphological characteristics: forearm length of 44-50 mm, body mass of 5.5 – 10 grams, and tail length of 21 – 30 mm. The fur color ranges from grayish-brown or yellowish-brown to bright reddish-brown or orange. The nose is reddish-gray. The nose is of moderate size with two leaflets. The central leaflet is narrower than the posterior leaflet. This species is commonly found in urban areas and secondary forests (Mohd Nasir et al., 2021), consistent with findings in grid C area (Figure 1), which serves as the entrance to the secondary forest and passes through the remnants of previous oil palm worker housing. Groups of Hipposideros cervinus were also found hanging in large numbers on the walls of these remaining buildings. Based on observations at this location, vegetation such as water apple trees (Syzygium aqueum), cocoa trees (Theobroma cacao), wild rambutan (Baccaurea tetandra), and durian (Durio zibethinus) are fruit-bearing trees abundant around these buildings. The diversity of surrounding plants allows Chiroptera to have various ecological roles, including seed dispersal as potential food for other mammal species such as Elephants (Elephas maximus) (Berliani et al., 2022).

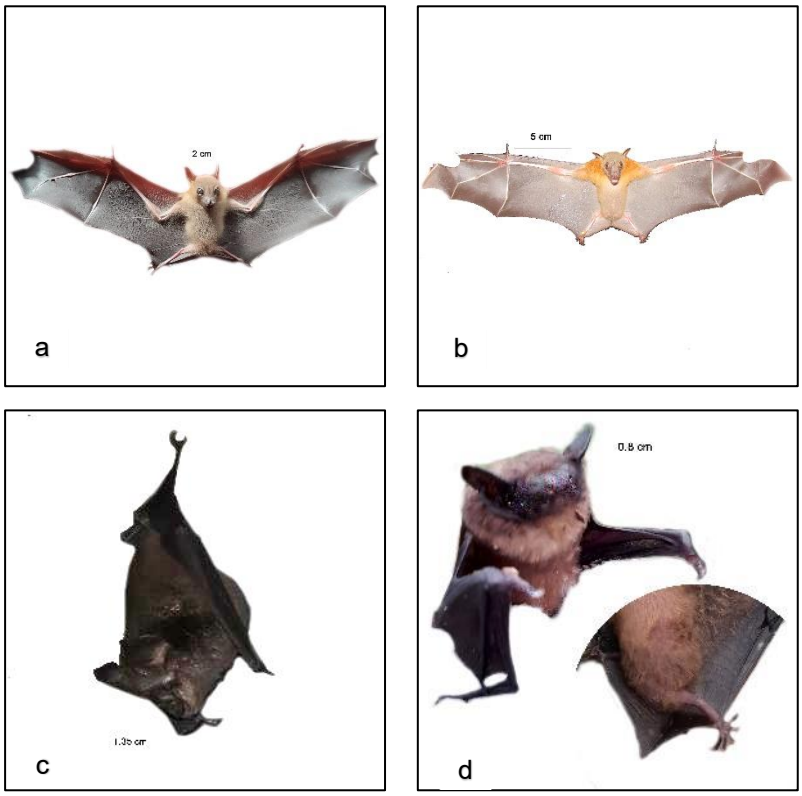

Figure 2. Bat species found in the Halaban Monitoring Post: Cynopterus minutus (a), Cynopterus brachyotis (b), Hipposideros cervinus (c), and Glischropus tylopus (d).

Cynopterus minutus is the species with the third-highest number of individuals (15 individuals or 17%) out of the total individuals. This bat species was found in observation grids B and D. This bat species has the smallest body size among Cynopterus genera with forearm length of 53 - 60 mm and weight 30 mm. This species acts as a pollinator and soil fertilization (Kwatrina et al., 2023). *C. minutus* is commonly found in various habitat types and is also consumed by the Dumoga community in North Sulawesi, Indonesia (Ransaleleh et al., 2020).

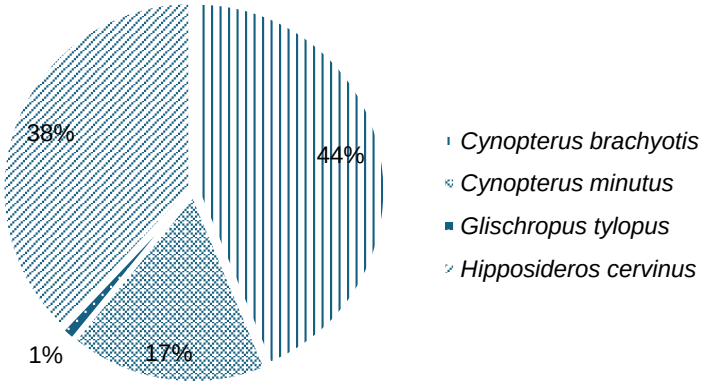

Figure 3. Percentage of individuals of each bat species at the Halaban Monitoring Post

Only 1 individual of *Glischropus tylopus* was caught, and this species was found in observation grid E. Its morphological characteristics are: forearm length 27 mm, ear length 13 mm, tail 8 mm, and leg length 10mm. All Glischropus species have thick pads on the thumbs and feet. Their hair is reddish-yellow without a pattern with round and dark brown ears. Its tragus is relatively narrow with a rounded tip and slightly convex forward and its skull is flatter than *G. bucephalus* and *G. aquilus*. This species can be distinguished from the Javan thick-thumbed Bat (G. javanus) by its shorter forearm (Payne et al., 2000). This insect-eating bat species prefers to roost in rock crevices, inhabiting primary and secondary forests with abundant bamboo (Francis & Bouillard, 2021).

Table 3. Species Richness Index (Dmg), Evenness Index (E), Diversity (H'), Dominance Index (D), Bats at Halaban Monitoring Post

Parameter	Grid					**Average**
	A	B	C	D	E	
Species Richness Index (Dmg)	0	0.698*	0.494	0.782	0.642	0.654
Evenness Index (E)	0	0.858	1.359*	1.089	0.294	0.765
Dominance Index (D)	0	0.109	0.737	0.611	0.857*	0.547
Diversity Index (H')	0	0.595	0.942*	0.755	0.204	0.592

* = highest value

Table 3 shows the Species Richness Index in the observation grids, with the highest species richness index in grid B (Dmg = 0.69), followed by grid D (Dmg = 0.78), while in grid A the index cannot be calculated due to the absence of bat individuals. The number of species found accounts for only 1.6% out of 238 bat species in Indonesia (Maryanto et al., 2020). Overall, the mean value of Species Richness Index at the Halaban Monitoring Post was 0.65. This value is lower compared to bat diversity studies in other areas such as the study in Lombok, West Nusa Tenggara, with Species Richness Index values ranging from 0.68 - 1.46Dmg (Mohd Nasir et al., 2021). The species richness index value is greatly influenced by the total number of individuals found in a particular area. Bat species richness at the Halaban Monitoring Post has a lower value due to the high total number of individuals (87 individuals) compared to the number of species obtained (4 species).

Shannon-Wiener Diversity Index obtained H' values was observed, ranging from 0.942 to 0.204 with grid A excluded. The highest diversity index (H' = 0.942) was observed in grid C due to the presence of two dominant bat species. This range of values is lower than the bat diversity index in the secondary forests of Ulu Gombak, Malaysia, with an H' value of 2.47 (Mohd Nasir et al., 2021).

Evenness Index (E) measures how evenly individuals are distributed among different species in each grid. Grid E has the lowest value (0.294), indicating that one bat species dominates the area, thus affecting its species evenness. This is supported by the dominance index (D) with the highest value in grid E at 0.857. (Piksa et al., 2022) indicating that bat dominance values increase in undisturbed forest habitats.

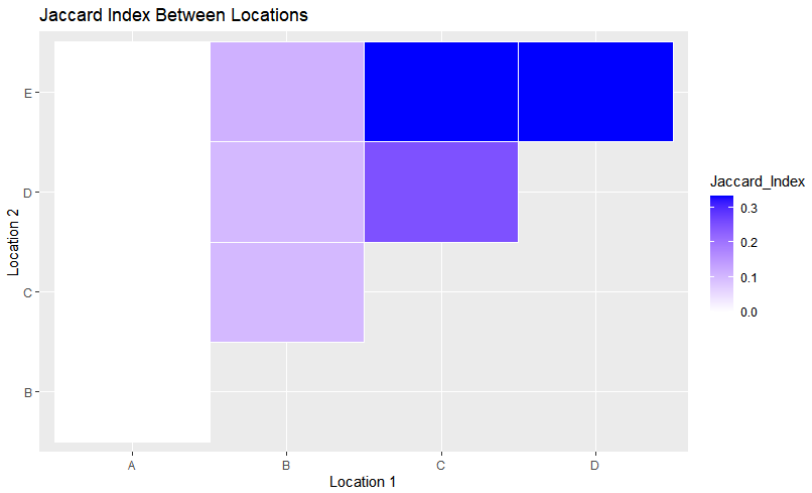

Figure 4. Visualization of Observation Location Similarity at the Halaban Monitoring Post

The Jaccard index results (Figure 4) indicate that there are no identical species between location A and other locations B, C, D, and E. This is due to the absence of bat individuals in location A, which can be attributed to its open environment characterized by understory vegetation such as ferns. Meanwhile, there is a higher level of similarity between location C and E compared to other location pairs, with a Jaccard index value of 0.333. This indicates that the species composition in both locations has a higher level of similarity. Moreover, location B and D, as well as D and E, showed moderate levels of similarity with Jaccard index values of 0.1 and 0.333, respectively. The Jaccard index analysis provides a clear picture of the similarity of species composition among the various observed locations. This is consistent with the diversity of bats in caves in nearby locations with similarity values ranging from 0.1 to 1 (Prakarsa et al., 2022).

CONCLUSION

This study found that a total of 87 bat individuals were observed, consisting of four species from three families. *Cynopterus brachyotis* emerged as the species with the highest number of individuals, followed by *Hipposideros cervinus.* The highest species richness index was recorded in grids B and D, while location A could not be calculated due to the absence of bat individuals. The highest diversity index was observed at observation point 4, and the similarity values among locations could be identified through the Jaccard index. The highest similarity was found between locations C and E, whereas Location A exhibited zero similarity with other locations due to the absence of bat individuals.

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