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Diversity and Distribution of Bats in Several Prefectures of Forest Guinea in 2025

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Abstract

Bats are a group of mammals that play a major ecological role in tropical ecosystems, particularly in regulating insect populations, pollination, and seed dispersal. This study aimed to characterize the diversity, spatial distribution, and ecological preferences of bats in forested Guinea. Captures were conducted at several sites across the prefectures of Lola, Macenta, N'Zérékoré, and Guéckédou in 2025 using Japanese nets set up in various habitat types. Captured individuals were identified based on morphological and taxonomic criteria. The data were analyzed using descriptive statistics and a χ^2 test to assess the association between species and habitats. A total of 94 individuals belonging to 7 species and 5 families were recorded. The community was dominated by *Miniopterus spp.* (35.1%), followed by *Hipposideros caffer* (19.1%) and *Epomops buettikoferi* (13.8%). Species distribution varied by prefecture and habitat. Caves and caverns were the most common habitat (50.0% of captures), particularly hosting the cave-dwelling species *Miniopterus spp.* and *Rhinolophus ziama*. Statistical analysis revealed a highly significant association between species and habitat types ($\chi^2 = 169.02$; ddl = 18; $p < 0.0001$; Cramer's $V = 0.774$), indicating a strong influence of ecological conditions on their distribution. Insectivorous species accounted for 76.6% of the individuals captured, compared to 23.4% for frugivorous species. The observed sex ratio was balanced between males and females. These results highlight the importance of forest and cave habitats for the conservation of bats in forested Guinea and

underscore the need to preserve these habitats in order to maintain the ecosystem services they provide.

Keywords

Bats, Species Diversity, Habitat, Caves, Insectivores, Forested Guinea

1. Introduction

Bats (Order Chiroptera) are one of the most diverse groups of mammals in the world, with more than 1400 described species. They play an essential ecological role in the functioning of ecosystems by regulating insect populations, pollinating plants, and dispersing seeds, thereby contributing to the maintenance of biodiversity and the dynamics of natural habitats. In African tropical ecosystems, bats represent a significant component of the mammalian fauna and play an active role in maintaining ecological balance [1] [2].

Forest Guinea, located within the Upper Guinea Forest biodiversity hotspot, is one of West Africa's major centers of biological diversity. This region is known for its high rate of endemism and exceptional species richness, particularly in the Nimba, Ziama, and Simandou mountain ranges. Studies conducted in these ecosystems have revealed the presence of a remarkable chiropteran fauna comprising several species that are rare, endemic, or globally threatened, notably *Rhinolophus ziama*, *Hipposideros marisae*, and *Hipposideros lamottei* [3]-[5].

The earliest research on bats in Guinea dates back to surveys conducted in the caves of Guinea and on Mount Nimba [6]-[8]. Subsequently, several studies have contributed to improving our understanding of the systematics, distribution, and ecology of the region's bats [9]-[11]. Despite these advances, available information remains limited for many areas of forested Guinea, particularly regarding the local distribution of species, their ecological preferences, and their habitat use.

The main recent data come from surveys conducted in the protected forests of Ziama, Diécké, and the Simandou Massif [4] [12] [13]. These studies have highlighted the importance of montane forests and cave systems as refuges for several specialized species. According to [14], the high-altitude areas of forested Guinea constitute major biological refuges for species with restricted ranges and play an essential role in maintaining regional bat diversity.

However, for several decades, the region has been under increasing anthropogenic pressure linked to agricultural expansion, logging, mining, and urbanization. This gradual degradation of natural habitats poses a significant threat to the conservation of bats and the ecosystem services they provide [14] [15]. Forest loss and cave disturbance can lead to population declines or even the local extinction of species that are particularly dependent on these habitats.

Recent research has confirmed the exceptional importance of forested Guinea

for bat conservation in West Africa. The discovery and description of new species over the past decade further attest to the region's under-explored biological richness. For example, *Myotis nimbaensis*, a species endemic to the Nimba Mountains, was recently described and classified among the most threatened species due to its extremely restricted range [16]. Furthermore, up-to-date African bat databases highlight the importance of having accurate information on species distribution in order to improve conservation strategies and the management of critical habitats [17]. Recent continental assessments have also shown that the Ziama and Nimba forest massifs are among the African protected areas harboring the greatest number of threatened or poorly known species, confirming their critical role in the conservation of regional chiropterological biodiversity [18]. These findings highlight the need to continue biological inventories and ecological studies in Guinea's forest ecosystems in order to better document their diversity and guide conservation measures.

The conservation of bats is also of particular importance due to their role in the functioning of forest ecosystems. Insectivorous species contribute to the natural control of insect populations, while frugivorous species actively participate in seed dispersal and the regeneration of tropical forests [19]. Thus, bat conservation is a major challenge for maintaining the ecological integrity of Upper Guinea's forest landscapes.

In this context, this study aims to assess the species diversity, geographic distribution, and ecological preferences of bats in several locations in forested Guinea. More specifically, it seeks to 1) inventory the species present, 2) analyze their distribution by prefecture and habitat type, 3) characterize the trophic structure of the surveyed communities, and 4) contribute to improving the knowledge necessary for the conservation of bats in this region, which is considered one of West Africa's major biodiversity hotspots.

1.1. General Objective

To assess the species diversity and ecological distribution of bats in the N'Zérékoré forest region (Guinea) in order to contribute to a better understanding of their ecology and to their conservation.

1.2. Specific Objectives

1) To invent the bat species present in the various surveyed locations within the N'Zérékoré forest region.

2) Determine the relative abundance and frequency of the various species recorded.

3) Analyze the spatial distribution of bats across the prefectures and study sites.

4) Assess the influence of habitat types (forest, cave/cavern, agricultural area, and urban/suburban area) on species distribution.

5) Describe the trophic structure of bat communities.

6) Examine the sex ratio within captured populations.

7) Identify habitats and sites of particular conservation interest for bats in the N'Zérékoré forest region.

2. Materials and Methods

2.1. Study Areas

2.1.1. Forest Guinea

Forest Guinea (Figure 1) is a region with significant mining potential, home to the Nimba Mountains (1752 m) and Simandou Mountains (1600 m), two world-class iron ore deposits. Characterized by a series of mountain ranges, its vegetation consists mainly of primary forests. Rainfall, distributed throughout the year, supports agriculture, forestry, and fish farming in the region. Its potential arable land amounts to 1.4 million hectares, of which more than 400,000 hectares are cultivated each year. Guinée Forestière covers an area of 49,500 km^2, which is equivalent to approximately 20% of Guinea's total land area, with a population of 1,989,740 in 2016 [20].

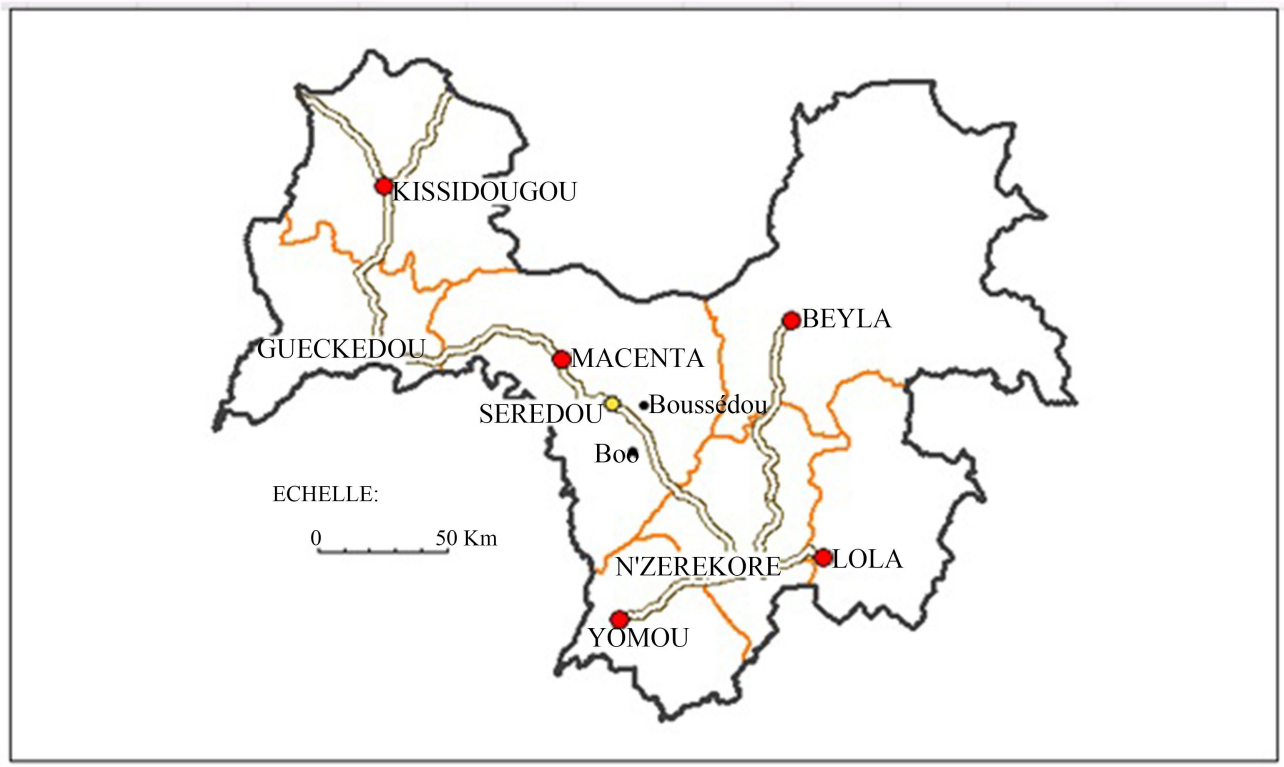

Figure 1. Map of forest Guinea (Source: Camara *et al.* (2012)).

2.1.2. Field Equipment

The field equipment used in this study primarily consisted of mist nets, holding bags, a Global Positioning System (GPS) device, an electronic balance, digital calipers, a digital camera, field data sheets, protective gloves, sampling tubes containing 70% ethanol for specimen preservation, and a computer equipped with Microsoft Excel and R software for statistical analyses (Figure 2).

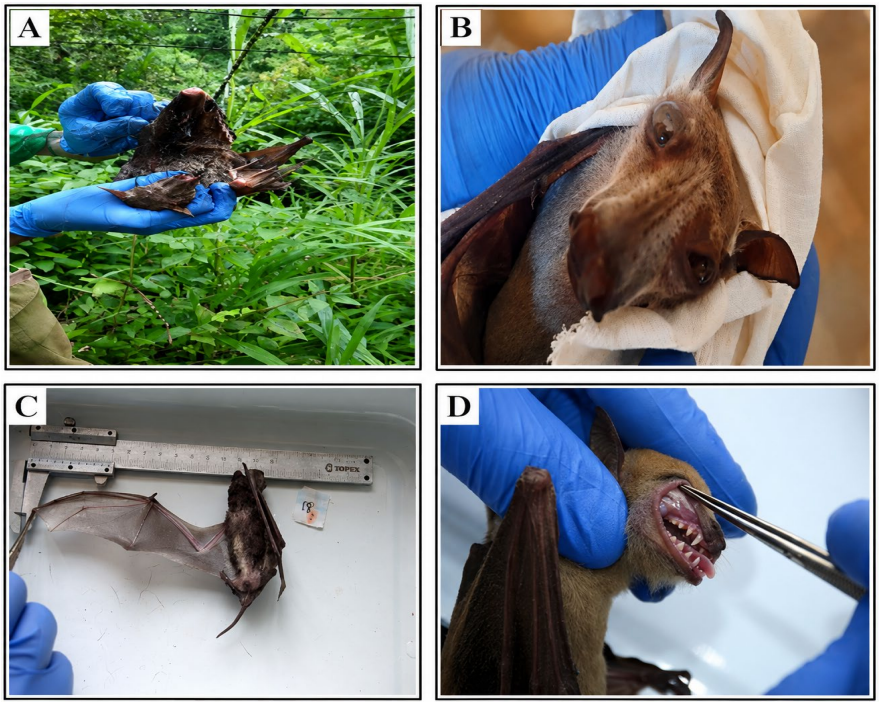

Figure 2. Representative photographs of bat capture and morphological examination: (A) bat captured in a mist net; (B) external examination; (C) wing morphometric measurements; (D) dentition examination.

2.1.3. Sampling and Data Analysis

Bat surveys were conducted between June and September 2025 in several localities within the Guinean Forest Region of N'Zérékoré. Bats were captured using mist nets deployed across different habitat types, including forests, agricultural areas, urban and peri-urban environments, as well as in the vicinity of caves.

A total of 32 capture nights were conducted in terrestrial habitats, together with 16 daytime surveys in caves. On average, four mist nets were deployed each night. The mist nets measured 12 × 2.8 m and 6 × 2.8 m, with a mesh size of 16 mm. Nets were generally opened from 18:00 to 00:00, corresponding to the peak period of bat activity.

The total sampling effort was estimated at 128 net-nights, representing approximately 768 net-hours. Mist nets were inspected at regular intervals to minimize stress and injuries to captured bats.

Sampling was conducted over a total of 32 nights across the four prefectures. In each locality and habitat, four mist nets measuring 12 × 2.8 m and 6 × 2.8 m, with a mesh size of 16 mm, were deployed for 6 hours per night. A total of 16 cave visits were conducted (4 in Macenta, 4 in Nzérékoré, 4 in Lola, and 4 in Guéckédou).

The cave-related data combined mist-net captures conducted at roost entrances at dusk and during daytime visits. To avoid double counting, individuals captured with mist nets were measured, released, and temporarily marked on the wing claw using a non-toxic marker to identify any recaptures during the same sampling session. Only unique individuals were included in the abundance analysis.

Captured individuals were identified using standard morphological and taxonomic criteria based on external morphology, forearm length, pelage coloration, and other species-specific diagnostic characteristics. In the absence of molecular data (Cytochrome *b* gene sequencing) or high-frequency acoustic recordings, identification was retained at the species-complex level or adjusted based on the following morphometric characteristics: forearm length (FA), tibia length, and tragus shape. We explicitly designated the taxon as *Miniopterus spp.* (the *inflatus/schreibersii* complex) to avoid overestimating taxonomic resolution.

All field data were entered into Microsoft Excel and subsequently analyzed using R statistical software.

Descriptive statistics were used to determine relative abundance, species frequencies, and the spatial distribution of bat species. Ecological diversity indices, including the Shannon-Wiener, Simpson, Pielou's evenness, Margalef, and Menhinick indices, were calculated to assess community diversity. Because a high proportion of cells in the species-habitat contingency table had low or zero expected frequencies (78.6% of expected frequencies were <5), the conventional asymptotic chi-square test of independence was not considered valid. Therefore, the association between species distribution and habitat types was assessed using a chi-square test with a Monte Carlo simulation based on 100,000 random replications, using a permutation procedure with fixed marginal totals.

All capture and handling procedures were carried out in accordance with internationally accepted guidelines for the capture, handling, and ethical treatment of bats.

2.1.4. Research Permits and Ethics

Bat capture and handling were conducted in accordance with international guidelines for the ethical treatment of wild animals. The fieldwork authorization for sampling and access to the study sites was issued by the Governor of the Administrative Region under reference No. 17/RA/CAB/N'Z/2025, dated 5 July 2025. The study protocol was approved by the Scientific Committee of the Laboratory of Research in Natural Sciences (LARSCINA) at the University of Kindia. All field procedures strictly followed hygiene and biosafety standards, including the use of protective gloves and FFP2 masks, to minimize animal stress and reduce the risk of zoonotic transmission.

3. Results

The study conducted in the Forest Region of Guinea resulted in the capture of 94 bats belonging to 7 taxa distributed across several families within the order Chiroptera. These results show that the study area is home to significant chiropterological diversity, dominated by a few very abundant species, while others remain underrepresented (Table 1).

The community is dominated by *Miniopterus spp.* with 33 individuals (35.1%), followed by *Hipposideros caffer* with 18 individuals (19.1%). Next come *Epomops*

buettikoferi (13 individuals; 13.83%), *Chaerephon major* (11 individuals; 11.7%), *Rhinolophus ziama* (10 individuals; 10.6%), followed by *Rousettus aegyptiacus* and *Myonycteris torquata*, which are less common (Figure 3).

Table 1. Taxonomic distribution of the species caught.

Order	Family	Species	Number (n)	Percentage (%)
Chiroptera	Miniopteridae	*Miniopterus spp.*	33	35.11
	Hipposideridae	*Hipposideros caffer*	18	19.15
	Molossidae	*Chaerephon major*	11	11.70
	Pteropodidae	*Epomops buettikoferi*	13	13.83
		Rousettus aegyptiacus	8	8.51
		Myonycteris torquata	1	1.06
	Rhinolophidae	*Rhinolophus ziama*	10	10.64
Total			**94**	**100**

This dominance of a few species reflects an unbalanced community structure, in which certain species are better adapted to local conditions than others. The most abundant species therefore appear to have an ecological advantage related to the availability of roosts, food, or their ability to adapt to the surveyed habitats.

The low number of *Myonycteris torquata* (1 individual) suggests either that the species is genuinely rare in the area or that it was difficult to detect during the captures.

Figure 3. Representative bat species captured during the survey. (A) *Miniopterus inflatus*; (B) *Epomops buettikoferi*; (C) (D) *Rhinolophus ziama*.

Table 2. Species composition of bats captured in forested Guinea.

Species	Number (n)	Frequency (%)
Miniopterus spp.	33	35.11
Hipposideros caffer	18	19.15
Epomops buettikoferi	13	13.83
Chaerephon major	11	11.70
Rhinolophus ziama	10	10.64
Rousettus aegyptiacus	8	8.51
Myonycteris torquata	1	1.06
Total	**94**	**100**

The bat community recorded in Forest Guinea comprises seven species, totaling 94 individuals. *Miniopterus spp.* is the dominant species with 33 individuals (35.11%), followed by *Hipposideros caffer* (19.15%) and *Epomops buettikoferi* (13.83%). The species *Rousettus aegyptiacus* and *Myonycteris torquata* are underrepresented, accounting for 8.51% and 1.06% of the captures, respectively (Table 2).

Table 3. Distribution of bats by prefecture.

Species	Lola	Macenta	N'Zérékoré	Guéckédou	Total
Chaerephon major	11	0	0	0	11
Hipposideros caffer	17	0	1	0	18
Epomops buettikoferi	0	5	3	5	13
Miniopterus spp.	0	33	0	0	33
Rhinolophus ziama	0	0	0	10	10
Rousettus aegyptiacus	0	0	8	0	8
Myonycteris torquata	0	0	1	0	1
Total	**28**	**38**	**13**	**15**	**94**

The distribution of bats in forested Guinea shows significant variation among prefectures. Macenta has the highest number of individuals (38; 40.4%), mainly due to the high abundance of *Miniopterus spp.* Lola ranks second (28 individuals; 29.8%), dominated by *Hipposideros caffer* and *Chaerephon major*. Guéckédou (15 individuals; 16.0%) is distinguished by the exclusive presence of *Rhinolophus ziama*, while N'Zérékoré (13 individuals; 13.83%) is home primarily to frugivorous species such as *Rousettus aegyptiacus* and *Epomops buettikoferi* (Table 3).

This uneven distribution shows that bat species exhibit specific ecological preferences and that local environmental conditions strongly influence their distribution in forested Guinea.

The species richness of bats varies across the prefectures of the N'Zérékoré Forest Region. The N'Zérékoré Prefecture has the highest species richness (4 species),

while Macenta has the highest abundance (38 individuals). However, abundance does not necessarily reflect species richness, since Macenta has the largest number of individuals but low species diversity. These results show that the distribution of bats is strongly influenced by local ecological characteristics and highlight the importance of N'Zérékoré for the conservation of bat species diversity in forested Guinea (Table 4).

Table 4. Per capita wealth by prefecture.

Prefecture	Nomber especies
Lola	2
Macenta	2
N'Zérékoré	4
Guéckédou	2

Table 5. Distribution of bats by sex.

Sex	Number (n)	Percentage (%)
Femelles	47	50.0
Mâles	47	50.0
Total	**94**	**100**

The sex ratio is perfectly balanced:

- Females: 47 (50%).
- Males: 47 (50%).

This balance suggests that there is no sex bias in the sampling and that the captures involved both sexes equally. It may also reflect similar activity levels among males and females at the study sites at the time of the surveys (Table 5).

Table 6. Distribution of bat species by habitat type in forest Guinea.

Especies	Forest	Cave/Cavern	Agricultural Area	Urban/Suburban Area	Total
Chaerephon major	0	0	0	11	**11**
Epomops buettikoferi	12	0	1	0	**13**
Hipposideros caffer	0	9	9	0	**18**
Miniopterus spp.	10	23	0	0	**33**
Myonycteris torquata	1	0	0	0	**1**
Rhinolophus ziama	0	10	0	0	**10**
Rousettus aegyptiacus	3	5	0	0	**8**
Total	**26**	**47**	**10**	**11**	**94**

Chi-square test: $\chi^2 = 169.02$; df = 18; $p < 0.0001$.

The results indicate a statistically significant association between bat species and habitat types, as demonstrated by the chi-square test:

- $\chi^2 = 169.02$
- df = 18
- $p < 0.0001$

The distribution of bat species differed significantly among habitat types ($\chi^2 = 169.02$; df = 18; $p < 0.0001$; Monte Carlo test based on 100,000 permutations). This variation suggests a non-homogeneous distribution of species across the habitats studied (Table 6). Some species were more frequently associated with particular habitat types, notably *Chaerephon major*, which was mainly recorded in urban habitats, as well as *Rhinolophus ziama* and *Hipposideros caffer*, which were more frequently represented in cave and forest habitats (Figure 4).

Figure 4. Main bat capture habitats and roosting sites: (A) shrub savanna; (B) rocky roost; (C) oil palm plantation; (D) secondary forest habitat near human settlements.

Table 7. Distribution of bats by major trophic groups.

Trophic group	Species involved	Number (n)	Percentage (%)
Insectivores	*Miniopterus spp.*, *Hipposideros caffer*, *Chaerephon major*, *Rhinolophus ziama*	72	76.60
Frugivores	*Epomops buettikoferi*, *Rousettus aegyptiacus*, *Myonycteris torquata*	22	23.40
Total		**94**	**100**

The trophic analysis reveals a clear dominance of insectivores:

- Insectivores: 72 individuals (76.6 per cent)
- Frugivores: 22 individuals (23.4 per cent)

This composition indicates that the captured fauna consists mainly of species that feed on insects. This may reflect a good availability of prey in the surveyed habitats, but also the high abundance of cave-dwelling and arboreal insectivorous

species (Table 7).

Frugivores, although fewer in number, play an essential ecological role in seed dispersal and forest regeneration, making them of great importance for the maintenance of ecosystems.

Table 8. Distribution of species by location.

Especies	Lola	Sibata-2	Kpoda	Karanah	Boma	Guecké-Bumou	Yendè Millimou	Total
Chaerephon major	11	0	0	0	0	0	0	**11**
Hipposideros caffer	0	0	0	17	0	1	0	**18**
Epomops buettikoferi	0	5	0	1	2	0	5	**13**
Miniopterus spp.	0	0	33	0	0	0	0	**33**
Rousettus aegyptiacus	0	0	0	7	1	0	0	**8**
Myonycteris torquata	0	0	0	0	1	0	0	**1**
Rhinolophus ziama	0	0	0	0	0	0	10	**10**
Total	**11**	**5**	**33**	**25**	**4**	**1**	**15**	**94**

The distribution by locality confirms a concentration of species in certain specific sites (Table 8):

Kpoda has the highest number of individuals, mainly due to *Miniopterus spp.*

- Karanah is home to several species, suggesting a certain diversity of habitats.
- Yendè Millimou is characterised by the exclusive presence of *Rhinolophus ziama*.
- Lola is mainly represented by *Chaerephon major*.
- Sibata-2, Boma and Guecké-Bumou have lower numbers.

The observed distribution highlights variations in species richness among localities. Some localities showed higher species diversity or harbored species whose occurrence appeared more localized. These findings underscore the importance of considering differences among localities in strategies for monitoring and conserving bat diversity.

Table 9. Ecological indices of the bat community in forested Guinea.

Category	Ecological index	Symbol	Value
Population size	Total number of individuals	N	94
Richness	Specific richness	S	7
Richness	Margalef's index	DMg	1.32
Richness	Menhinick's index	DMn	0.72
Diversity	Shannon-Wiener	H'	1.705
Dominance	Simpson	D	0.211
Diversité	Simpson (1-D)	1-D	0.789
Evenness	Pielou	J'	0.876

Analysis of the ecological indices reveals a species richness of seven species, with a total of 94 individuals captured. The Shannon-Wiener index (H' = 1.705) indicates a relatively high level of community diversity. The Simpson's index (1-D = 0.789) confirms this diversity and reflects low overall dominance. Simpson's dominance (D = 0.211) shows that no single species strongly dominates the community, despite the predominance of *Miniopterus spp*. Pielou's evenness (J' = 0.876) reveals a relatively even distribution of individuals across species. The Margalef (DMg = 1.32) and Menhinick (DMn = 0.72) richness indices indicate moderate species richness in the community studied (**Table 9**).

4. Discussion

This study identified 94 individuals belonging to seven bat species across several families within the order Chiroptera. Although the number of species observed remains relatively modest compared with the known chiropterological potential of forested Guinea, the results confirm the ecological importance of this region for the conservation of bats in West Africa.

The dominance of *Miniopterus spp.* (35.1 per cent) and *Hipposideros caffer* (19.1 per cent) reflects a strong representation of insectivorous species in the communities studied. This predominance is consistent with observations made in several African tropical ecosystems, where insectivorous bats generally constitute the dominant component of bat communities due to the abundance of food resources and the availability of suitable roosting sites [4] [21]. The high abundance of *Miniopterus spp.* may be linked to the presence of natural cavities offering favourable conditions for reproduction and daytime rest, as well as to the high availability of insects in the surveyed habitats.

The species richness observed remains lower than that reported in the Nimba, Ziama or Simandou mountain ranges, where several surveys have recorded a higher number of species [13] [22]. This difference may be explained by the limited duration of the sampling, the relatively small number of sites surveyed and the exclusive use of Japanese nets. Several authors have shown that certain species flying at high altitudes or inhabiting complex forest habitats are difficult to detect using this method and require the supplementary use of acoustic detectors or harp traps [23].

The study also highlights a strong spatial structure within the communities. Macenta Prefecture has the highest number of individuals, whilst Guéckédou is characterised by the exclusive presence of *Rhinolophus ziama*. This heterogeneous distribution may reflect differences in the ecological requirements of the species, particularly in relation to roost availability, vegetation structure, and local microclimatic conditions. These observations are consistent with the conclusions of [17], who emphasise the importance of environmental characteristics in determining the ranges of African bats.

The presence of *Rhinolophus ziama* is of particular conservation interest. This species is closely associated with the humid forests and cave systems of Upper

Guinea. Its relatively restricted distribution and dependence on specialised habitats confer high conservation value on this species. Recent work by [18] has, moreover, identified Guinea's forest massifs as priority areas for the conservation of threatened or poorly understood bat species in Africa.

The highly significant association observed between the species and habitat types ($\chi^2 = 169.02$; ddI = 18; $p < 0.001$; Cramér's V = 0.774) demonstrates that the distribution of bats is strongly influenced by the ecological characteristics of their environments. Caves and caverns alone account for half of the individuals captured and constitute the main refuges for *Miniopterus spp.* and *Rhinolophus ziama*. Cavernine systems play a vital role in the life cycle of many species by providing stable microclimatic conditions conducive to reproduction, hibernation or daytime rest [23] [24].

Fruit-eating species, notably *Epomops buettikoferi* and *Rousettus aegyptiacus*, were mainly observed in forest habitats. This distribution is consistent with their fruit-based diet and their dependence on plant resources available in tropical forests. These species play a major role in seed dispersal and the natural regeneration of forest ecosystems. According to [1], fruit-eating bats are among the main agents in maintaining plant diversity in tropical regions.

The high dominance of insectivorous bats (76.6%) observed in this study likely reflects the high availability of insect prey within the surveyed habitats, as well as the effectiveness of the sampling methods used for this trophic group. Insectivorous bats provide essential ecosystem services by naturally regulating insect populations, including numerous agricultural pests and disease vectors. Their ecological and economic importance has been widely recognized worldwide [1] [25].

The balanced sex ratio observed between males and females suggests the absence of any major sampling bias. This distribution indicates that both sexes used the surveyed habitats similarly during the sampling period. Comparable findings have been reported in several ecological studies investigating tropical bat communities [23].

Finally, our findings confirm the importance of the Guinean Forest Region as a priority area for bat conservation in West Africa. However, increasing anthropogenic pressures associated with logging, agricultural expansion, urbanization, and mining activities represent major threats to the long-term persistence of bat populations. Several recent assessments have highlighted that the loss and degradation of natural habitats remain among the leading drivers of global bat declines [26]. In this context, the conservation of forest ecosystems, caves, and ecological corridors is essential to maintain bat species diversity and preserve the ecosystem services they provide across the landscapes of the Guinean Forest Region.

5. Conclusions

This study documented the species diversity, spatial distribution, and ecological preferences of bats across several localities in the Guinean Forest Region. A total of 94 individuals belonging to seven species distributed among five families were

recorded. The bat community was dominated by insectivorous species, particularly *Miniopterus spp.* and *Hipposideros caffer*, which accounted for the majority of captured individuals.

The results revealed a marked spatial structuring of bat populations and a significant influence of habitat type on species distribution. Caves were identified as essential habitats for several specialized species, particularly *Miniopterus spp.* and *Rhinolophus ziama*, whereas frugivorous species were more closely associated with forest habitats.

The caves of Kpoda and Yendè Millimou, together with the forest habitats of N'Zérékoré, appear to be priority sites for bat conservation in the Guinean Forest Region. Protecting these habitats would contribute to the conservation of specialized species and the maintenance of the ecosystem services they provide.

Statistical analysis confirmed a highly significant association between bat species and habitat types ($\chi^2 = 169.02$; df = 18; $p < 0.001$; Cramer's V = 0.774), highlighting the importance of ecological conditions in shaping bat community structure. The occurrence of species of high conservation value and restricted distribution, such as *Rhinolophus ziama*, further emphasizes the importance of the Guinean Forest Region as a priority area for bat conservation in West Africa.

Given the increasing pressures associated with agricultural expansion, logging, mining activities, and urbanization, the conservation of forest and cave habitats is essential to ensure the long-term persistence of bat populations and the ecosystem services they provide. Further studies incorporating acoustic surveys, molecular techniques, and long-term ecological monitoring are needed to improve our understanding of the ecology and conservation of bats in the Guinean Forest Region.

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Conflicts of Interest

The authors declare no conflicts of interest regarding the publication of this paper.

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