

# The birds of Cameroon: bird survey in a forest plain of the Congo basin forest (Oveng, Cameroon) confirms the great diversity of birds linked to the vegetation of the second largest biodiversity reserve in the world as well as the distribution pattern of taxa

## Abstract

We carried out a bird survey in the Oveng plain in the Congo Basin Forest to investigate the avifauna as well as to explore the abundance, diversity and distribution of taxa. To obtain abundance of bird species and analyze their diversity and distribution, we used the mist net method for bird sampling for five months and performed analyzes with SAS/STAT and PAST software, respectively; moreover, to compare the diversity and dominance of the Oveng plain to other plains already explored, we proceeded to a simple comparison for a small sample, placing the values in a double-entry table and analyzing them. We captured 146 individuals belonging to 22 bird families and compared to previous surveys in this region, we recorded three new species, *Campethera maculosa*, *Buccanodon duchaillui* and *Alethe diademata*; the birds caught were mainly sedentary and the rest were a mixture of intra-African, seasonal and Palearctic migrants, etc. Values of the diversity indices show a great avifaunistic diversity within the Oveng site; thus, the Shannon-Wiener index ( $H' = 3.09$ ) expresses the high number of the species within the Oveng avifauna while the Equitability index ( $J' = 0.83$ ) reveals an absence of dominance of one species and therefore an equal distribution of individuals within species. The Simpson index ( $\lambda = 0.92$ ) supports abundant species representation in Oveng's birdlife due to the presence of year-round vegetation. The distribution pattern of taxa appeared directly linked to vegetation. Comparison of the diversity and dominance of plains avifauna supports a close relationship between the presence of vegetation and a high diversity of birds and that between an absence of vegetation and a more pronounced dominance.

**Keywords:** Congo basin forest, mist net method, diversity, distribution, dominance, avifauna

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## Introduction

Cameroon is located in the Congo Basin region in which the climate is a mixture of equatorial and tropical climate, with the northern part under the tropical climate while the southern part is under the equatorial climate.<sup>1,2</sup> Cameroon is also one of the countries in the world which presents a very great diversity of vegetation, at least 9 different types of vegetation (equatorial forest, Guinean savannah, savannah forest mosaic, sahel, mountainous region, etc.), and often this vegetation appears richer in mountain regions than in plain regions.<sup>2-5</sup> Only contrary to mountains, the plain is a biogeographical domain without relief and we mainly find in Cameroon the northern lowlands, the coastal plains and some parts of the southern Cameroonian plateau; the Oveng plain belongs to the southern Cameroonian plateau and contrary to the northern lowlands, it is covered in places with rich forest vegetation.<sup>3,4</sup>

The Oveng site is located in the Centre region of Cameroon, more precisely thirty-five kilometers (35 km) from Yaounde, in the department of Mefou and Akono and the district of Mbankomo (Figure 1). Concerning the climate, weather data show that the Oveng site is characterized by the same Guinean equatorial climate of the Yaounde type.<sup>6</sup> Geographically, the Oveng site is crossed by a plain

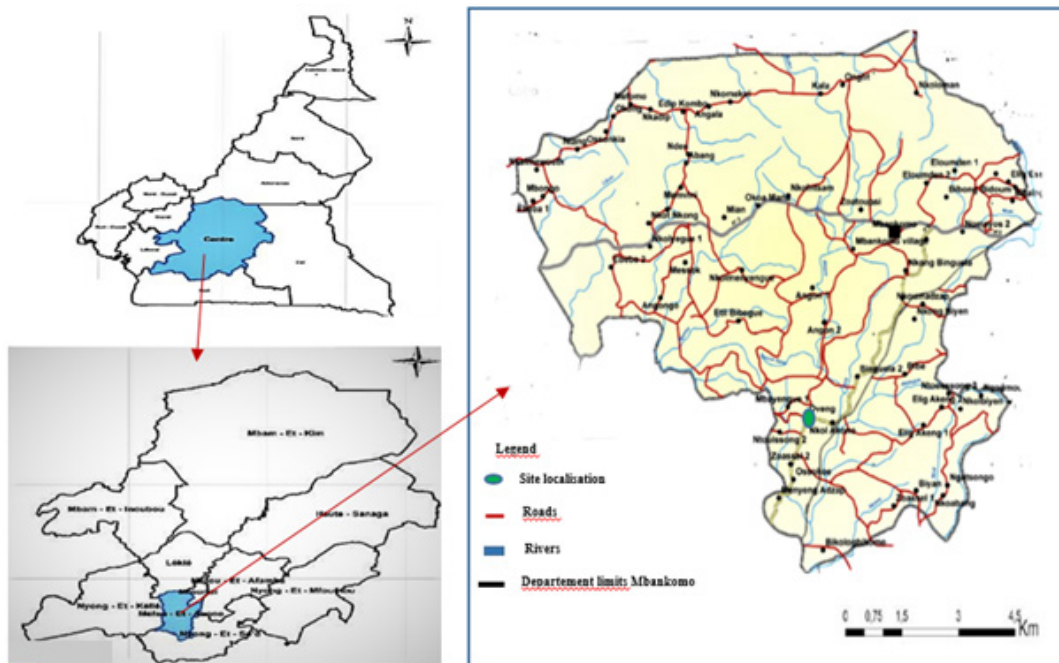
without high altitude but it is covered with lush vegetation throughout the year; more generally, it is a secondary drill-type vegetation that provides permanently food for birds.<sup>3,7</sup>

Because of its multitude of vegetation, Cameroon has a great diversity of birds. According to Avibase<sup>8</sup>, there are 966 resident or transient species divided into 27 orders and 105 families found in Cameroon (Pycnonotidae, Ploceidae, Malaconotidae, Monarchidae, Coliidae, Accipitridae, Corvidae, etc). And of this avian diversity, Cameroon has at least 11 endemic bird species, namely *Ploceus bannermani* Chapin, 1932; *Tauraco bannermani* Bates, 1923; *Telophorus kupeensis* Serle, 1951; *Apalis Bamendae* Bannerman, 1922; *Platysteira laticincta* Bates, 1926; *Ploceus batesi* Sharpe, 1908; *Turdoides gilberti* Serle, 1949; *Melichneutes robustus* Bates, 1909; *Laniarius atroflavus* Shelley, 1887; *Pternistis camerunensis* Alexander, 1909.<sup>8</sup>

Regarding the Central region of Cameroon, former authors such as<sup>7,9,10</sup> identified 16 passerine families (Pycnonotidae, Muscicapidae, Timaliidae, Hirundinidae, Corvidae, Picathartidae, Nectariniidae, Fringillidae, Emberizidae, Ploceidae, Campephagidae, Dicuridae, Laniidae, Sturnidae, Motacillidae and Oriolidae); but since then other families have been recorded in this region such as Monarchidae,

Malaconotidae, Platysteiridae, Phylloscopidae, etc.<sup>11,12</sup> The first ornithological investigations date from the colonial period and showed a great representation of passerines compared to non-passerines birds.<sup>7,10,13</sup> For only a few years, several recent works on the avifauna of Cameroon (Centre and Adamawa regions) have confirmed

this trend towards the high representativeness of passerines; but they also made it possible to update the list of Cameroonian taxa and particularly that of the Central region in which several new bird taxa have recently been recorded in different sites in this region.<sup>5,11,12,14,15</sup>



**Figure 1** Localization of the Oveng plain in the Congo basin forest (Cameroon).

On the other hand, according to several authors, the distribution of birds depends on various factors such as environmental factors;<sup>16–18</sup> only for others, it may equally depend on the interaction between evolutionary and environmental factors.<sup>19–21</sup> However, many research works carried out in several regions of Cameroon have shown that the distribution of birds is function of the vegetation and often, it is very dependent on the composition, the structure and even the density of the vegetation.<sup>5,7,12,14</sup> Moreover, dominance within the living environment, which often involves few species, seems to be function of a combination of factors, particularly a reduction or even an absence of vegetation.<sup>5,22,23</sup>

In this study, which took place in the Oveng site, we followed two goals fold: on the one hand, we investigated the avifauna of the Oveng plain over most of its area; and on the other hand, we explored the abundance, diversity and distribution of the Oveng avifauna in order to suggest a hypothesis on the species distribution pattern in this plain and on the basis of these results, to propose after a comparative glance on the diversity and dominance within this Oveng plain compared to others, a hypothesis on the link between the diversity and dominance of birds and their living environment.

## Materials and methods

**Investigation of the Oveng avifauna:** During the bird survey in the Oveng site, the mist-netting method by dark-coloured nylon nets with three vertical pockets running horizontally along the length of the net was used. This method is suitable for capturing small and medium-sized birds such as passerines. Our mist nets were fixed with the mounting poles which had been chosen carefully and the choice of an appropriate mist-netting site was important for the capture success. In order to ensure the capture success, we mainly identified

their preferred flight paths, feeding areas, roosting and shaded sites. Generally, we started our capture very early in the morning (5:00 AM) and we finished very late in the evening (sometimes 6:30 PM). In order to avoid a skew in our bird survey, we used the same seven (7) mist nets in our different field mission and we did not capture in the same transects on two successive missions; furthermore, we did nine (9) field missions during five (5) months.

**Method for the calculation of the relative abundance of the Oveng avifauna:** To calculate the relative abundance, we chose to use the Statistical Analysis System.<sup>24</sup> We input data as explained in the user guide and ran software until the obtaining of the results. And we used Excel software program to obtain our histograms.<sup>25</sup>

**Method for the calculation of the occurrence of the Oveng avifauna:** In order to calculate the occurrence, we used the same software, the Statistical Analysis System.<sup>24</sup> 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 the measure of the distribution of the Oveng avifauna in line with their environment: 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:

$$H' = -\sum_{i=1}^S (p_i \times \log_2 p_i) \text{ with } p_i = n_i/N$$

Where  $p_i$  = proportion of individuals of the species “i”;

S = total number of species of the sample.

$n_i$  = 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.<sup>26</sup>

**Simpson index ( $\lambda$ ):** The Simpson index represents the proportion of abundance of the species “i”.<sup>26</sup> This index measures the degree of concentration when individuals are classified into types. It is determined by the following relationship

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

where  $n_i$  = 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 ( $1/\lambda$ ) and the Gini-Simpson index ( $1 - \lambda$ ) 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.<sup>26</sup>

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

$H'_{max} = \log_2 S$  (S = the total number of species).

In our study, the Equitability index was calculated with the PASTv3.16 software.<sup>26</sup>

All these indices have been obtained with a confidence threshold of 95%.

**Method of comparing the diversity and the dominance of the Oveng plain to that of another plain:** After obtaining the Simpson index, we used it to calculate the Dominance ( $D = 1 - \lambda$ ). D is a measure of dominance and it measures the extent of common species in the habitat; it ranges from 0 to 1. Furthermore, it is well known

that the Shannon-Wiener index is a widely used index for comparing the diversity between various habitats.<sup>27</sup> With our small sample, we proceeded to a simple comparison, by placing in a double entry table, on the one hand the values obtained in the Oveng plain and on the other, those obtained in the various plains already investigated in our laboratory to have a glimpse between the diversity and the dominance of the Oveng plain compared to other plains.

## Results

### Abundance and occurrence of the Oveng avifauna

**Familial abundances of the Oveng avifauna:** During this study, we captured 146 individuals belonging to 41 species, 32 genera and 22 families. We found that 64% of the captures were from the passerine families and 36% from non-passerine (Table 1). The family with the high diversity and abundant is the family Pycnonotidae with seven species and five genera, followed by the Estrildidae family with four genera and four species and the Nectariniidae family with two genera and three species (Tables 2 & 3, Figure 2).

**Table 1** Familial abundance of the Oveng avifauna obtained after the bird survey between October 2020 and February 2021 in the Oveng plain of the Congo basin forest

Families	Absolute Abundance	Relative Abundance (%)
Pycnonotidae	55	37,67
Nectariniidae	21	14,38
Platysteiridae	3	2,05
Estrildidae	13	8,9
Monarchidae	4	2,73
Malaconotidae	1	0,68
Muscicapidae	2	1,36
Turdidae	3	2,05
Coliidae	1	0,68
Picidae	3	2,05
Passeridae	2	1,36
Hirundinidae	4	2,73
Alcedinidae	3	2,05
Columbidae	4	2,73
Meropidae	1	0,68
Cisticolidae	1	0,68
Nicatoridae	2	1,36
Capitonidae	1	0,68
Lybiidae	2	1,36
Hylidae	1	0,68
Accipitridae	1	0,68
Ploceidae	18	12,32
<b>Total</b>	<b>146</b>	<b>100</b>

**Table 2** Generic abundance of the Oveng avifauna obtained after the bird survey between October 2020 and February 2021 in the Oveng plain of the Congo basin forest

Genre	Absolute abundance	Relative abundance (%)	Frequency	Occurrence (%)
Eurillas	26	17,8	7	77,77%
Chlorocichla	3	2,05	2	22,22%
Thescelocichla	2	1,36	1	11,11%
Pycnonotus	23	15,75	4	44,44%
Phyllastrephus	1	0,68	1	11,11%
Cyanomitra	18	12,32	6	66,66%
Cinnyris	3	2,05	2	22,22%
Platysteira	3	2,05	2	22,22%

Table 2 Continued...

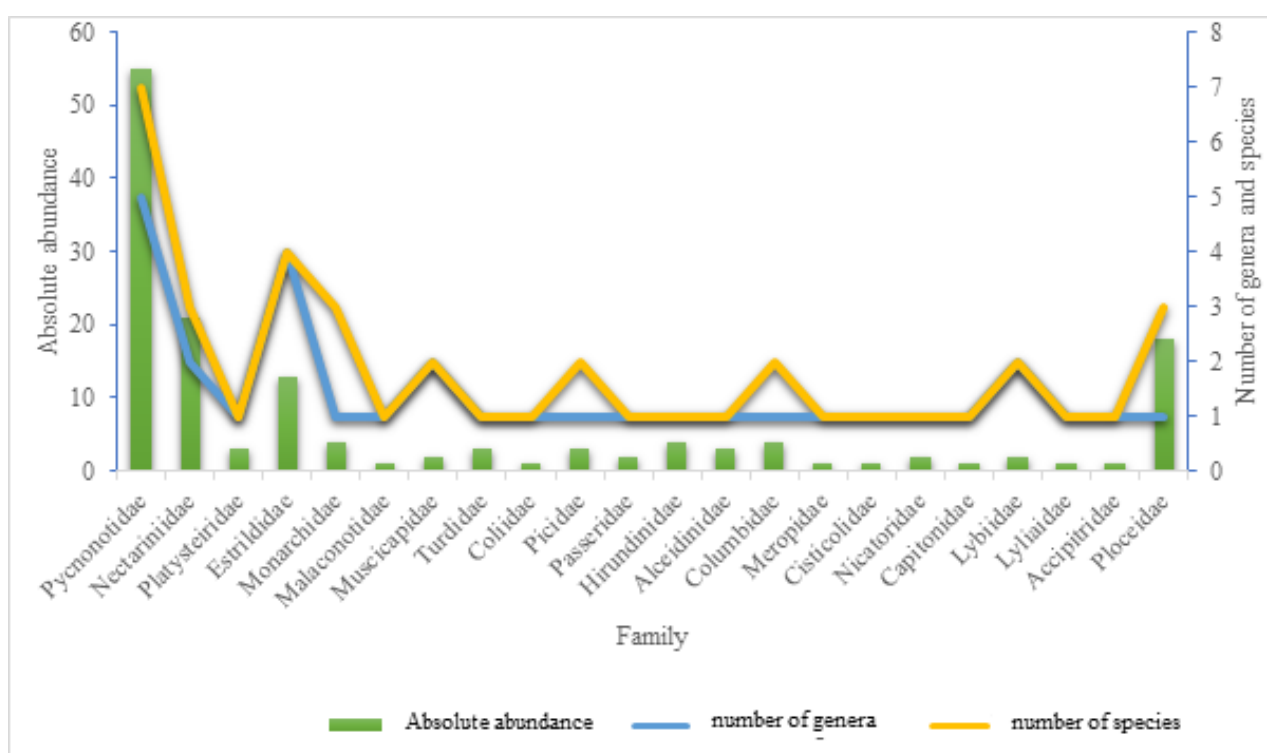
Genre	Absolute abundance	Relative abundance (%)	Frequency	Occurrence (%)
Pyrenestes	1	0,68	1	11,11%
Spermophaga	2	1,36	2	22,22%
Lonchura	7	4,79	2	22,22%
Mandingoa	3	2,05	2	22,22%
Terpsiphone	4	2,73	2	22,22%
Malaconotus	1	0,68	1	11,11%
Cossypha	1	0,68	1	11,11%
Alethe	1	0,68	1	11,11%
Turdus	3	2,05	1	11,11%
Colius	1	0,68	1	11,11%
Campethera	3	2,05	2	22,22%
Passer	2	1,36	1	11,11%
Psalidoprocne	4	2,73	2	22,22%
Ispidina	3	2,05	3	33,33%
Turtur	4	2,73	2	22,22%
Merops	1	0,68	1	11,11%
Eremomela	1	0,68	1	11,11%
Nicator	2	1,36	2	22,22%
Pogoniulus	1	0,68	1	11,11%
Buccanodon	1	0,68	1	11,11%
Lybius	1	0,68	1	11,11%
Hylia	1	0,68	1	11,11%
Accipiter	1	0,68	1	11,11%
Ploceus	18	12,32	5	55,55%
<b>Total</b>	<b>146</b>	<b>100</b>	<b>/</b>	<b>/</b>

**Table 3** Specific abundance and occurrence of each captured species of the Oveng avifauna during the bird survey between October 2020 and February 2021 in the Oveng plain of the Congo basin forest (Central Africa)

Scientific name	Common name	Absolute abundance	Relative abundance (%)	Frequency	Occurrence (%)
<i>Accipiter castanilius</i>	Chestnut-flanked Sparrowhawk	1	0,68	1	11,11
<i>Alethe diademata</i>	White-tailed Alethe	1	0,68	1	11,11
<i>Buccanodon duchailui</i>	Yellow-spotted Barbet	1	0,68	1	11,11
<i>Campethera caroli</i>	Brown-eared Woodpecker	2	1,36	1	11,11
<i>Campethera maculosa</i>	Little Green Woodpecker	1	0,68	1	11,11
<i>Chlorocichla falkensteini</i>	Yellow-necked Greenbul	1	0,68	1	11,11
<i>Chlorocichla simplex</i>	Simple Greenbul	2	1,36	2	22,22
<i>Cinnyris chloropygius</i>	Olive-bellied Sunbird	3	2,05	2	22,22
<i>Colius striatus</i>	Speckled Mousebird	1	0,68	1	11,11
<i>Cossypha niveicapilla</i>	Snowy-crowned Robin-Chat	1	0,68	1	11,11
<i>Cyanomitra olivacea</i>	Olive Sunbird	17	11,64	5	55,55
<i>Cyanomitra verticalis</i>	Green-headed Sunbird	1	0,68	1	11,11
<i>Eremomela pusilla</i>	Senegal Eremomela	1	0,68	1	11,11
<i>Eurillas latirostris</i>	Yellow-whiskered Greebul	4	2,73	3	33,33
<i>Eurillas virens</i>	Little Greenbul	22	15,06	7	77,77
<i>Hylia prasina</i>	Green Hylia	1	0,68	1	11,11
<i>Ispidina picta</i>	African Pygmy Kingfisher	3	2,05	3	33,33
<i>Lonchura bicolor</i>	Black-and-white Mannikin	7	4,79	2	22,22
<i>Lybius vieilloti</i>	Vieillot's Barbet	1	0,68	1	11,11
<i>Malaconotus cruentus</i>	Fiery-breasted Bushshrike	1	0,68	1	11,11
<i>Mandingoa nitidula</i>	Green Twinspot	3	2,05	2	22,22
<i>Merops pusillus</i>	Little Bee-eater	1	0,68	1	11,11
<i>Nicator vireo</i>	Yellow-throated Nicator	2	1,36	2	22,22
<i>Passer griseus</i>	Northern Grey-headed Sparrow	2	1,36	1	11,11
<i>Phyllastrephus scandens</i>	Red-tailed Leaflove	1	0,68	1	11,11
<i>Platysteira cyanea</i>	Brown-throated Wattle-eye	3	2,05	2	22,22
<i>Ploceus cucullatus</i>	Village Weaver	5	3,42	3	33,33
<i>Ploceus nigerrimus</i>	Vieillot's Black Weaver	5	3,42	2	22,22
<i>Ploceus nigricollis</i>	Black-necked Weaver	8	5,47	3	33,33
<i>Pogoniulus atroflavus</i>	Red-rumped Tinkerbird	1	0,68	1	11,11

Table 3 Continued...

Scientific name	Common name	Absolute abundance	Relative abundance (%)	Frequency	Occurrence (%)
<i>Psalidoprocne prisoptera</i>	Black Saw-wing	4	2,73	2	22,22
<i>Pycnonotus barbatus</i>	Common Bulbul	23	15,75	4	44,44
<i>Pyrenestes ostrinus</i>	Black-bellied Seedcracker	1	0,68	1	11,11
<i>Spermophaga haematina</i>	Western Bluebill	2	1,36	2	22,22
<i>Terpsiphone rufiventer</i>	Red-bellied Paradise Flycatcher	1	0,68	1	11,11
<i>Terpsiphone rufocinerea</i>	Rufous-vented Paradise Flycatcher	1	0,68	1	11,11
<i>Terpsiphone viridis</i>	African Paradise-Flycatcher	2	1,36	2	22,22
<i>Thescelocichla leucopleura</i>	Swamp Greenbul	2	1,36	1	11,11
<i>Turdus pelios</i>	African Thrush	3	2,05	1	11,11
<i>Turtur afer</i>	Blue-spotted Wood Dove	3	2,05	2	22,2
<i>Turtur tympanistria</i>	Tambourine Dove	1	0,68	1	11,11
<b>Total</b>	/	146	100	/	/



**Figure 2** Relative familial abundance histogram in function of genera and species captured during the bird survey between October 2020 and February 2021 in the Oveng plain of the Congo basin forest (Cameroon).

**Generic abundance and occurrence of the Oveng avifauna:** The 146 individuals captured belong to 32 genera (Table 2). Within the Oveng avifauna, the most representative genus was *Eurillas* (17,8%) (Pycnonotidae family). This genus is followed by *Pycnonotus* (15,75%), *Ploceus* (12,32%), *Cyanomitra* (12,32%), *Lonchura* (4,79%), *Terpsiphone*, (2,73%), *Mandingoa* (2,05%), *Platysteira* (2,05%), belonging to passerine families while genera *Turtur* (2,73%), *Ispidina* (2,05%) and *Campethera* (2,05%) belong to non-passerine families. The underrepresented genera (relative abundance more or less around 1%) belong to ten passerines, *Hylia*, *Nicator*, *Eremomela*, *Passer*, *Cossypha*, *Alethe*, *Phyllastrephus*, *Thescelocichla*, *Pyrenestes*, and *Spermophaga* while five belong to non-passerines, *Merops*, *Pogoniulus*, *Accipiter*, *Colius* and *Lybius* (Table 2).

Based on Dajoz<sup>28</sup>, 84,37% of the genera sampled on the Oveng plain were accidental (25% > FO ≥ 5%) (Table 2). However within the most representative family, that of Pycnonotidae, the genus *Eurillas*

appeared very frequent with a frequency of occurrence of 77,77% (Table 2). According to our results, three other genera were frequent in the Oveng plain among which *Cyanomitra* (FO=66,66%), *Ploceus* (FO=55,55%) and *Pycnonotus* (FO=44,44%) (Table 2).

**Specific abundances and occurrences of the Oveng avifauna:** The Oveng avifauna presents 41 species which have been classified into several categories according to their frequency of occurrence.<sup>28</sup> Thus within passerines, *Eurillas virens* (FO=77,77%) is appeared constant while *Cyanomitra olivacea obscura* (FO=55,55%) is appeared regular in the study area. Several accessory species have been recorded including passerines *Eurillas latirostris* (FO=33,33%), *Pycnonotus barbatus* (FO=44,44%), *Ploceus nigricollis* (FO=33,33%) and *Ploceus cucullatus* (FO=33,33%), and the non-passerine, *Ispidina picta* (FO=33,33%). Accidental species were passerines *Chlorocichla simplex* (FO=22,22%), *Terpsiphone viridis* (FO=22,22%), *Platysteira cyanea* (FO=22,22%), *Lonchura bicolor* (FO=22,22%), *Chlorocichla*

*falkensteini* (FO=11,11%), *Phyllastrephus scandens* (FO=11,11%), *Terpsiphone rufiventer* (FO=11,11%) and *Terpsiphone rufocinerea* (FO=11,11%), and non-passerines have been *Turtur afer* (FO=22,22%), *Merops pusillus* (FO=11,11%), *Colius striatus* (FO=11,11%) and *Turtur tympanistria* (FO=11,11%). Rare species were not observed in the study site (Table 3).

**Diversity indices:** According to the analysis of the diversity indices, the Shannon-Wiener index had a value of 2,21 at the family level, 2,79 at the generic level and 3,1 at the specific level (Table 4). The Simpson index, for its part, had a value of 0,81 at the family level, 0,9 at the generic level and 0,93 at the specific level (Table 4). The Equitability index values were 0,72 at the family level, 0,8 at the generic level and 0,83 at the specific level (Table 4); as for other indices, the values obtained also appear far from 0 (Table 4).

**Table 4** Diversity indexes of the avifauna obtained within different taxonomic levels in the Oveng village

Indexes	Family	Genera	Species
Taxa (S)	22	32	41
Individuals	146	146	146
Dominance (D)	0,19	0,09	0,07
Simpson ( $\lambda= 1-D$ )	0,81	0,9	0,93
Shannon (H)	2,21	2,79	3,1
Hmax (ln S)	3,09	3,45	3,71
Equitability (J)	0,72	0,8	0,83

**Comparison of the diversity and the dominance between two lowlands studied in the center region of Cameroon:** By putting side by side, values of diversity and dominance of the three plains on which we conducted research, namely the sites of Ekoko II, Mbog-doum and Oveng, we noted that the avifauna of the site of Ekoko II is slightly more diversified ( $H' = 3,14$ ) than that of the sites of Oveng ( $H' = 3,1$ ) and Mbog-doum ( $H' = 3,05$ ), respectively (Table 5); but the dominance appeared the same between the sites of Ekoko II and Oveng ( $D = 0,07$ ) while it was slightly more pronounced in the site of Mbog-doum ( $D = 0,08$ ) (Table 5).

**Table 5** Comparing of the diversity and dominance indexes between three lowlands studies in the Center region of Cameroon

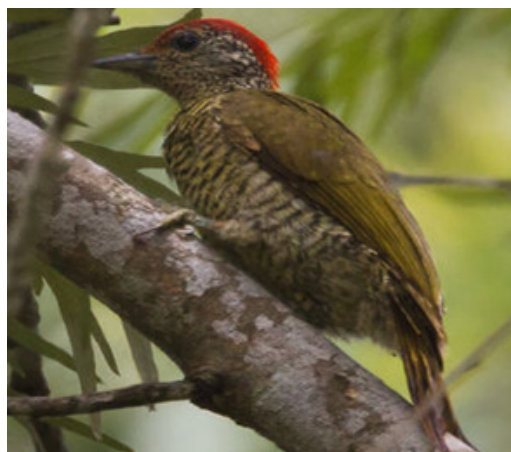
Indexes	Ekoko II village	Mbog-doum village	Oveng village
Shannon-Weiner diversity index ( $H'$ )	3,14	3,05	3,1
H'max ( $H'$ )	3,83	3,83	3,71
Dominance (D)	0,07	0,08	0,07
Simpson diversity index ( $\lambda= 1-D$ )	0,93	0,92	0,93

## Discussion

### Avifauna of the Oveng plain, a lowland of the Congo basin forest:

The Congo Basin Forest is home to great animal and plant biodiversity with approximately 1 086 bird species already identified.<sup>29,30</sup> This large ecoregion is crossed by a vast hygrophilous forest and is shared by six countries, including Cameroon; according to Avibase<sup>8</sup>, the avifauna recorded in Cameroon is very diverse with among others Palearctic, intra-African and seasonal migrants, vagrants, visitors and many residents. Several bird surveys have been carried out in Cameroon and systematically passerines always appear more numerous compared to non-passerines.<sup>5,7,10,11,12,14</sup> In line with the bird surveys already realized in the Central region of Cameroon, the bird survey accomplished in

the Oveng site shows the high representativeness of passerines (64%) compared to non-passerines (36%) (Table 1, Figure 2); this high representativeness of passerines thus confirms the previous results obtained with bird surveys carried out in different sites in the Central region of Cameroon.<sup>5,7,9,10,11,12,14</sup> All bird families reported in this study have already been mentioned in the Central region of Cameroon such as Pycnonotidae, Nectariniidae, Ploceidae, Monarchidae, Estrildidae, etc. but until now, a few families have not yet been directly mentioned in the Oveng site.<sup>5,7,9,10,11,12,14</sup> Only at the specific level, out of the forty-one species of birds recorded compared to previous surveys carried out in the Central region of Cameroon, three new bird species were highlighted in this study (Table 3); it's about: *Campethera maculosa* Valenciennes, 1826 belongs to the Picidae family (Figure 3); until our study, *Campethera maculosa* was not yet reported in Cameroon. It is an endemic bird usually found in Ivory Coast, Ghana, Mali, Mauritania, Senegal, Sierra Leone, Guinea-Bissau and Togo; it lives in forests and edges.<sup>31,32</sup> *Campethera maculosa* has two subspecies: *C. m. maculosa* Valenciennes, 1826, the nominate subspecies, found from Senegal and Guinea-Bissau to southern Ghana and *C. m. permista* Reichenow, 1876, found from eastern Ghana to southwestern South Sudan and both in northern Angola and in the Center of the Democratic Republic of Congo.<sup>31,32</sup> According to the IUCN, this species is also listed as <<Least concern>> (www.iucnredlist.org).



**Figure 3** *Campethera maculosa* Valenciennes, 1826.

*Buccanodon duchaillui* Cassin, 1855 belongs to the Lybiidae family (Figure 4). It is a species of small African bird and it is the only species in the genus *Buccanodon*. Its geographic range extends throughout equatorial Africa and it lives in forests.<sup>31,32</sup> *Buccanodon duchaillui* is generally solitary in the canopy, but several individuals may cluster together in a fruit tree and sometimes join in mixed rounds.<sup>33</sup> This species is also classified in the category <<Least concern>> by the International Union for the Conservation of Nature (www.iucnredlist.org).

*Alethe diademata* Bonaparte, 1850 belongs to the Muscicapidae family (Figure 5); until this study, *Alethe diademata* had not yet been reported in Cameroon. This flycatcher lives in humid forests, gallery forests and forest patches in the savannah.<sup>31</sup> It is found in Ivory Coast, Ghana, Togo, Senegal, Guinea-Bissau, Equatorial Guinea, Liberia, Sierra Leone, Gabon, Democratic Republic of Congo, Uganda and Rwanda.<sup>31,32</sup> This flycatcher has a particular song made up of three rising whistles *uh ih ihu* but the third note is sometimes absent.<sup>33</sup> It is a monotypic species which is classified as <<Least concern>> according to the International Union for Conservation of Nature (www.iucnredlist.org).

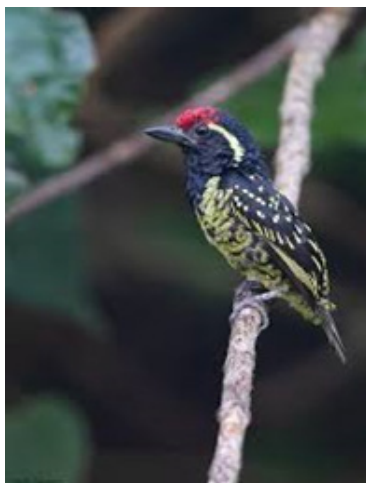


Figure 4 *Buccanodon duchaillui* Cassin, 1855.



Figure 5 *Alethe diademata* Bonaparte, 1850.

#### Distribution and diversity of the avifauna in the Oveng site:

On the basis of statistical analyzes carried out, the Oveng plain site presents a great avifaunistic diversity. Thus, the Shannon-Wiener index, with a value of  $H^2=3,1$  for a  $H^2max=3,71$ , reflects the high number of species within the Oveng avifauna while the Simpson's index with a value of 0,92 showed that the various inventoried species were abundantly represented in the study area (Table 4). These results appear similar to those already obtained in the Central region of Cameroon with the Oveng plain which globally presents the same characteristics as the sites already investigated in this region.<sup>5,12,14</sup> Thus, unlike some authors.<sup>19-21</sup> who suggested that the distribution pattern of species in their living environment may depend on historical factors such as adaptation, the distribution of birds within the Oveng avifauna appeared directly linked to ecological factors in this case the vegetation as recently observed in other sites of the Central region;<sup>5,12,14</sup> it is thus related to the permanent vegetation of the Oveng plain with its galleries of forests, crop fields, pockets of secondary forest, marshy lowlands with raffia, etc. encountered in the study site.<sup>6,34</sup> In addition, the Pielou Equitability index with a value of 0,83 showed an equal distribution of individuals within bird species in the Oveng plain; this could be explained by the low competition between birds due to the presence of permanent vegetation all year round. This result is close line with those obtained at other sites in the

Central region of Cameroon;<sup>5,11,12,14</sup> for instance, the Oveng plain and that of Ekoko II share the same Yaoundean-type equatorial climate as well as their permanent vegetation which provides a food resource for both generalist and specialist birds.<sup>12</sup> According to Nguembock *et al.*<sup>5,11,12,14</sup>, the permanent vegetation present in the explored sited of the Central region of Cameroon in the Congo Basin Forest greatly reduces intra-and interspecific competition between the taxa of birds encountered in these sites.

#### Comparison of the diversity and the dominance of the avifauna of the Ekoko II, Mbog-doum and Oveng plains:

Our results on the comparison of the diversity and dominance of the avifauna of the plains revealed that the diversity was higher in the Ekoko II plain then a little less in the Oveng plain but low in the Mbog-doum plain compared to that of Oveng; for dominance, it is relatively the same in these different plains even if it appeared a little more pronounced in the Mbog-doum plain (Table 5). The diversity of bird species is higher in areas where vegetation is abundant and more diversified while dominance, which is related to little or one predominant species in a given area, depends on the reduction of vegetation or even its absence and therefore a scarcity of food resources.<sup>5,22,23,35,36</sup>

The vegetation of Ekoko II has a particularity, its composition as described by Olivry<sup>37</sup> shows that it offers a multitude of food preferences for birds living in this area, for instance fruits, berries, seeds, nectar, small arthropods, even as there is an absence of vegetation cover in this area.<sup>14</sup> On the other hand, the vegetation of the Oveng plain is a secondary forest which is well degraded due to human activities in some places, notably agriculture although many pockets of forest are still observed but that of the Mbog-doum plain, which is really no different from that of the Oveng plain, is dominated by grasses, lianas, palms, shrubs and some large trees.<sup>34,38</sup> Since then, our results on the diversity of avifauna in these different lowlands explored confirm the link between the lush vegetation, often with its diverse composition ensuring a certain food availability, and the observed diversity of bird species as suggested by Nguembock *et al.*<sup>5,12</sup>; this could therefore explain the greater diversity of bird species highlighted in the plain of Ekoko II compared to the other two lowlands (Table 5). On the other hand, the scarcity of food resources can induce greater competition for food and favor the dominance of a few species or of a predominant species within a community. Thus, according to some authors such as,<sup>39,40</sup> competition between different species can have an impact on the abundance of some species within their community and Triplett<sup>41</sup> states speaking ecological dominance that the animals which dominate the food zones occupy the zones of higher density prey and force subdominants to use zones of lower quality. In this case concerning the lowlands explored, this could therefore explain the dominance which appeared more pronounced in the plains of Oveng and Mbog-doum where the vegetation appeared more degraded and offered less diversity in terms of food resources compared to the Ekoko II where the lush and its diversity offers more food resources for birds.<sup>12,34,38</sup>

## Conclusion

With 41 different species, 32 genera and 22 families identified during this study, the Oveng site located in a plain in the Central region of Cameroon confirms the high diversity of birds in one of the six countries of the Congo Basin Forest. Compared to previous studies carried out in the same region, this current study has highlighted three species newly recorded in this Central region, *Campethera maculosa*, *Buccanodon duchaillui* and *Alethe diademata*. On the other hand, the distribution pattern of taxa within the Oveng site appeared to be directly related to environmental factors in the present case, the vegetation.

Furthermore, the comparison of the diversity and dominance of the Oveng plain to other recently explored plains supports the link between favorable conditions through the presence of lush and a high vegetation diversity of birds against the link between unfavorable ones by the absence of vegetation and a more pronounced dominance.

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## Conflicts of interest

The authors declare that there are no conflicts of interest.

## References

- Suchel JB. *The Climates of Cameroon*. D'Etat, Saint-Etienne: University of St Etienne;1988:4:1188.
- Nguembock B. *Study phylogenetique et biogeographique de l'avifaune forestiere des montagnes de l'Ouest du Cameroun*. France: Doctorat Thesis: University from Paris; 2008:301.
- Letouzey R, Carte phytogéographique du Cameroun au 1/500000 avec notice explicative. *Institut de la Carte internationale de la végétale*. Toulouse, France. 1986;63–94.
- Stuart SN. Conservation of Cameroon montane forests. *International Council for Bird Preservation (ICBP)*. Cambridge, UK. 1986;250–263.
- Nguembock B, Guehoada Y, Azang EDO, et al. The birds of Cameroon: a bird survey from the Febe mountain (Centre region, Cameroon) coupled with a diversity analysis confirm a higher bird diversity in mountains compared to lowlands in this region of the Congo Basin Forest. *Biodiversity International Journal*. 2020;4(3):140–149.
- PCD *Plan communal de développement de Mbankomo*. Commune de Mbankomo. 2018:24–32.
- Louette M. *The birds of Cameroon. An annotated check-list*. Jaargang; 1981;43:1–163.
- The world birds database. *Avibase*. 2022.
- Good AI. *The birds of French Cameroon*. Mém IFAN; 1952;2:1–270.
- Germain M, Dragesco J, Roux F, et al. Contribution to l'Ornithologie du Sud-Cameroun II. Passerines. *L'Oiseau*. 1973;43:59–212.
- Nguembock B, Mahamat S, Kemtchouang W, et al. Bird survey of Abobo-Etetak hill (Yaounde, Cameroon) and a glance of the avifaunistic diversity of this hill (Abobo-Etetak). *The Open Ornithology Journal*. 2017;10:31–41.
- Nguembock B, Djopmou HN, Mahamat S, et al. A study on bird diversity and abundance in a lowland of the centre region of Cameroon (Ekoko II village) confirm high diversity in the Congo basin forest and a greater dominance in the distribution of species in the Lowlands. *International Journal of Animal Research*. 2019;4:31.
- DeLancey MD, Mbuh RN, Marck WD. *Historical dictionary of the republic of Cameroon*. 4<sup>th</sup> ed. Lanham: Maryland; Scarecrow Press; 2010:1–491.
- Nguembock B, Azang EDO, Mahamat S. Bird survey in a forest mountain of Congo basin (Eloumden, Cameroon) and diversity analysis confirm high diversity of world second reserve and correlation between species diversity and vegetation. *International Journal of Avian & Wildlife Biology*. 2019;4(4):118–127.
- Mahamat S, Nguembock B, Azang EDO et al. The extension of the distribution range of the Rock Firefinch *Lagonosticta sanguinodorsalis* (Estrildidae, Passeriformes) to the Adamawa Plateau of Cameroon in the Congo Basin Forest. *Biodiversity International Journal*. 2021;5(2):31–35.
- Brown JH, Lomolino MV. *The Forest of the Congo Basin: State of the Forests 2006*. Biogeography 2<sup>nd</sup> ed. Sinauer: Sunderland. CBFP; 2006.
- Jetz W, Rahbek C. Geographic range size and determinants of avian species richness. *Science*. 2002;297:1548–1551.
- Peng Hou, Junjun Bai, Yan Chen, et al. Analysis on the hotspot characteristics of bird diversity distribution along the continental coastline of China. *Frontiers Marine Science*. 2022;9:1007442.
- Hawkins BA, Diniz Filho JAF. Beyond Rapoport's rule: evaluating range size patterns of New World birds in a two-dimensional framework. *Glob Ecol Biogeogr*. 2006;15(5):461–469.
- Fjeldsa J, Johansson US, Lokugalappatti LGS, et al. Diversification of African greenbuls in space and time: linking ecological and historical processes. *Journal of Ornithology*. 2007.148:S359–S367.
- Sato Eri, Buntarou Kusumoto, Cagan H, et al. The influence of ecological traits and environmental factors on the co-occurrence patterns of birds on islands worldwide. *Ecological Research*. 2020;35(2):394–404.
- Pennington DN, Blair RB. Habitat selection of breeding riparian birds in an urban environment: untangling the relative importance of biophysical elements and partial scale. *Biodiversity Research*. 2011;17(3):506–518.
- Bideberi G. Diversity, distribution and abundance of avifauna in respect to habitat types: a case study of Kilakala and Bigwa, Morogoro, Tanzania. Master Thesis, Morogoro: Tanzania; University of Agriculture. 2013.
- Stephenie P Joyner. SAS/STAT guide for personal computers. In: Cary NC editor; 6<sup>th</sup> ed. SAS Institute; 1985.
- Microsoft Excel, 2016. Microsoft ® Office Excel.
- Pearson TH, Rosenberg R. Macrobenthic succession in relation to organic enrichment and pollution of marine environment. *Oceanography and Marine Biology: An Annual Review*. 1978;16:229–311.
- Clarke KR, Warwick RM. *Change in Marine Communities: An Approach to Statistical Analysis and Interpretation*: Plymouth, UK. Primer-E Ltd; 2001.
- Dajoz R. *Précis d'écologie*. Bordas, Paris. 1985:503.
- CBFP *The Forest of Congo Basin: State of the Forest 2006*.
- Congo Basin Forests* report. WWF. 2007:4.
- Borrow N, Demey R, *Guia dos oiseaux da África do Oeste*. Delachaux et Niestle S.A editors. Paris. 2008:511.
- Gill F, Donsker D, Rasmussen P. *IOC World Bird List V13.2*. 2022.
- Borrow N, Demey R. *A guide to the birds of western Africa*. Princeton and Oxford, Princeton University Press: UK. 2001.
- Kendeg Kendeg GA. *Evaluation de la diversité ainsi que la distribution de l'avifaune du village Oveng (Mbankomo) et analyse phylogenetique du genre Terpsiphone Gloger, 1827 (Oiseaux, Monarchidae)*. Master Thesis, The University of Yaounde. 2021:5.
- Clergeau P, Savard JPL, Mennechez G, et al. Bird abundance and diversity along an urban-rural gradient: a comparative study between two cities on different continents. *The Condor*. 1998;100(3):413–425.
- Chace J, Walsh JJ. Urban effects on native avifauna: A review. *Landscape and Urban Planning*. 2006; 74(1):46–49.
- Olivry JC. Fleuves et rivières du Cameroun. *Monographies hydrologiques: Mesres/Orstom*. 1986;9:733.



38. Factheu C. *Inventaire de l'avifaune du village Mbog-doum (Nkolbisson) et analyse phylogenetique de la famille des Lybiidae Sibley et Ahlquist, 1985 (Oiseaux, Piciformes)*. Master Thesis, The University of Yaounde. 2018:53.
39. Klein DR. The introduction, increase, and crash of reindeer on St. Matthew Island. *The Journal of Wildlife Management*. 1968;32:350–367.
40. Feldhamer GA, Thompson BC, Chapman JA. *Wild Mammals of North America: Biology, Management, and Conservation*. 2nd ed. Baltimore, Maryland. The Johns Hopkins University Press; 2003:1216.
41. Triplet P. *Dictionnaire encyclopédique de la diversité biologique et de la conservation de la nature*. 8<sup>th</sup> ed, 2022:1315.