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Species Diversity and Demographic Distribution of Volant Mammals in the Riparian Ecosystems of the Ilog-Hilabangan River Basin

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Abstract
Aim: This study assessed the species diversity, demographic distribution, and population structure of volant mammals in the riparian ecosystems of the Ilog-Hilabangan River Basin (IHRB), Negros Island, Philippines. The research aimed to determine reproductive trends, habitat associations, and the conservation significance of bat communities across spatially variable riparian zones.
Methodology: Field surveys were conducted from January to May 2025 in six riparian sites using nocturnal mist-netting. A total of 182 bats were captured and identified to species level. Morphometric data were recorded, and individuals were classified by age (juvenile, subadult, adult), sex, and reproductive status. Diversity indices (Shannon–Wiener, Simpson), relative dominance, and sex ratios were computed. Habitat data were also collected to analyze species–habitat associations.
Results: Five species from four families were documented: *Cynopterus brachyotis*, *Eonycteris spelaea*, *Ptenochirus jagori*, *Nyctimene rabori*, and *Rhinolophus* sp. *C. brachyotis* dominated across all sites (77.4%), followed by *E. spelaea* (16.6%). Site-level differences in richness and diversity were significant, with the TICATO Area exhibiting the highest diversity (H' = 0.67) and species richness (4 species). Adults comprised 62.6% of captures, and nine lactating females and multiple juveniles indicated active reproduction, particularly in the TICATO Area and Andolawan. *P. jagori* and *N. rabori* were rare and site-specific, highlighting their sensitivity to disturbance. The sex ratio was male-biased (70 females vs. 112 males), with subadults and juveniles confirming ongoing recruitment.
Conclusion: The riparian habitats of the IHRB support moderate bat diversity dominated by generalist frugivores but also harbor endemic and disturbance-sensitive species. The presence of reproductive females and juveniles indicates stable and viable populations. Variation in diversity and demographics was linked to habitat structure and disturbance levels. These results underscore the importance of riparian corridors in sustaining bat-mediated ecosystem services. Conservation efforts, such as maintaining vegetation integrity and reducing habitat fragmentation, are essential for protecting both common and rare volant mammals in tropical watersheds.
Keywords: *volant mammals, riparian ecosystem, species composition, population structure, biodiversity conservation*

INTRODUCTION

Riparian ecosystems are dynamic transition zones between land and water that provide essential ecological functions, particularly in tropical landscapes. They regulate water quality, control sedimentation, mitigate flood risks, and serve as biodiversity corridors that connect fragmented habitats (Mullin et al., 2020). In tropical environments, these habitats also create cooler microclimates, offer stable food resources, and provide critical roosting sites—making them especially important for volant mammals such as bats. Bats, in turn, are vital providers of ecosystem services, including pollination, seed dispersal, and insect population regulation (Willig et al., 2019; Garcia-Garcia et al., 2023).

The Philippines, a recognized megadiversity hotspot, harbors a rich assemblage of bat species, many of which are endemic and evolutionarily distinct (Heaney et al., 2016; Lagat et al., 2023). Despite their ecological importance, studies focusing on bats in riparian habitats remain scarce, particularly in the Ilog-Hilabangan River Basin (IHRB) of southern Negros. This watershed, characterized by a mosaic of forest patches, agricultural lands, and human settlements, presents an ideal setting to investigate how habitat fragmentation influences bat

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populations. However, baseline data on species composition, demographic patterns, and habitat utilization in the IHRB are lacking.

This study addresses this gap by presenting the first comprehensive assessment of volant mammals in the IHRB. Through site-stratified mist-netting across six riparian zones, we examined species diversity, abundance, reproductive activity, and age structure. These biological parameters were analyzed alongside habitat features such as canopy cover, floristic composition, and understory density to explore species–habitat relationships. This integrative approach not only evaluates bat population health but also refines methodologies for tropical bat ecology research.

The findings are relevant to landscape ecology, biodiversity conservation, and sustainable resource management. They align with the Philippine Biodiversity Strategy and Action Plan (PBSAP 2015–2028) and contribute to global conservation priorities under Sustainable Development Goal 15 (Life on Land). Moreover, the results highlight the crucial ecological services bats provide to rural communities, underscoring the need for integrated, ecosystem-based management of riparian zones. This work establishes a scientific foundation for targeted conservation interventions, environmental education, and adaptive management within one of the country's most significant freshwater ecosystems.

Objectives

This study investigates the species composition, demographic structure, and habitat associations of volant mammals in the riparian ecosystems of the Ilog-Hilabangan River Basin. By examining their ecological roles, conservation status, and spatial distribution, the research aims to provide baseline data that can guide biodiversity management and riparian conservation efforts. Specifically, the study seeks to:

1. Assess the species composition, relative dominance, and diversity indices of volant mammals.
2. Characterize age-class distribution and population structure to identify patterns in recruitment, maturity, and overall population health.
3. Analyze reproductive demographics through sex ratio evaluation and assessment of female reproductive condition to determine population stability.
4. Examine habitat associations and spatial distribution patterns of volant mammals across different riparian sites.

METHODS

Research Design

This study adopted a descriptive, quantitative, field-based ecological survey to evaluate species diversity, demographic composition, and spatial distribution of volant mammals in riparian zones of the Ilog-Hilabangan River Basin (IHRB), Negros Island, Philippines. Standardized mist-netting protocols for tropical biodiversity assessment were used to systematically document species richness, abundance, age structure, and reproductive condition. Biological data were linked to site-specific habitat characteristics to explore species–habitat relationships.

Study Sites and Sampling

Six riparian sites were selected through purposive sampling based on proximity to the river, vegetation type, disturbance level, and accessibility. These were located in:

- Negros Oriental – Barangay Dawis (Bayawan City), Barangays Pantao and New Namangka (Mabinay)
- Negros Occidental – Barangays Balicotoc and Andolawan (Ilog), TICATO Area (Tagukon, Inapoy, Camingawan, Tampalaon, and Oringao; Kabankalan City)

Instruments and Field Procedures

Mist-nets (12 m × 2.5 m; 36 mm mesh) were the primary capture tool, with 10–15 nets deployed per site depending on vegetation structure. Nets were placed at ground level before sunset (17:00–17:30) and monitored every 15–20 minutes until midnight. Captured bats were gently removed, placed in clean cloth holding bags, and processed immediately to minimize stress.

Data were recorded using standardized field sheets based on the Manual on Biodiversity Assessment and Monitoring System for Terrestrial Ecosystems (DENR–BMB and GIZ). Morphometric measurements included forearm, ear, hind foot, and tail length, as well as body mass. Individuals were classified by species (following Heaney et al., 2016; Lagat et al., 2023), sex, age class (juvenile, subadult, adult), and reproductive condition. Nets and procedures were pre-tested during reconnaissance visits to ensure safety and consistency.

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Data Collection Period

Fieldwork was conducted from January to May 2025 (dry season) to ensure accessibility. Each site was surveyed for 2–3 consecutive nights. Environmental parameters such as canopy cover, understory density, elevation, and proximity to water were recorded using GPS, a laser rangefinder, and visual assessments.

Data Analysis

Species richness (S), Shannon–Wiener Diversity Index (H'), and Simpson's Dominance Index (D) were calculated to assess biodiversity per site. Demographic data (age structure, sex ratio, reproductive status) were analyzed descriptively. Relative abundance and dominance were computed as:

$$\text{Relative Abundance (\%)} = \frac{\text{Number of individuals of species}}{\text{Total number of individuals of all species}} \times 100$$

$$\text{Dominance Index} = \frac{\text{Total number of individuals of all species}}{\text{Total basal area or total count of all species}}$$

Ethical Considerations

All capture and handling protocols complied with the American Society of Mammalogists' Guidelines (Sikes et al., 2016) and were conducted under permits issued by the Philippine Department of Environment and Natural Resources (DENR). Gloves were worn at all times to protect both handlers and bats, and all individuals were released at the site of capture immediately after processing.

RESULTS AND DISCUSSION

Findings reveal that habitat quality—specifically vegetation structure and disturbance levels—significantly shapes bat community composition. Generalist species like *Cynopterus brachyotis* dominate in disturbed sites, while more sensitive species such as *Ptenochirus jagori* and *Nyctimene rabori* occur in structurally complex habitats. These patterns highlight the role of riparian vegetation as both refuge and reproductive habitat, and position bats as effective bioindicators for monitoring ecosystem integrity (Racey & Entwistle, 2000; Marques et al., 2022).

Species Composition and Diversity of Volant Mammals Across Sites.

Table 1 highlights clear variations in volant mammal community structure across six riparian sites in the Ilog-Hilabangan River Basin, reflecting ecological differences in species richness, abundance, density, dominance, and diversity—key indicators of habitat integrity (Magurran, 2004). Brgy. Dawis exhibited low diversity (H' = 0.3251) and high dominance (D = 0.8105), with *Cynopterus brachyotis* dominating a simplified community, typical of disturbed habitats (Medellín et al., 2000).

In contrast, Brgy. Pantao, despite the lowest abundance (8 individuals), showed the highest diversity (H' = 0.7356) and lowest dominance (D = 0.5357), indicating a more balanced, possibly less disturbed habitat with niche diversity (Fenton et al., 1992). New Namangka and Balicotoc showed moderate densities and diversity, suggesting intermediate habitat complexity that supports both generalists and some specialists (Kunz et al., 2011).

The TICATO Area emerged as the most biodiverse site with the highest richness (4 species), abundance (56 individuals), and presence of sensitive species like *Nyctimene rabori* and *Ptenochirus jagori*. These findings suggest better habitat quality, intact microhabitats, and higher floristic diversity, consistent with Sritongchuay et al. (2023). Conversely, Andolawan, though high in abundance (50 individuals), had low diversity (H' = 0.3251) and high dominance, indicating habitat stress or resource limitation (Racey & Entwistle, 2000).

Overall, species distribution patterns reflect the interplay of habitat quality, disturbance, and floristic structure across sites. The findings underscore the importance of conserving structurally diverse riparian habitats to support both generalist and specialist volant mammals and ensure long-term biodiversity resilience.

Table 1: Species Richness, Abundace, Density, Simpson Dominance and Shannon Diversity per site in Ilog Hilabangan River Baisn Riparin Area

Site	Species Present	Species Richness	Abundance	Density	Dominance	Diversity
Brgy. Dawis	*A. brachyotis, E. spelaea, R. hipposideros*	3	21	21.0	0.8105	0.3251

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Brgy. Pantao	*B. brachyotis, P. jagori, R. hipposideros*	3	8	8.0	0.5357	0.7356
Brgy. New Namangka	*C. Brachyotis, E. spelaea*	2	25	25.0	0.7200	0.4397
TICATO Area	*C Brachyotis, E. spelaea, N. rabori, P. jagori*	4	56	56.0	0.6578	0.6737
Brgy. Balicotoc	*C Brachyotis, E. spelaea*	2	22	22.0	0.6320	0.5360
Brgy. Andolawan	*C Brachyotis, E. spelaea*	2	50	50.0	0.8163	0.3251

Species Composition and Dominance

The volant mammal community in the Ilog-Hilabangan River Basin was overwhelmingly dominated by *Cynopterus brachyotis*, which accounted for 140 of the 182 captures (77.35%) and had a density of 140 ind/ha. Its high proportional representation yielded a low contribution to diversity ($P_i \cdot \ln P_i = -0.1984$), reflecting strong dominance and reduced evenness typical of disturbed or simplified habitats where generalist species prevail (Tan et al., 2021; Lagat et al., 2023). *Eonycteris spelaea* was the second most abundant species (16.57%; 30 ind/ha) and, despite lower abundance, made a relatively larger contribution to diversity ($P_i \cdot \ln P_i = -0.2979$) due to its lower proportional dominance; this nectarivorous bat is functionally important for pollination of key tropical crops such as durian and banana (Marques et al., 2022; Sritongchuay et al., 2023). Three rarer species—*Ptenochirus jagori* (8 individuals, 4.42%, 8 ind/ha; $P_i \cdot \ln P_i = -0.0286$), *Nyctimene rabori* (2 individuals, 1.10%, 2 ind/ha; $P_i \cdot \ln P_i = -0.0496$), and *Rhinolophus hipposideros* (1 individual, 0.55%, 1 ind/ha; $P_i \cdot \ln P_i = -0.1378$)—were detected at low frequencies. Their presence, despite steep log-values indicative of rarity, signals habitat heterogeneity and the retention of microhabitats suitable for more specialized or sensitive taxa; *P. jagori* is a disturbance-sensitive Philippine endemic associated with semi-intact forests (Lagat et al., 2023), while *N. rabori*'s detection underscores riparian corridors as refugia for rare frugivores (García-García et al., 2023). The overall Shannon diversity index was low (H′ = 0.7123), substantially below expected values for moderately disturbed (≥1.5) and intact riparian forests (≥2.0), indicating ecological homogenization driven by dominance of tolerant species like *C. brachyotis* (Mullin et al., 2020; Tan et al., 2021). Such skewed dominance reduces functional redundancy, threatening ecosystem resilience and the stability of key services such as pollination and seed dispersal if rare species continue to decline under ongoing habitat degradation (Marques et al., 2022; Sritongchuay et al., 2023).

Table 2: Diversity and Density of Volant Mammal Species in the Riparian Zone of Ilog Hilabangan River Basin Using Shannon Diversity Index (H′).

Species	Individuals (n)	Density (ind/ha)	Proportion (p_i)	In(P_I)	P_i*In(P_i)
Cynopterus brachyotis	140	140	0.7735	-0.2565	-0.1984
Eonycteris spelaea	30	30	0.1657	-1.7977	-0.2979
Rhinolophus hipposideros	1	1	0.0442	-3.1191	-0.1378
Nyctimene rabori	2	2	0.0110	-4.5099	-0.0496
Ptenochirus jagori	8	8	0.0055	-5.2030	-0.0286
Total	181				H = 0.7123

Endemicity and Conservation Status of Volant Mammals

Table 3 summarizes the species composition, frequency, endemicity, and conservation status of volant mammals in the riparian ecosystems of the Ilog-Hilabangan River Basin. Five species were recorded—three exotic and two endemic—with varied conservation classifications under DAO 2019-09 and the IUCN Red List (2020), reflecting differing levels of ecological vulnerability.

Cynopterus brachyotis, a generalist frugivore and the most abundant species (140 individuals), is categorized as "Other Wildlife Species" (OWS) by DAO and "Least Concern" (LC) by IUCN. Its dominance in disturbed landscapes, agroforests, and urban areas has been attributed to dietary flexibility and roosting adaptability (Tan et al., 2021; Lagat et al., 2023). *Eonycteris spelaea* (30 individuals), also exotic and listed as OWS/LC, is ecologically vital for pollinating tropical crops like durian and banana, making it functionally significant in both natural and agricultural settings (Marques et al., 2022; Sritongchuay et al., 2023).

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Rhinolophus hipposideros, the only insectivorous bat detected (1 individual), was also classified as exotic and LC. Its rarity may be linked to mist-net bias or limited roost availability, suggesting a need for acoustic surveys to better capture insectivore presence (García-García et al., 2023).

In contrast, *Nyctimene rabori* (2 individuals), an endemic and endangered species, reflects high habitat sensitivity. Its detection underscores the conservation value of riparian zones as refugia (Heaney et al., 2016). Similarly, the endemic *Ptenochirus jagori* (8 individuals) is listed as OWS/LC but is ecologically relevant due to its role in seed dispersal and preference for semi-natural habitats (Mullin et al., 2020).

These findings indicate ecological heterogeneity: while exotic species dominate, the presence of rare endemics highlights the importance of conserving structurally complex riparian habitats to sustain biodiversity and prevent ecosystem homogenization.

Table 3. List of all Volant Mammal species with their Endemicity and Conservation Status in Reference to DAO 2019-09 and IUCN 2020 of the Riparian Area of Ilog Hilabangan River Basin.

Taxonomic Name			**Frequency**	**Endemicity**	**Conservation Status**	
Family Name	**Scientific Name**	**Common Name**			**DAO 2019-09**	**IUCN (2020)**
Pteropodidae	*Cynopterus brachyotis*	Short-nosed Fruit Bat	140	Exotic	OWS	LC
Pteropodidae	*Eonycteris spelaea*	Dawn Bat or Cave Nectar Bat	30	Exotic	OWS	LC
Rhinolopodae	*Rhinolophus hipposideros*	Horshoe Bat	1	Exotic	OWS	LC
Pteropodidae	*Nyctimene rabori*	Philippine Tube-nosed Fruit Bat	2	Endemic	EN	EN
Pteropodidae	*Ptenochirus jagori*	Greater Musky Fruit Bat	8	Endemic	OWS	LC

Legend: EN - Endangered; OWS - Other Wildlife Species ; LC - Least Concern

Classification of Volant Mammals by Age Class and Population Structure Analysis

Table 4 presents the age structure of volant mammals across six riparian sites in the Ilog-Hilabangan River Basin, categorized into adults, sub-adults, and juveniles by sex. Of the 182 individuals recorded, 112 (61.54%) were adults, 36 (19.78%) sub-adults, and 34 (18.68%) juveniles. The high adult proportion suggests reproductively mature populations, while the presence of younger cohorts, especially *Cynopterus brachyotis*, indicates ongoing recruitment and reproductive success.

Site 4 (TICATO Area) had the highest total captures (56), including 22 juveniles (18.85%), dominated by *C. brachyotis*, reflecting favorable breeding conditions likely due to intact canopy, rich fruit availability, and low disturbance—factors known to support maternity roosts and juvenile development (Sritongchuay et al., 2023; Mullin et al., 2020). Conversely, Sites 1 and 2 recorded no juveniles and limited sub-adults, possibly due to habitat degradation or unsuitable microclimatic conditions for reproduction (Marques et al., 2022).

C. brachyotis showed broad demographic distribution across sites. In Site 6 (Andolawan), 25 male and 3 female sub-adults were observed alongside juveniles and adults, suggesting stable post-weaning recruitment and population resilience. This pattern aligns with regional findings that generalist bats maintain viable populations even in fragmented landscapes (Tan et al., 2021).

In contrast, endemic species like *Ptenochirus jagori* and *Nyctimene rabori* were only represented by adults. Their absence of juveniles and sub-adults may indicate aging populations, low recruitment, or sampling limitations, but nonetheless highlights conservation concern (Lagat et al., 2023; García-García et al., 2023).

Eonycteris spelaea exhibited balanced age distribution in Site 5 (Balicotoc), with all age classes present, confirming its ability to reproduce in moderately disturbed areas where floral resources are sufficient (Marques et al., 2022).

Overall, the age-class structure indicates robust regeneration among generalist species but demographic fragility among endemic taxa. These findings underscore the need for sustained demographic monitoring and riparian habitat protection to ensure long-term viability and support broader conservation goals under SDGs 13 and 15.

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Table4. Classification of Volant Mammals by age (Adult, sub-adult, juvenile) across sites.

Sample Site	Species	Age Classification									TOTAL
		Adult			Sub-adult			Juvenile			
		M	F	%	M	F	%	M	F	%	
Site 1: Brgy. Dawis, Bayawan City	*Cynopterus brachyotis*	*10*	*9*	*14.95*	-	-	-	-	-	-	19
	Eonycteris spelaea	*1*	-	*1.00*	-	-	-	-	-	-	1
	Rhinolophus hipposideros	-	*1*	*0.55*	-	-	-	-	-	-	1
Site 2: Pantao, Mabinay	*Cynopterus brachyotis*	*4*	*2*	*5.10*	-	-	-	-	-	-	6
	Ptenochirus jagori	*1*	-	*1.00*	-	-	-	-	-	-	1
	Rhinolophus hipposideros	*1*	-	*1.00*	-	-	-	-	-	-	1
Site 3: New Namangka, Mabinay	*Cynopterus brachyotis*	*10*	*10*	*15.49*	*1*	-	1	-	-	-	21
	Eonycteris spelaea	-	*4*	*2.20*	-	-	-	-	-	-	4
Site 4: TICATO Area, Kabankalan City	*Cynopterus brachyotis*	*11*	*11*	*17.04*	*1*	-	1	15	7	18.85	45
	Ptenochirus jagori	*7*	-	*7.00*	-	-	-	-	-	0.00	7
	Eonycteris spelaea	*1*	*1*	*1.55*	-	-	-	-	-	0.00	2
	Nyctimene rabori	*1*	-	*1.00*	-	-	-	-	1	0.55	2
Site 5: Balicotoc, Candoni-Ilog	*Eonycteris spelaea*	*8*	*3*	*9.65*	*2*	2	2.71	2	-	2.00	17
	Cynopterus brachyotis	-	*4*	*2.20*	-	-	0.00	1	-	1.00	5
Site 6: Andolawan, Ilog	*Cynopterus brachyotis*	*2*	*7*	*5.85*	*25*	3	26.06	5	3	6.65	45
	Eonycteris spelaea	*2*	*1*	*2.55*	*2*	-	2.00	-	-	0.00	5
	GRAND TOTAL	**59**	**53**	**88.12**	**31**	**5**	**32.77**	**23**	**11**	**29.04**	**182**

The Reproductive Demographics of Vont Mammals Across Sampling Sites

The reproductive demographics of volant mammals in the Ilog-Hilabangan River Basin revealed a male-biased population, with 61.54% males and a sex ratio of 1.60:1, particularly skewed in Sites 2, 4, and 6. This aligns with Marques et al. (2022) and Sritongchuay et al. (2023), who associated male dominance with dispersal behavior and roost-site dynamics in disturbed habitats. Only eight reproductively active females, all *Cynopterus*

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brachyotis, were observed—mainly at Sites 2, 3, and 4. A rare case of a male carrying a pup suggested possible roost relocation. Limited female reproductive activity indicates ecological constraints, such as roost scarcity and habitat disturbance, potentially impeding breeding success (Tan et al., 2021; Lagat et al., 2023). *Eonycteris spelaea* showed minimal activity, consistent with its seasonal breeding and floral dependency. No reproductive signs were found in *Ptenochirus jagori* and the Endangered *Nyctimene rabori* (IUCN, 2020), raising conservation concerns. Site 3, with its balanced sex ratio and highest reproductive activity, may serve as a maternity refuge. These findings underscore the need to conserve structurally intact riparian zones that support breeding, roosting, and food access, which are vital for sustaining volant mammal populations (García-García et al., 2023) and ensuring long-term ecological resilience.

Table 5. Sex Classification of Volant Mammals, Sex Ratio and Reproductive Condition of Females Across Sites.

Sample Site	Species	Sex Classification				Sex Ratio (M:F)	Total Frquency	Reproductive Condition
		M	%	F	%			
Site 1: Brgy. Dawis, Bayawan City	*Cynopterus brachyotis*	10	5.49	9	4.95		19	1 Male Caried Baby, 1 Lactiting Mother
	Eonycteris spelaea	1	0.55		0.00		1	
	Rhinolophus hipposideros		0.00	1	0.55		1	
Sub-Total		***11***		***10***		***1.1:1***		
Site 2: Pantao, Mabinay	*Cynopterus brachyotis*	4	2.20	2	1.10		6	2 Lactating Mother
	Ptenochirus jagori	1	0.55		0.00		1	
	Rhinolophus hipposideros	1	0.55		0.00		1	
Sub-Total		***6***		***2***		***3:1***		
Site 3: New Namangka, Mabinay	*Cynopterus brachyotis*	11	6.04	10	5.49		21	3 Lactating Mother
	Eonycteris spelaea	-	0.00	4	2.20		4	1 Lactating Mother
Sub-Total		***11***		***14***		***0.79:1***		
Site 4: TICATO Area, Kabankalan City	*Cynopterus brachyotis*	27	14.84	18	9.89		45	1 Lactating Mother
	Ptenochirus jagori	7	3.85		0.00		7	
	Eonycteris spelaea	1	0.55	1	0.55		2	
	Nyctimene rabori	1	0.55	1	0.55		2	
Sub-Total		***36***		***20***		***1.8:1***		
Site 5: Balicotoc, Candoni-Ilog	*Eonycteris spelaea*	12	6.59	5	2.75		17	
	Cynopterus brachyotis	1	0.55	4	2.20		5	
Sub-Total		***13***		***9***		***1.44:1***		
Site 6: Andolawan, Ilog	*Cynopterus brachyotis*	31	17.03	14	7.69		45	
	Eonycteris spelaea	4	2.20	1	0.55		5	
Sub-Total		***35***		***15***		***2.33:1***		
Grand Total		**112**	**61.54**	**70**	**38.46**	**1.60:1**	**182**	

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Habitat associations and spatial distribution patterns of volant mammals across various sites.

The spatial distribution and habitat associations of volant mammals in the Ilog-Hilabangan River Basin are shaped by the diversity, density, and structural complexity of riparian forest vegetation. The basin supports a rich assemblage of forest tree species, with a total of 1,744 individuals recorded, spanning multiple families such as Moraceae, Euphorbiaceae, Dipterocarpaceae, and Fabaceae. Dominant tree species like *Sonneratia alba* (Pagatpat), *Ficus minahassae* (Hagimit), and *Macaranga tanarius* (Binunga) play a crucial role in influencing bat presence and activity, particularly for frugivorous and nectarivorous species that depend on fruiting and flowering trees (Medellín et al., 2018; Struebig et al., 2019).

The dominance index (0.04389) and Shannon diversity index (3.86) suggest a moderately diverse but unevenly distributed forest composition, which has implications for volant mammal foraging and roosting behavior. Higher tree species abundance and diversity provide more microhabitats and foraging resources, favoring higher bat species richness and population stability (Fukui et al., 2018). For instance, trees like *Ficus* spp. are known keystone resources for many fruit bats (Muscarella & Fleming, 2007), while stands of *Macaranga* and *Gmelina* may support insectivorous bats by attracting a wide range of insect prey.

Spatially, volant mammal distribution in riparian zones of the basin appears closely tied to vegetation density and stratification. Riparian corridors with dense canopy cover and structural heterogeneity provide critical roosting sites and flyways, facilitating species movement and reducing predation risk (Mendenhall et al., 2014). Furthermore, species like *Sonneratia alba* and *Ficus variegata*, with high species dominance values and extensive canopy spread, likely support large bat colonies, especially during reproductive seasons when energetic demands are high. The observed habitat associations indicate that forest health, as inferred from tree species diversity and dominance patterns, directly correlates with volant mammal richness and distribution. Conservation strategies should therefore prioritize maintaining high plant diversity and natural forest structure in riparian zones to support robust bat populations and their ecological services such as pollination and seed dispersal (Kunz et al., 2019).

Table 6. Species Abundnce, Density, Dominance, and Diversity of Forest Trees in IHRB.

Family Name	Scientific Name	Common Name	Species Abundance	Species Density	Species Dominance	Species Diversity
Acanthaceae	*Avicennia officinalis*	Api-api	28	0.016	0.00026	-0.06634
	Avicennia marina	Bungalon	8	0.005	0.00002	-0.02470
Alangiaceae	*Alangium meyeri*	Putian	1	0.001	0.00000	-0.00428
Anacardiaceae	*Dracontomelon edule*	Lamio	7	0.004	0.00002	-0.02215
	Darcontomelon dao	Dao	1	0.001	0.00000	-0.00428
	Koordersiodendron pinnatum	Amugis	9	0.005	0.00003	-0.02718
	Mangifera indica	Mangga	9	0.005	0.00003	-0.02718
	Mangifera monandra	Malapaho	1	0.001	0.00000	-0.00428
	Spondias pinnata	Libas	2	0.001	0.00000	-0.00776
	Spondias purpurea	Sineguelas	1	0.001	0.00000	-0.00428
Annonaceae	*Cananga odorata*	Ylang-ylang	2	0.001	0.00000	-0.00776
	Anona reticulata	Anonas	1	0.001	0.00000	-0.00428
Apocynaceae	*Wrightia pubescens*	Lanete	3	0.002	0.00000	-0.01095
	Alstonia scholaris	Dita	5	0.003	0.00001	-0.01678
	Voacanga globosa	Bayag Usa	6	0.003	0.00001	-0.01951
Araliaceae	*Polyscias nodosa*	Malapapaya	3	0.002	0.00000	-0.01095
Bombacaceae	*Ceiba pentandra*	Kapok	2	0.001	0.00000	-0.00776

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Boraginaceae	*Cordia dichotoma*	Anonang	4	0.002	0.00001	-0.01394
	Carmona retusa	Tsaang Gubat	5	0.003	0.00001	-0.01951
Burseraceae	*Canarium asperum*	Pagsahingin	13	0.007	0.00006	-0.03652
	Garuga floribunda	Bogo	14	0.008	0.00006	-0.03873
Clusiaceae	*Garcinia binucao*	Batuan	3	0.002	0.00000	-0.01095
Combretaceae	*Terminalia Catappa*	Talisay	1	0.001	0.00000	-0.00428
	Terminallia citrina	Bingas	1	0.001	0.00000	-0.00428
	Terminalia microcarpa	Kalumpit	3	0.002	0.00000	-0.01095
Cunoniaceae	*Weinmannia luzoniensis*	Itang-itang	1	0.001	0.00000	-0.00428
Dipterocarpa-ceae	*Shorea almon*	Almon	2	0.001	0.00000	-0.00776
	Parashorea malaanonan	Bagtikan	42	0.024	0.00058	-0.08974
	Vatica mangachapoi	Narig	2	0.001	0.00000	-0.00776
	Shorea negrosensis	Red Lauan	2	0.001	0.00000	-0.00776
	Shorea contorta	White Lauan	3	0.002	0.00000	-0.01095
	Shorea astylosa	Yakal	2	0.001	0.00000	-0.00776
Euphorbiaceae	*Neotrewia cumingii*	Apanang	8	0.005	0.00002	-0.02470
	Macaranga tanarius	Binunga	78	0.045	0.00200	-0.13897
	Macaranga bicolor	Hamindang	49	0.028	0.00079	-0.10036
	Melanolepis multiglandulosa	Alim	27	0.015	0.00024	-0.06453
	Cleistanthus pilosus	Banitlong	4	0.002	0.00001	-0.01394
	Hevea brasiliensis	Rubber Tree	1	0.001	0.00000	-0.00428
	Homonoia riparia	Miagos	5	0.003	0.00001	-0.01678
	Mallotus philippinensis	Red Kamala	1	0.001	0.00000	-0.00428
	Glochidion cagayanensis	Sangi	1	0.001	0.00000	-0.00428
	Aleurites mollocana	Candlenut	1	0.001	0.00000	-0.00428
	Croton heterocarpus	Tuba-tuba	12	0.007	0.00005	-0.03426
Fabaceae	*Milletia racemosa*	Malabalok	2	0.001	0.00000	-0.00776
	Pterocarpus indicus	Smooth Narra	5	0.003	0.00001	-0.01678
	Gliricidia sepium	Kakawate	29	0.017	0.00028	-0.06812
	Samanea saman	Raintree	5	0.003	0.00001	-0.01678
	Pongamia pinnata	Bani	13	0.007	0.00006	-0.03652
	Leucaena leucocephala	Ipil ipil	42	0.024	0.00058	-0.08974
	Gnetum gnemon	Bago	3	0.002	0.00000	-0.01095
	Wallaceodendron	Banuyo	1	0.001	0.00000	-0.00428

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	celebicum					
	Falcataria moluccana	Moloccansau	44	0.025	0.00064	-0.09284
Fagaceae	*Lithocarpus llanosil*	Ulayan	8	0.005	0.00002	-0.02470
Flacaceae	*Panguim edule*	Pangi	5	0.003	0.00001	-0.01678
Guttiferae	*Cratoxylum sumatranum*	Paguringon	1	0.001	0.00000	-0.00428
Lamiaceae	*Vitex parviflora*	Molave	1	0.001	0.00000	-0.00428
	Tectona grandis	Teak	2	0.001	0.00000	-0.00776
Lauraceae	*Persia amerikana*	Avocado	2	0.001	0.00000	-0.00776
	Litsea philippinensis	Bakan	45	0.026	0.00067	-0.09437
	Cinnamomum cebuense	Kaningag	1	0.001	0.00000	-0.00428
Lecythidaceae	*Petersianthus quadrialatus*	Toog	8	0.005	0.00002	-0.02470
Melastomata-ceae	*Everettia octodonta*	Tngau-gubat	1	0.001	0.00000	-0.00428
Meliaceae	*Melia dubia*	Bagalunga	6	0.003	0.00001	-0.01951
	Chisocheton cumingianus	Balukanag	4	0.002	0.00001	-0.01394
	Aglaia ilosiana	Bayanti	3	0.002	0.00000	-0.01095
	Toona calantas	Kalantas	4	0.002	0.00001	-0.01394
	Swietenia macrophylla	Mahogany	53	0.030	0.00092	-0.10617
	Dysoxylum gaudict haudianum	Igyo	4	0.002	0.00001	-0.01394
	Sandoricum koetjape	Santol	3	0.002	0.00000	-0.01095
	Lansium domesticum	Wild Rambutan	9	0.005	0.00003	-0.02718
Mimosaceae	*Albizia procera*	Akleng Parang	44	0.025	0.00064	-0.09284
	Acacia spectabilis	Antsoan Dilaw	1	0.001	0.00000	-0.00428
Moraceae	*Artocarpus nitidus*	Kubi	44	0.025	0.00064	-0.09284
	Artocarpus altilis	Kulos	31	0.018	0.00032	-0.07163
	Artocarpus blancoi	Antipolo/Tipolo	10	0.006	0.00003	-0.02959
	Artocarpus heterophyllus	Nangka	12	0.007	0.00005	-0.03426
	Artocarpus lacucha	Anubing	1	0.001	0.00000	-0.00428
	Artocarpus camansi	Kamansi	2	0.001	0.00000	-0.00776
	Artocarpus odoratissimus	Marang	1	0.001	0.00000	-0.00428
	Ficus saxophila	Balitarhan	1	0.001	0.00000	-0.00428
	Ficus minahassae	Hagimit	91	0.052	0.00272	-0.15409
	Ficus septica	Hauili	36	0.021	0.00043	-0.08010
	Ficus Odorata	Pakiling	29	0.017	0.00028	-0.06812

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	Ficus tinctoria	Baleting-bato	5	0.003	0.00001	-0.01678
	Ficus callos	Kalukoi	4	0.002	0.00001	-0.01394
	Ficus variegata	Talot-ot	62	0.036	0.00126	-0.11862
	Ficus gigantifolia	Talitigan	27	0.015	0.00024	-0.06453
	Ficus irisana	Haplas	1	0.001	0.00000	-0.00428
	Ficus ulmifolia	Is-is	4	0.002	0.00001	-0.01394
	Ficus polyantha	Is-is Babae	1	0.001	0.00000	-0.00428
	Ficus nota	Tibig	47	0.027	0.00073	-0.09739
	Ficus hirta	Hairy fig	2	0.001	0.00000	-0.00776
	Ficus nervosa	Veined-Leaf Fig	1	0.001	0.00000	-0.00428
	Ficus balete	Balete	4	0.002	0.00001	-0.01394
	Ficus concinna	Red Balete	4	0.002	0.00001	-0.01394
	Streblus asper	Kalios	5	0.003	0.00001	-0.01678
	Broussonetia papyrifera	Lapnis/ Paper mulbery	1	0.001	0.00000	-0.00428
Muntingiaceae	*Muntingia calabura*	Aratiles	4	0.002	0.00001	-0.01394
Myrtaceae	*Ardisia squamulosa*	Tagpo	8	0.005	0.00002	-0.02470
	Syzygium cumini	Duhat	3	0.002	0.00000	-0.01095
Oxalidaceae	*Averrhoa carambola*	Balimbing	1	0.001	0.00000	-0.00428
	Averrhoa bilimbi	Iba	1	0.001	0.00000	-0.00428
Phyllantaceae	*Antidesma bunius*	Bignai	2	0.001	0.00000	-0.00776
	Bischofia javanica	Tuai	5	0.003	0.00001	-0.01678
	Bridelia stipularis	Bankawilan	22	0.013	0.00016	-0.05516
Podocarpaceae	*Dacrycarpus cumingii*	Banahaw	1	0.001	0.00000	-0.00428
Rhizophoraceae	*Rhizophora mucronata*	Bakauan Babae	24	0.014	0.00019	-0.05898
	Rhizophora apiculata	Bakauan Lalaki	7	0.004	0.00002	-0.02215
Rubiaceae	*Nauclea orientalis*	Bangkal	15	0.009	0.00007	-0.04090
	Anthocephalus chinensis	Kaatoan Bangkal	1	0.001	0.00000	-0.00428
	Morinda citrifolia	Apatot	5	0.003	0.00001	-0.01678
	Neonauclea formicaria	Himbabalod	3	0.002	0.00000	-0.01095
	Mussaenda multibracteata	Langala	2	0.001	0.00000	-0.00776
Rutaceae	*Clausena brevistyla*	Kalomata	15	0.009	0.00007	-0.04090
	Citrus maxima	Camugao/ Pomelo	1	0.001	0.00000	-0.00428

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Sapindacee	*Pometia pinnata*	Malugai	9	0.005	0.00003	-0.02718
Sapotaceae	*Chrysophyllum cainito*	Kaimito	14	0.008	0.00006	-0.03873
	Palaquim luzoniense	Nato	12	0.007	0.00005	-0.03426
	Pouteria cmapechiana	Tiesa	7	0.004	0.00002	-0.02215
Sonneratiaceae	*Sonneratia alba*	Pagatpat	284	0.163	0.02652	-0.29556
Sterculiaceae	*Pterocymbium tinctorium*	Taluto	21	0.012	0.00014	-0.05322
	Pterospermum diversifolium	Bayok	2	0.001	0.00000	-0.00776
	Ptecymbium tinctorium	Taluto	10	0.006	0.00003	-0.02959
Tiliaceae	*Grewia multiflora*	Banhot	1	0.001	0.00000	-0.00428
Ulmaceae	*Trema orientalis*	Anabiong	6	0.003	0.00001	-0.01951
	Celtis philippinensis	Malaikmo	1	0.001	0.00000	-0.00428
Urticaceae	*Leucosyke capitellata*	Alagasi	12	0.007	0.00005	-0.03426
	Pipturus arborescens	Handalamay	12	0.007	0.00005	-0.03426
Verbenaceae	*Gmelina arborea*	Yemane	65	0.037	0.00139	-0.12260
	Premna odorata	Alagao	19	0.011	0.00012	-0.04924
TOTAL			1,744	1.000	0.04389	-3.85946

Dominance Index = 0.04389 Shannon = 3.85946

Conclusions

This study advances scientific understanding of volant mammal diversity, demographic structure, and habitat associations within the riparian ecosystems of the Ilog-Hilabangan River Basin (IHRB), southern Negros, Philippines. Through mist-netting and fine-scale habitat assessments, it provides the first comprehensive baseline on bat communities in this ecologically critical yet previously understudied watershed.

Results reveal moderate but ecologically significant bat diversity, dominated by the adaptable *Cynopterus brachyotis*alongside habitat-sensitive and endemic species such as *Ptenochirus jagori* and the endangered *Nyctimene rabori*. Evidence of reproductive females and juveniles in TICATO and Andolawan indicates that certain riparian corridors still sustain viable breeding populations. In contrast, male-biased sex ratios and low reproductive activity in degraded areas point to ecological stress and declining habitat quality.

By linking demographic trends to vegetation structure and habitat condition, the study demonstrates how riparian integrity influences bat population dynamics. It reinforces the value of volant mammals as bioindicators of ecosystem health—an approach rarely emphasized in Philippine mammalogy.

The findings carry direct conservation and policy relevance. They support prioritizing habitat protection and riparian buffer restoration, particularly in biodiversity-rich zones. Given their key ecological functions in pollination, seed dispersal, and pest regulation, frugivorous and nectarivorous bats are vital for forest regeneration and agricultural sustainability.

Aligned with the Philippine Biodiversity Strategy and Action Plan (PBSAP 2015–2028) and the UN Sustainable Development Goal 15 (Life on Land), this research provides a science-based foundation for conservation planning, environmental education, and community-led management in tropical river basins.

Recommendations

Strengthen Conservation and Habitat Management Policies. Key sites (e.g., TICATO, Balicotoc, Andolawan) with high bat abundance and reproductive activity should be prioritized in local and regional conservation plans. Integration of these findings into watershed management and land-use policies will guide zoning regulations, prevent habitat conversion, and promote enforcement against illegal activities. Protecting riparian buffers is critical to sustaining biodiversity and ecological services vital to rural livelihoods.

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Promote Community Engagement and Environmental Education. Empowering local communities through environmental education on the role of bats in seed dispersal, pollination, and pest control can reduce stigma, enhance awareness, and foster stewardship. Community-based conservation and participatory reforestation programs—especially in degraded areas—can improve ecological outcomes and support sustainable development goals.

Institutionalize Monitoring and Research for Adaptive Management. Establishing long-term monitoring of volant mammals and conducting further research on habitat use, roosting behavior, and anthropogenic threats will enable evidence-based conservation. Academic institutions and local governments should collaborate in data collection, training, and habitat assessments. This supports science-based policy making, ensures adaptive responses to environmental changes, and builds a knowledge base for future generations.

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