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The birds of Cameroon: bird survey in a forest mountain of the Congo Basin Forest (Mbam Minkom, Cameroon) supports the diversity of birds in the second largest biodiversity in the world as well as the distribution scheme of taxa in this area

Abstract

Understanding the birdlife of Cameroon is a major priority for the future development of conservation strategies in this country, which is rich in avian Biodiversity. To this end, we studied the diversity and distribution of birds on Mount Mbam-Minkom, a relict forested mountain in the Centre Region of Cameroon. Sampling was carried out between October 2021 and February 2022 using mist nets, and diversity and distribution analyses were performed using SAS/STAT and PAST Software. Furthermore, we compared the diversity results obtained with those of another mountain in the same region, Mount Eloumden, by recording the values in two-way table and analyzing them. A total of 139 individuals were captured, belonging to 16 families, 21 genera, and 29 species with passerines being the most numerous (84.49%) compared to 15.51% for non-passerines. Compared to previous surveys in this region, we recorded a new species, *Cisticola bulliens*; the most represented family was the Pycnonotidae, with the most abundant species, *Eurillas virens*. Both resident and migratory species were observed. Calculated diversity indices revealed some avifauna diversity in the Mbam-Minkom area; the Shannon-Wiener index (H' = 2.86) comes out an average number of species, while the Equitability index (J = 0.85) indicates a homogenous distribution of individuals. The Simpson index (1-D = 0.91) confirms the absence of any single species dominance with low competition for food resources and species distribution appears closely linked to the vegetation present at this Mbam-Minkom site throughout the year. A comparison of the diversity results with those of the Mount Eloumden confirms the interdependence between abundant vegetation (Eloumden) and high bird species diversity.

Keywords: birdlife, avian biodiversity, Mount Mbam-Minkom, mist nets, interdependence

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Introduction

Due to their ability to fly, birds have colonized all environments, from the poles to snowy regions and the rainforests of various countries located south of the Equator, notably Cameroon; these countries often harbor the greatest number of bird species.[1,2] Currently, 1718 bird species have been recorded for the entire avifauna of West Africa, while approximately 970 have been recorded for that of Cameroon within the Ethiopian ecozone; the avifauna of this part of the world thus appears particularly rich in terms of species, genera and orders.[3]

With a variety of climates (generally tropical in the north and equatorial in the south) and diverse ecosystems (forests, savannas, mangroves, etc.), Cameroon, located in the heart of the Congo Basin, a region renowned for its rich animal and plant biodiversity, is home to a birdlife that is fairly concentrated in forested areas and much less so in Sahelian zones, as is the case in most West African countries, in the forest areas and much less in the Sahelian areas.[1,4-8] This avifauna is quite diverse and, as observed in some ecozones, several factors influence its distribution, including biotic factors (predation, competition, etc…), environmental factors (vegetation, etc…), abiotic factors (environmental conditions, etc…).[4,6,9,10]

Of the approximately 970 bird species identified in Cameroon, eleven are endemic, but more generally overall these species are distributed among 27 orders and 105 families such as Pycnonotidae, Nectariniidae, Ploceidae, Accipitridae, etc.[2] This avifauna is more diverse in mountainous areas than in lowland regions.[11-17] Despite this diversity, only a few studies have been carried out in certain regions of Cameroon and they have often been limited to a few specific sites;[4,18-20] however, for some years now, studies have been continuously conducted in both the mountains and the plains of several regions of Cameroon.[11,13-17,21,22] In the Centre Region of Cameroon, several studies have identified around twenty families of passerine and non-passerine birds.[4,20] Recent research has allow for some updating of the list of taxa in certain localities, notably by Nguembock and his collaborators.[13-17] Thus, until very recently in the Centre region, the avifauna was mainly known due to the work of Good,[18,19] Germain et al.,[20] and Louette;[4] but in recent years, several works of Nguembock et al.,[13-17] have therefore been carried out in this region only without covering its entire extent, including Mount Mbam Minkom in the Yaounde area and its surroundings.

Yaounde, also called the city of seven hills, is located on a network of hills dominated by Mount Mbam-Minkom (1295m) to the northwest, Mount Nkolondom (1221m) in the same area, Mount Eloumdem (1159m) to the southwest and Mount Messa (1015m) to the west.[12,23] Mount Mbam-Minkom is a five-peaked mountain range ; it is located in the village of Mbam Minkom and extends between 3°57'44'' north latitude, and 11° 23'30'' east longitude. The highest peak in the Centre region, the Mbam Minkom village is located 39 km

from Yaounde in the Lekie department (Figure 1) and is characterised by a Guinean equatorial climate. The vegetation is of intertropical type with a predominance of the southern semi-deciduous Guineo-Congolese humid forest;[5,24-27] secondary forests, composed of a mixture of forest and cultivated land, as well as peri-forest savannas, are present in the Mbam Minkom locality. However, the disappearance of vegetation cover is observed due to the overexploitation of cultivable land.[28] Thus, this site offers a favorable habitat for birds, although it remains poorly documented since the first surveys carried out during the colonial period.[4]

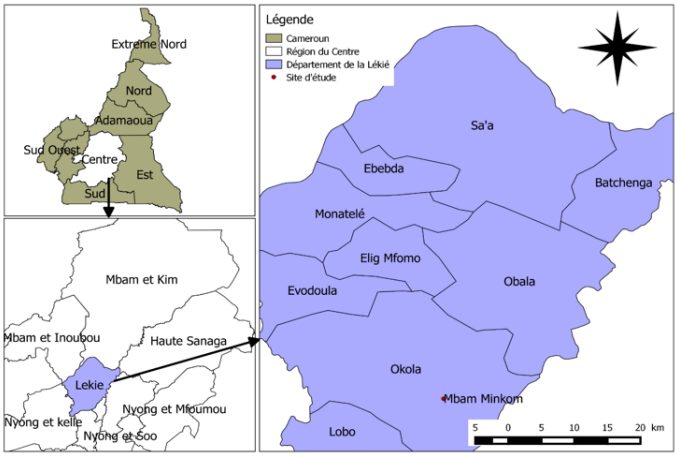

Figure 1 Localization of Mount Mbam Minkom in a country of the Congo Basin forest (Cameroon).

In this study, conducted in the highest peak of the Yaounde mountain range, we pursued two main objectives: firstly, to investigate the avifauna of this mountain, characterized by varied vegetation; and secondly, to analyze the abundance, diversity, and distribution of the avifauna of Mount Mbam Minkom and, if possible, formulate a hypothesis on the distribution pattern of species in this mountain. Based on the results obtained regarding diversity and after a brief comparison of the values of the diversity with those of Mount Eloumden, to propose a hypothesis on the link between bird diversity and their habitat.

Materials and methods

Sampling and identification of the Mbam Minkom avifauna

During the ornithological survey in Mount Mbam Minkom, we used the mist-netting method with seven standard three-pocket vertical nets. Captures began very early in the morning, as early as 5:00 a.m., and ended late in the evening, sometimes around 6:30 p.m., during seven field trips spread over five months, from October 2021 to February 2022. This method is well known for its effectiveness in capturing small and medium-sized birds, especially passerines.[17,21,22] The sampling effort was standardised by reusing the same equipment for each mission.[23] In order to ensure the capture success, we mainly identified their preferred flight paths, feeding areas, roosting and shaded sites. Birds were identified *in situ* based on both morphological characteristics (e.g. number and arrangement of toes, plumage colouration, size and shape of the beak) and their geographic distribution as provided in the *Birds of Western Africa* field guide.[1,6]

Method for the calculation of the relative abundance of the Mbam Minkom avifauna

To calculate the relative abundance, we chose to use the Statistical Analysis System.[29] We input data as explained in the user guide and ran software until the obtaining of the results. Otherwise, we used Excel software program to obtain our histograms.[30]

Method for the calculation of the occurrence of the Mbam Minkom avifauna

In order to calculate the occurrence, we used the same software, the Statistical Analysis System;[29] the results obtained were discussed according to the intervals given by Dajoz.[31] Thus, if FO<5%, the species is said to be sporadic; if 5%≤FO<25%, the species is said to be accidental; if 25%≤FO<50%, the species is said to be accessory; if 50%≤FO<75%, the species is regular; if 75%≤FO<100, the species is constant; and finally if FO=100%, the species is said to be omnipresent. Otherwise, as for the calculation of the relative abundance, we input data as explained in the user guide and ran software until the obtaining of the results.

Methods for characterizing the avian community of Mount Mbam Minkom

Shannon index (H'): The Shannon's diversity index represents the measure of the sum of degree of the uncertainty when it suggests predicting to which species would belong to an individual taken by chance in a collection of S species and N individuals. *H'* = 0 if the community has only one species; *H'* takes the maximal value $\log_2 S$ only when all species are represented by the same number of individuals. This index is determined by the following relationship:

$$H' = -\sum_{i=1}^{S} (p_i x \, Log_2 p_i) \text{ with } pi = n_i/N$$

Where pi = proportion of individuals of the species "i";

S = total number of species of the sample.

ni = number of individuals of the species "i";

N = total number of individuals of the sample.

The Shannon index (*H'*) increases when the number of the species of the community grows and, theoretically, it can reach elevated values. The value of *H'* varies from 1 to $\log_2 S$. In our study, the Shannon index was calculated with the PASTv3.16 software.[32]

Simpson index (λ): The Simpson index represents the proportion of abundance of the species "i".[32] This index measures the degree of concentration when individuals are classified into types. It is determined by the following relationship

$$ë = \sum_{i=1}^{S} \frac{n_i(n_i - 1)}{n(n-1)}$$

where *ni* = number of individuals of the species "i";

n = total number of individuals of the sample.

Nevertheless, the most popular of such indices have been the inverse Simpson index (1/λ) and the Gini-Simpson index (1 – λ) and both have also been called the Simpson index in the ecological literature. In our study, the Simpson index was calculated with the PASTv3.16 software.[32]

Equitability index: The Equitability index measures the distribution of individuals within species independently to the specific richness. Its

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value varies from 0 (supremacy of one species) to 1 (equal distribution of individuals within species).

Thus, the Equitability index of Pielou (*J'*) is determined by the following formula:

$J' = H'/H'max$

H' = Shannon index

$H'max$ = log2S (S = the total number of species).

In our study, the Equitability index was calculated with the PASTv3.16 software.[32]

All these indices were obtained with a 95% confidence threshold.[33]

Method for comparing diversity between Mount Mbam Minkom and Mount Eloumdem

It is well known that the Shannon-Wiener index is a widely used tool for comparing diversity between different habitats.[34] Based on our small sample, we performed a simple comparison by recording, in a two-way table, the diversity values obtained at Mount Mbam Minkom and, on the other hand, those already obtained at Mount Eloumdem by another team from our Ornithology Laboratory in Yaounde I under relatively similar conditions, thus allowing us to carry out this simple comparison.

Results

Overall taxonomic richness of the avifauna of Mount Mbam-Minkom

During field surveys, 139 individuals belonging to 29 species, 21 genera, 16 families, and five (05) orders were captured (Table 1). The order Passeriformes was the richest (22 species), followed by Piciformes (04 species); the other orders Coraciiformes, Columbiformes, and Cuculiformes were monospecific (one species each) (Table 1). Regarding families, Nectariniidae exhibited the greatest species richness (05 species), followed by Cisticolidae (04 species); the other families, such as Hyliidae, Macrosphenidae, Columbidae, Alcedinidae, Cuculidae, Muscicapidae, Malaconotidae, Picidae, and Indicatoridae were monospecific (Table 1 & Figure 2). For the genera, the most represented were *Cinnyris* and *Camaroptera* (03 species each); the other genera were monospecific, without necessarily exhibiting low species richness (Table 1).

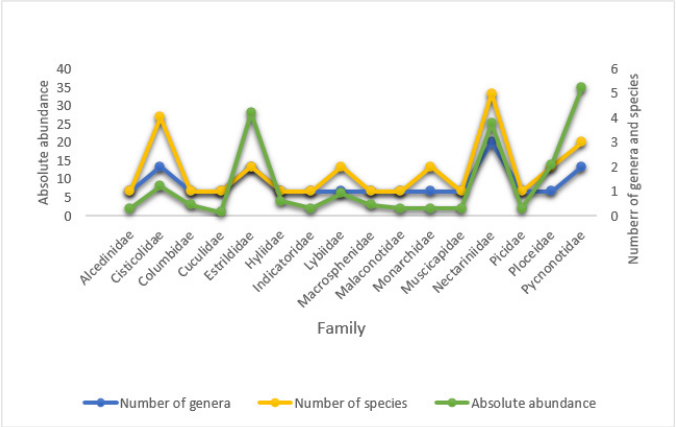

Figure 2 Histogram of relative family abundance in function of genera and species captured on Mount Mbam-Minkom

Table 1 Overall taxonomic richness of the Avifauna of Mount Mbam-Minkom

Order	Family	Genus	No. of species	% of Total species
Passeriformes	Ploceidae	*Ploceus*	2	6.90
	Nectariniidae	*Cinnyris*	3	10.34
		Hedydipna	1	3.45
		Cyanomitra	1	3.45
	Cisticolidae	*Camaroptera*	3	10.34
		Cisticola	1	3.45
	Macrosphenidae	*Macrosphenus*	1	3.45
	Hyliidae	*Hylia*	1	3.45
	Pycnonotidae	*Pycnonotus*	1	3.45
		Eurillas	2	6.90
	Estrildidae	*Spermophaga*	1	3.45
		Nigrita	1	3.45
	Monarchidae	*Terpsiphone*	2	6.90
	Muscicapidae	*Cossypha*	1	3.45
	Malaconotidae	*Tchagra*	1	3.45
Columbiformes	Columbidae	*Turtur*	1	3.45
Coraciiformes	Alcedinidae	*Ispidina*	1	3.45
Piciformes	Lybiidae	*Pogoniulus*	2	6.90
	Picidae	*Campethera*	1	3.45
	Indicatoridae	*Indicator*	1	3.45
Cuculiformes	Cuculidae	*Chrysococcyx*	1	3.45
05	16	21	29	100

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Absolute and Relative Abundance by Family

The most abundant family was Pycnonotidae (35 individuals, 25.18%), followed by Estrildidae (28 individuals, 20.14%) and Nectariniidae (25 individuals, 19.99%), respectively (Table 2 & Figure 2). The other families, such as the Cuculidae, Alcedinidae, Monarchidae, Muscicapidae, Malaconotidae, Picidae, and Indicatoridae, were the least represented (2 individuals each) (Table 2 & Figure 2).

Table 2 Absolute and relative abundance by family with the number of genera and species

Family	Absolute abundance	Relative abundance (%)	No. of genera	No. of species
Pycnonotidae	35	25.18	2	3
Estrildidae	28	20.14	2	2
Nectariniidae	25	19.99	3	5
Ploceidae	14	10.07	1	2
Cisticolidae	8	5.76	2	4
Lybiidae	6	4.32	1	2
Cyanomitra	6	4.32	-	-
Hyliidae	4	2.88	1	1
Spermophaga	4	2.88	-	-
Columbidae	3	2.16	1	1
Macrosphenidae	3	2.16	1	1
Alcedinidae	2	1.44	1	1
Monarchidae	2	1.44	1	2
Muscicapidae	2	1.44	1	1
Malaconotidae	2	1.44	1	1
Picidae	2	1.44	1	1
Indicatoridae	2	1.44	1	1
Cuculidae	1	0.72	1	1
Total	139	100%	21	29

Abundance by genus

Among the 21 genera identified, the most represented were *Eurillas* (23.74%), *Nigrita* (17.27%), *Cinnyris* (12.23%), and *Ploceus* (10.07%), respectively (Table 3). These were followed by less represented genera such as *Cyanomitra, Pogoniulus, Camaroptera, Hylia, Spermophaga, Turtur, Cisticola, Hedydipna, Macrosphenus, Pycnonotus, Terpsiphone, Ispidina, Cossypha, Tchagra, Campethera, Indicator*, with *Chrysococcyx* being the least represented at 0,72% (Table 3).

Table 3 Absolute and relative abundance and number of species per genus

Genus	Absolute abundance	No. of species	Relative abundance (%)
Camaroptera	5	4	3.6
Campethera	2	1	1.44
Chrysococcyx	1	1	0.72
Cinnyris	17	3	12.23
Cisticola	3	1	2.16
Cossypha	2	1	1.44
Cyanomitra	6	1	4.32
Eurillas	33	2	23.74
Hedydipna	2	1	1.44
Hylia	4	1	2.88
Indicator	2	1	1.44
Ispidina	2	1	1.44
Macrosphenus	2	1	1.44
Nigrita	24	1	17.27
Ploceus	14	1	10.07
Pogoniulus	6	2	4.32
Pycnonotus	2	1	1.44
Spermophaga	4	1	2.88
Tchagra	2	1	1.44
Terpsiphone	2	2	1.44
Turtur	3	1	2.16
Total	139	29	100

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Abundance and frequency of occurrence of species on Mount Mbam-Minkom

Twenty-nine bird species (passerines and non-passerines) were recorded among the 139 individuals captured during the sampling period (Table 4). The most abundant species was *Eurillas virens* with a relative abundance of 19.42%, followed by *Nigrita bicolor* (17.27%) and *Ploceus nigerrimus* (11.64%), respectively (Table 4). Alongside this first group of relatively abundant species, eleven species were represented by two individuals each (1.44%) while four species by a single individual (0.72%) (Table 4).

Table 4 Specific abundance and occurrence of each species recorded on Mount Mbam-Minkom

Scientific name	Common name	Abundance	Relative (%)	No. of field occurrences	Frequency of occurrence (%)
Camaroptera brachyura	Bleating Camaroptera	2	1.44	1	14.29
Camaroptera chloronata	Olive-green Camaroptera	3	2.16	1	14.29
Camaroptera superciliaris	Yellow-browed Camaroptera	1	0.72	1	14.29
Campethera cailliautii	Green-backed Woodpecker	2	1.44	1	14.29
Chrysococcyx klaas	Klaas's Cuckoo	1	0.72	1	14.29
Cinnyris batesi	Bates's Sunbird	6	4.32	3	42.86
Cinnyris chloropygius	Olive-bellied Sunbird	7	5.04	4	57.14
Cinnyris cupreus	Copper Sunbird	4	2.88	1	14.29
Cisticola bulliens	Bubbling Cisticola	3	2.16	1	14.29
Cossypha natalensis	Red-capped Robin-chat	2	1.44	1	14.29
Cyanomitra olivacea	Olive Sunbird	6	4.32	4	57.14
Eurillas latirostris	Yelloow-whiskered Greenbul	6	4.42	3	42.86
Eurillas virens	Little Greenbul	27	19.42	6	85.71
Hedydipna collaris	Collared Sunbird	2	1.44	2	28.57
Hylia prasina	Green Hylia	4	2.88	3	42.86
Indicator exilis	Least Honeyguide	2	1.44	1	14.29
Ispidina picta	African pygmy-kingfisher	2	1.44	2	28.57
Macrosphenus concolor	Gray Longbill	2	1.44	2	28.57
Nigrita bicolor	Chesnut-breastes Negrofinch	24	17.27	2	28.57
Ploceus nigerrimus	Viellot's black Weaver	12	8.63	4	57.14
Ploceus nigricollis	Black-necked Weaver	2	1.44	1	14.29
Pogoniulus scolopaceus	Speckled Tinkerbird	4	2.88	2	28.57
Pogoniulus subsulphureus	Yellow-throated Tinkerbird	2	1.44	1	14.29
Pycnonotus barbatus	Common Bulbul	2	1.44	3	43.86
Spermophaga haematina	Western Bluebill	4	2.88	3	42.86
Tchagra senegalus	Black-crowned Tchagra	2	1.44	1	14.29
Terpsiphone rufocinera	Paradise Flycatcher	1	0.72	1	14.29
Terpsiphone viridis	African Paradise-flycatcher	1	0.72	1	14.29
Turtur tympanistria	Tambourine Dove	3	2.16	2	28.57
Total		139	100		

Frequency of occurrence data made it possible to categorize species in the field: *Eurillas virens* (FO = 85.71%) was omnipresent; followed by *Cyanomitra olivacea*, *Cinnyris chloropygius* and *Ploceus nigerrimus* (FO = 57.14%) which appeared as regular species; subsequently the constant species included *Cinnyris batesi*, *Eurillas latirostris*, *Macrosphenus concolor* and the non-passerine *Ispidina picta*; finally, the following species *Camaroptera brachyura* and *Terpsiphone viridis* (FO = 14.29%) were accessory (Table 4).

Diversity indices by taxonomic rank

The Shannon diversity index increased from 2.179 at the family level, to 2.489 at the genus level, and then reached 2.861 at the species level (Table 5). Similarly, the Simpson's diversity index showed a corresponding increase in diversity: 0.8453 (at the family level), 0.8774 (at the genus level), and 0.9097 (at the species level) (Table 5). The Equitability Index (J) also increased with finer taxonomic resolution: 0.7859 (at the family level), 0.8175 (at the genus level) and 0.8495 (at the species level), reflecting a relatively even distribution of individuals across species (Table 5).

Table 5 Diversity indices by taxonomic rank

Index	Family	Genus	Species
Richness (S)	16	21	29
Simpson (1-D)	0.8453	0.8774	0.9097
Shannon (H')	2.179	2.489	2.861
H'max (lnS)	2.772	3.044	3.367
Equitability (J)	0.7859	0.8175	0.8495

Comparison of diversity between Mount Mbam-Minkom and Mount Eloumdem

Under relatively similar conditions, we note that Mount Mbam-Minkom exhibits lower species richness than Mount Eloumden (29 versus 51) (Table 6). Furthermore, the Shannon diversity index is

lower in Mount Mbam-Minkom compared to Mount Eloumden (2.861 vsersus 3.620), despite a similar climate but significantly different vegetation cover (Table 6).

Table 6 Comparison of diversity between two mountains, Mount Mbam-Minkom versus Mount Eloumdem, in the Centre region of Cameroon in the Congo Basin forest

Index	Mbam-Minkom	Eloumdem
Species Richness (S)	29	51
Simpson (1-D)	0.9097	0.9600
Shannon (H')	2.861	3.620
H'max (lnS)	3.367	3.930
Evenness (J)	0.8495	0.9200

Discussion

Structure of the avian community

The ornithological survey carried out on Mount Mbam-Minkom reveals a diverse bird community, dominated by passerines, which represent more than 84% of the captures (Table 1). This predominance is consistent with previous observations in other areas in the Centre Region of Cameroon, where the presence of vegetation, often mixed with a blend of secondary forests, plantations, and fallow land, favors their presence by providing them with permanent food resources throughout the year.[13-17, 22] Thus, the overall taxonomic richness observed on Mount Mbam-Minkom (Table 1), testifies to the habitat's capacity to shelter a diverse birdlife through a varied and permanent food source on this mountain.[13,14,16]

The most represented families (Pycnonotidae, Estrildidae, and Nectariniidae) are commonly associated with open, degraded, or regenerating environments. The presence of a large majority of these taxa, often composed of generalist species or species of damp forests and thickets, suggests a certain ecological tolerance across varied habitats, a flexible diet, and resistance to natural disturbances.[1,14,17,35] However, the presence of typical forest species such as *Eurillas virens* and *Cyanomitra olivacea* also underscores the persistence of pockets of residual forest in the study area.[1,14,17,35]

Advantages of the different types of vegetation on Mount Mbam-Minkom for bird diversity

Several types of bird species are present in the avifauna of Mbam-Minkom, including generalist species (*Spermophaga haematina*, etc.), specialist species (*Cyanomitra olivacea*, etc.), opportunist species (*Chrysococcyx klaas*, etc.), and even ubiquitous species (*Pycnonotus barbatus*, etc.) (Table 4). Indeed, the Mount Mbam-Minkom site comprises a mosaic of secondary forests, cultivated farmland, large plantations, and even fallow land, thus offering a diversity of vegetation. Consequently, it appears that these different types of vegetation at the Mount Mbam Minkom site favor the coexistence of generalist, specialist, opportunist, and even ubiquitous bird species, thereby creating a balanced bird community.[36,37] Otherwise, we note that human activities such as agriculture, artisanal logging, and firewood collection, without fundamentally altering the vegetation composition of the environment, have not necessarily reduced the bird diversity of Mount Mbam-Minkom as long as the vegetation cover remained present, their environment was not profoundly disturbed, and above all, food resources remained available.[38-,40] Moreover, some ubiquitous species, such as *Pycnonotus barbatus* and *Ploceus cucullatus*, actually benefit from these changes, which could ultimately explain the expansion of their range in some regions of the world.[35,41]

Characterization of the bird community of Mount Mbam-Minkom and species distribution model

The calculated diversity indices of Shannon (H' = 2.86) and Simpson (1-D = 0.91) indicate the diversity within the Mbam-Minkom avifauna, and the absence of supremacy of one species over others in this study area, respectively. This result is similar to those of several bird surveys carried out in the Centre region of Cameroon.[13,14,16,17,22] In the same line, and compared to these previous results,[13,14,16,17,22] the calculated Pielou's Equitability index (J = 0.85) also indicates the absence of species dominance of any one species and a relatively homogeneous distribution of individuals within species. On the other hand, according to several authors, the pattern of distribution of the bird species in their environment is linked to environmental factors, particularly the vegetation;[4,10,38,16,17] thus, the diversity observed at Mount Mbam-Minkom would be due to the presence, throughout the year, of secondary forests and peri-forest savannas in this locality.[5,24-28] This environment offers favorable conditions for birds, in particular an abundance of food, and drastically limits competition and predation between species ; consequently, species of Mount Mbam-Minkom appear to be distributed according to available food resources, primarily vegetation but also the microhabitats present at this site.[14,42-44]

Significance of identifying *Cisticola bulliens* in the Centre region of Cameroon

The capture of the bubbling cisticola is a noteworthy achievement in the Centre region of Cameroon (Figures 3a, 3b).

Figure 3a The Bubbling cisticola *Cisticola bulliens* Lynes, 1930 from eBird

Figure 3b The Bubbling cisticola *Cisticola bulliens* Lynes, 1930 from Oiseaux.net

Cisticola bulliens Lynes, 1930 belongs to the Cisticolidae family; until this study, it had not yet been observed in the region, making this a new regional census.[45] This warbler lives in lowland rainforest, dry savannas, dry scrubland, dry grasslands, and on artificial land (plantation, old-growth forests). This species comprises two subspecies.[1,2,6] *Cisticola bulliens* is distributed in Angola and

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the Democratic Republic of Congo, with *C. bulliens bulliens* (from west-central to southwestern Angola) and *C. bulliens septentrionalis* (northwestern Angola and southwestern Democratic Republic of Congo). Thus, its presence on Mount Mbam-Minkom could indicate an expansion of its range or simply reflect a lack of previous surveys in the mountainous areas of Cameroon.[1-3,6] The song of the bubbling cisticola consists of *che* notes followed by a long, liquid trill; according to the IUCN, it is classified as <<Least Concern>>.[1,6] This identification underlines the importance of local inventories for enhancing knowledge of biodiversity; it also highlights the potential of secondary forests as refuges for lesser-known species.[8]

Ecological comparison with Mount Eloumdem

A comparison of diversity with Mount Eloumdem, another mountain in the Centre Region, reveals greater bird diversity at this site (H' = 3.62 versus 2.86 at Mbam-Minkom).[12] This difference could be due to greater heterogeneity of microhabitats or varying degrees of human pressure. Eloumdem harbors a more extensive secondary forest; although disturbed, this forest exhibits denser plant stands and greater plant diversity.[5] Nevertheless, the relatively high abundance of certain species on Mount Mbam-Minkom, such as *Eurillas virens* and *Nigrita bicolor*, indicates that specific environmental conditions favour breeding or foraging. These results should inform wildlife management strategies adapted to each landscape context.[15,16,42,43]

Conclusion

This study of Mount Mbam-Minkom provided a rigorous assessment of avian diversity in a relatively unexplored mountainous area of the Centre Region of Cameroon. Using mist nets and quantitative analysis based on diversity indices, we were able to evaluate the overall taxonomic richness. The results, 29 species, 21 genera, 16 families, and 5 orders identified, clearly confirm the bird diversity at this site. They also demonstrate that this relict forest area possesses high ecological value, capable of supporting a balanced and diverse avifauna despite increasing human pressure, with the coexistence of generalist, specialist, opportunist, and even ubiquitous species. Compared to previous surveys conducted in the same region, this study highlighted the observation of a new regional species, *Cisticola bulliens*. On the other hand, comparison with the nearby Mount Eloumdem confirms that forests with denser vegetation and greater plant diversity lead to a greater diversity of birds. On Mount Mbam-Minkom, species appear to be distributed according to available food resources, primarily vegetation but also the microhabitats present on this site.

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Conflicts of interest

All the authors declare that there is no conflicts of interest.

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