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Faunistic assessment of butterflies (Lepidoptera: Papilionoidea) in three localities of the southern-plateau of Cameroon

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Abstract
Butterflies are one of the major insect groups in Cameroon. Despite their high diversity, ecological, and socio-economic importance their diversity and ecology are poorly documented. The present study aims to provide a preliminary data on butterfly communities occurring in three understudied zones of the southern plateau of Cameroon, Akonolinga, Kikot and Obout. Sampling was conducted from December 2017 to April 2019 at Obout; then, from March to April 2022 at both Akonolinga and Kikot. Butterflies were collected both actively, using butterfly nets and passively using baited charaxes-traps, in diversely disturbed forest plots. Specimens' identifications were done at the Laboratory of Zoology of the University of Yaoundé I (UYI-FS-LZ) where Voucher collection is kept. This was based on various specialized identification keys. A total of 374 butterfly species unequally distributed between five families, 22 subfamilies and 80 genera were determined from a set 3607 individuals. These sample were unequally distributed between the three zones, with 2648 individuals representing 307 species at Obout, 736 individuals representing 158 species at Kikot and 222 individuals representing 69 species at Akonolinga. Globally, without studied zone considerations, the family of Nymphalidae was the most important both in number of individuals (2944 individuals, 81.64%) and number of species (278 species, 74.33%). Among the subfamilies, Charaxinae, with 774 individuals (21.46%), was the most important; while at the generic level, the genus *Charaxes*, with 744 individuals (20.63%) and the species *Charaxes tiridates*, with 146 individuals (4.05%) ws the most important. 253 appeared zone's specific while 39 in all the zones. This result confirmes the hight diversity of butterflies communitys in souther Cameroon, and suggest a geographic variation in home range of various species.

Keywords: Papilionoidea, southern plateau Cameroon; taxonomic diversity, geographic distribution

Introduction
The forest region of South-Cameroon is located in the Guineo-congolian biogeographical region of Africa (Linder *et al*., 2012) [1]. It provides various ecological and economical services to human being. The region ranks among the most diverse and complex ecosystems of the world (de la Estrella *et al*., 2020) [2], and hosts a rich community of plants and animals, including many species of butterflies (Bergl *et al*., 2007) [3]. One of the major features of the tropical rainforest is the complexity of its vegetation's spatial structure. Its heterogeneous layers provide to phytophagous communities a wide range of microenvironments. Moreover, it harbours a high botanical diversity induced by the overlapping of both the influence of Atlantic Ocean from the west and the Congo basin from the East (Amiet, 2012) [4] that provides to butterfly immatures a wide range of food resources. Indeed, the spatial distribution of immatures is closely related to plant diversity and distribution. Also, adult community structure may vary in relation to the stability of the habitats for larvae development.

Nowadays, tropical rainforests appear as highly dynamic ecosystems because of the global changes related mainly to natural and anthropogenic disturbances, with deep consequences on the composition of butterfly's communities. Recurrently, literature point out global changes, human predation and other threats like fire, pesticides and invasive species as main factors of the decline of insect abundance (Grimm *et al*., 2008 [5]; Dogmo *et al*., 2023 [6]; de la Estrella *et al*., 2020 [2]). Thus, making available, reliable data on the distribution and diversity of butterflies in Cameroon, is of crucial consideration as initial steps for conservation. The present study aims at improving knowledge on the taxonomic diversity and distribution of butterflies in Cameroon by analysing their taxonomic diversity and geographic distribution in three poorly studied but highly predated areas of the southern plateau.

Material and Methods
Geographic situation and characteristic of the Plateau of south-Cameroon
The South Plateau of Cameroon is a large and complex landscape that ranged from the parallel 2°N to the 6°N and from the longitude 11°32' E to 13.6°E, with an above sea level ranging from 600 to 900 m (Amiet, 2012 [4]). It's limited in the West by the Western highlands Eco zone and in the East by the Congo basin and the Central African Republic (Figure 1). Letouzey (1985) [7] recognised two main vegetation gradients that may increase botanical and structural complexity on this Plateau: A West-East gradient leading progressively from the Atlantic vegetation type to the congolian type and, a South-North gradient leading from a typical equatorial evergreen forest to mosaic of the semi-deciduous forest. Following a latitudinal gradient, the climate varies progressively from typical equatorial to a subequatorial climate; these variations are expressed by rainfall intensity decreased and vegetation composition and structure (Suchel, 1988) [8].

Studied zones and sampling design

The three zones were rxplored in the present study. They varied in terms of overall vegetation composition and anthropogenic pressures level: high at Obout, moderate at Akonolinga and low at Kikot. Anthropogenic activities were dominated by traditional farmlands and non-selective logging. Farmlands included palm grove, cocoa and/coffee plantations, small size multispecies orchards.

Obout (4°37'- 4°46'N; 11°6'-11°8' E) is located in the subdivision of Nkol-Metet, Nyong et So'o Division. The region falls within the typical equatorial climate with low influence of the Congo basin (Suchel, 1988) [8]. The dominant vegetation is a mosaic of tropical evergreen forest and semi deciduous forest, highly degraded by agriculture and non-selective logging (Letouzey, 1985) [7]. In this zone, the butterfly community is subject to a high pressure of illegal capture conducted by locals specialized peoples. These insects are collected mainly for European insect traders (pers. obs.).

Kikot locality (4.16° N - 4.24°N; 10.8°E-11.22°E) is located at the North-eastern edge of costal plane (along the Sanaga river, with average above sea level ranging between 300 and 400 meters). The climate is of a transitional type, between coastal and subequatorial climates; it's characterized by temperatures varying between 22 and 32°C, and a bimodal rainfall regime (with 1200-1800 mm/year). The original vegetation is a dense moist tropical forest with great of Atlantic influence (Letouzey, 1985) [7] savanna patches at the Northern edges. The forest part is weakly disturbed by anthropogenic activities in the major part of the locality. Anthropogenic activities include mainly agriculture and non-selective logging.

Akonolinga (3.48°N - 3.81°N; 11.99°E-12.33°E) is located in the Nyong and Mfoumou division. Climate is similar to that observed at Obout. About the landscape, the vegetation in the Akonolinga area is dominated by large patches of evergreen and semi deciduous tropical forests with high influence of the Congo basin (Letouzey 1985) [7]; these included patches of degraded forest related to urbanization, agricultural activities, mainly farmland, a small-scale cocoa plantations and, bamboo in swampy areas.

Sampling design

Butterflies sampling was conducted from December 2017 to April 2019 at Obout, and from March to April 2022 successively at Kikot and Akonolinga. The following technics were used: (1) the active sampling using butterfly nets; this was conducted along traditional tracks, used by local peoples for different activities. (2) The passive baited approach, using the *Charaxes* trap, baited with rotten banana or decaying beef flesh (Freitas *et al*., 2021) [9].

Sample treatment

The butterflies' specimen collected were determinate base on morphological caracters, mainly wing patterns, using diverse keys from documents (Darge, 1983 [10]; Vande Veghe, 2000 [11]; Larsen, 2005 [12]; Bouyer *et al*., 2008 [13]; Levêque & Pierre, 2017 [14]; Woodhall, 2020 [15], Williams, 2023 [16].).

Data analysis

For data analysis, sampling plot were considered as sampling Unite: that made a total of 4 sampling units at Akonolinga, eight at Kikot and four at Obout. Data were analyzed using Excel 2016, Past version.3.2 and R version 3.2. this software allowed to: (1) to estimate the theoretical species richness based on eight non-parametric estimators and sampling effort; (2) to determine the distribution model of different communities based on rank-frequency diagram and the AIC and BIC criteria procedure.

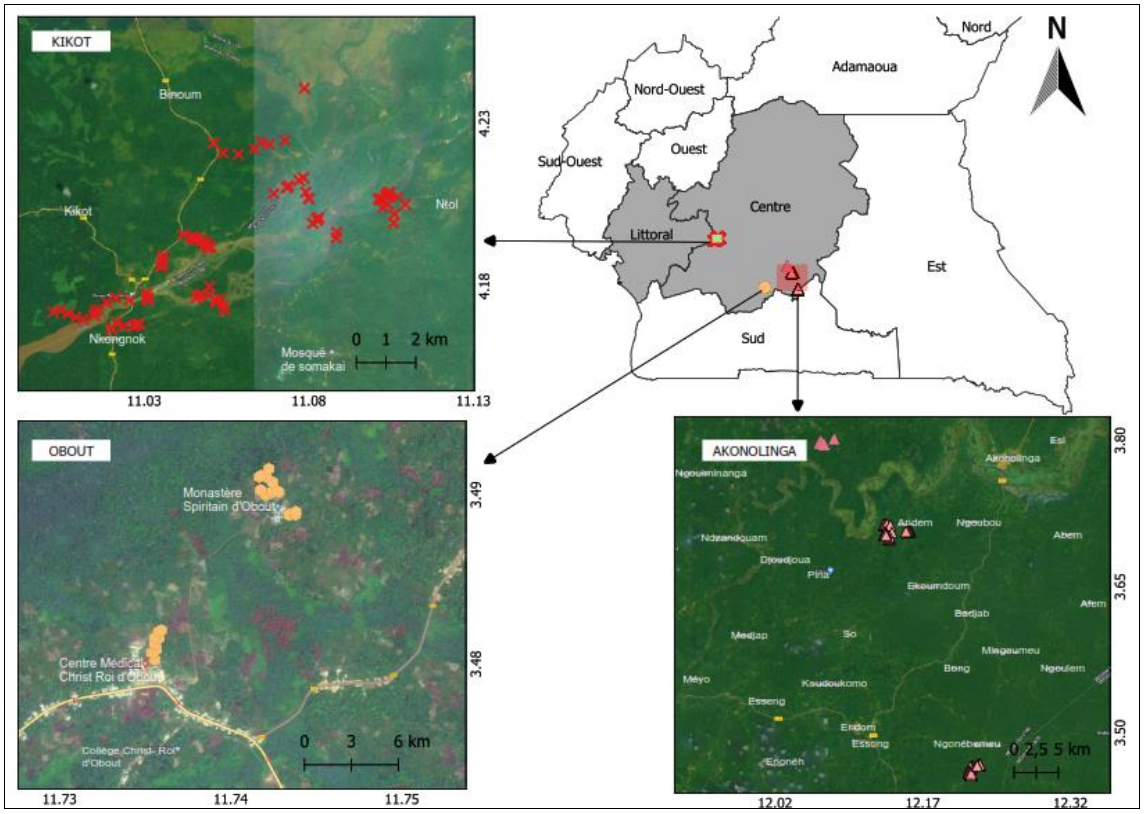

Fig 1: Map localization of sampling localities

Results

Taxonomic diversity of Papilionoidea

From the three zones explored, a total of 3606 individuals were collected. They were unequally distributed between localities, with 222 individuals at Akonolinga; 736 at Kikot and 2648 at Obout. The morphological analysis of this sample completed when needed by anatomical observations, allowed to determine 374 butterfly species unevenly distributed among five families, 22 sub-families and 80 genera (Table I). Hence, the taxonomic diversity varied between families (with $P < 10^{-3}$ for each taxonomic scale) (Table I), with the family Nymphalidae being globally more diverse, harboring 40.90% of the subfamilies, 52.50% of the genera and 74.33% of the species. Same trend was observed for the numerical abundances.

Table 1: Contribution of the families to the diversity (at subfamilies, genera and species levels) and to the global sample abundance

Family	Number of taxa			Sample Size
	Sub family	Genus	Species	Abundance
Hesperiidae	4 (18.18 %)	8(10.00 %)	10(2.67 %)	18(0.50%)
Lycaenidae	6 (27.27 %)	19(23.75 %)	24(6.42 %)	64 (1.77%)
Nymphalidae	9 (40.90 %)	42(52.50 %)	278(74.33 %)	2944 (81.64%)
Papilionidae	1 (4.54 %)	2(2.50 %)	18(4.81 %)	129(3.57%)
Pieridae	2 (9.09 %)	9(11.25 %)	44(11.76 %)	451(12.51%)
	$\chi^2 = 9.36$; df=4, P<0,05	$\chi^2 = 62.125$ df=4 ; P<10-3	$\chi^2 = 698.46$ df=4 ; P<10-3	$\chi^2 = 8722.9$; df=4, P<10-3

Legend: figures represent the absolute abundances and in brackets, the Relative abundances

Variation of abundance in butterfly communities

At the family level

The number of individuals collected varied between families. Meanwhile, without site consideration, the family Nymphalids dominated with respectively 87.39% of the total sample at Akonolinga, 83.88% at Obout and 71.88% at Kikot. At opposite, Hesperidae and Lycaenidae were completely absent at Akonolinga (tableau II).

At subfamily level

At the subfamily level, contribution of each taxon to the composition of the community varied differentially from one site to another.

At Akonolinga, the community was dominated by the Charaxinae with 146 individuals from the 222 collected (65.76%. At the opposite, Danainae was less represented subfamily with a singe individual collected (0.45% of the abundance).

At Kikot, the community was dominated by the Limenitidinae with 184 individuals out of 736 collected; Charaxinae appeared at the second position (with 177 individuals); the less represented were the sudfamilies Lybitheinae, polyommatinae and Pyrginae with one individual.

At Obout the most represented subfamily was Satirynae with 627 individuals (23.67% of the site abundance), followed by Charaxinae 451 individuals and the Limenitidinae (411) corresponding respectively to 17.03% et 15.52% of the total abundance. The less represented subfamilies were Cyrestinae, Heteropterinae, Lycaeninae et des Theclinae with only 0.04% of the abundance each.

At a global scale; it appears three subfamilies Charaxinae, Limenitidinae, Satyrinae that dominated respective communities belonged to the family Nymphalidae.

Table 2: Geographic distribution of abundance of the butterfly families and subfamilies

Family	Sub Family	Akonolinga		Kikot		Obout		Total	
		AA	AR	AA	AR	AA	AR	AA	AR
	Coeliadinae	0.00	0.00	10.00	1.36	0.00	0.00	10.00	0.28
	Hesperiinae	0.00	0.00	0.00	0.00	4.00	0.15	4.00	0.11
	Heteropterinae	0.00	0.00	0.00	0.00	1.00	0.04	1.00	0.03
	Pyrginae	0.00	0.00	1.00	0.14	2.00	0.08	3.00	0.08
Hesperiidae		**0.00**	**0.00**	**11.00**	**1.49**	**7.00**	**0.26**	**18.00**	**0.50**
	Lipteninae	0.00	0.00	0.00	0.00	4.00	0.15	4.00	0.11
	Lycaeninae	0.00	0.00	0.00	0.00	1.00	0.04	1.00	0.03
	Miletinae	0.00	0.00	0.00	0.00	2.00	0.08	2.00	0.06
	polyommatinae	0.00	0.00	1.00	0.14	43.00	1.62	44.00	1.22
	Poritiinae	0.00	0.00	0.00	0.00	10.00	0.38	10.00	0.28
	Theclinae	0.00	0.00	2.00	0.27	1.00	0.04	3.00	0.08
Lycaenidae		**0.00**	**0.00**	**3.00**	**0.41**	**61.00**	**2.30**	**64.00**	**1.77**
	Biblidinae	9.00	4.05	5.00	0.68	272.00	10.27	286.00	7.93
	Charaxinae	146.00	65.77	177.00	24.05	451.00	17.03	774.00	21.46
	Cyrestinae	0.00	0.00	7.00	0.95	1.00	0.04	8.00	0.22
	Danainae	1.00	0.45	21.00	2.85	47.00	1.77	69.00	1.91
	Heliconiinae	5.00	2.25	38.00	5.16	188.00	7.10	231.00	6.41
	Limenitidinae	20.00	9.01	184.00	25.00	411.00	15.52	615.00	17.05
	Lybitheinae	0.00	0.00	1.00	0.14	0.00	0.00	1.00	0.03
	Nymphalinae	9.00	4.05	86.00	11.68	224.00	8.46	319.00	8.85
	Satyrinae	4.00	1.80	10.00	1.36	627.00	23.68	641.00	17.78
Nymphalidae		**194.00**	**87.39**	**529.00**	**71.88**	**2221.00**	**83.87**	**2944.00**	**81.64**
	Papilioninae	20.00	9.01	58.00	7.88	51.00	1.93	129.00	3.58
Papilionidae		**20.00**	**9.01**	**58.00**	**7.88**	**51.00**	**1.93**	**129.00**	**3.58**
	Coliadinae	0.00	0.00	4.00	0.54	4.00	0.15	8.00	0.22
	Pierinae	8.00	3.60	131.00	17.80	304.00	11.48	443.00	12.29
Pieridae		**8.00**	**3.60**	**135.00**	**18.34**	**308.00**	**11.63**	**451.00**	**12.51**

At genus level

At the genus level the distrubution of abundances varied from one genus to another within sites and differentially between sites. Hence, globally, only 24 genera among the 80 determined presented relative abundance greater than 1%. These included *Charaxes* (20,63%), *Bicyclus* (10.95%) (Appendix). Among them, some may appeared completely absent in some site (these included *Ariadne*, *Bebearia*, *Belenois*, *Bicyclus*, *Catuna*, *Euphaedra*, *Eurema*, *Eurytella*, *Ngnophodes*, *Junonia*, and *Leptosia* absent at Akonolinga and *Sevenia*, absent at Kikot).

At species level

At the species level, among the 374 species observed (Appendix), no more than 20 species presented a relative abundance above 1% of the total sample (table III), while 262 species had an abundance of less than 1%. The model of distribution of the abundance of each single species of butterflies also varied between the three zones (Table III). As for genera, some species that appeared well represented in the global samples were completely absents in certain sites. These included *Bicyclus dorothea*, *B. sandace*, *Eurema senegalensis*, *Gnophodes betsimena*, *G. chelys*, *Eurytelle driope*, *Junonia eonone* and *Leptosia nupta* at Akonolinga.

Table 3: Geographic distribution of abundance the 20 numerically dominant butterfly species

Genera	Species	Abondance relative et absolue par zone						Total	
		Akonolinga		Kikot		Obout			
		Aa	Ar	Aa	Ar	Aa	Ar	Aa	Ar
Acraea	*Acraea bonasia* Fabricius, 1775	1	0.45%	0	0.00%	71	2.68%	72	2.00%
Bicyclus	*Bicyclus dorothea* Cramer, 1779	0	0.00%	0	0.00%	60	2.27%	60	1.66%
	Bicyclus sandace Hewitson, 1877	0	0.00%	0	0.00%	42	1.59%	42	1.16%
Charaxes	*Charaxes brutus* Cramer, 1779	8	3.60%	12	1.63%	20	0.76%	40	1.11%
	Charaxes catachrous Van Someren & Jackson, 1952	17	7.66%	7	0.95%	15	0.57%	39	1.08%
	Charaxes cynthia Butler, 1866	13	5.86%	10	1.36%	21	0.79%	44	1.22%
	Charaxes lucretius, Cramer, 1775	26	11.71%	14	1.90%	62	2.34%	102	3.83%
	Charaxes protoclea Feisthamel, 1850	6	2.70%	12	1.63%	44	1.66%	62	1.72%
	Charaxes tiridates Cramer, 1777	21	9.46%	44	5.98%	81	3.06%	146	4.05%
Cymothoe	*Cymothoe caenis* Drury, 1773	1	0.45%	9	1.22%	67	2.53%	77	2.13%
Elymniopsis	*Elymniopsis bammakoo* westwood, 1851	4	1.80%	2	0.27%	84	3.17%	90	2.50%
Eurema	*Eurema senegalensis* Boisduval, 1836	0	0.00%	0	0.00%	58	2.19%	58	1.61%
Eurytela	*Eurytela dryope* Cramer, 1775	0	0.00%	2	0.27%	78	2.94%	80	2.22%
Gnophodes	*Gnophodes betsimena* Doubleday, 1849	0	0.00%	1	0.14%	64	2.42%	65	1.80%
	Gnophodes chelys Fabricius, 1793	0	0.00%	0	0.00%	53	2.00%	53	1.47%
Hypolimnas	*Hypolimnas anthedon* Doubleday, 1845	3	1.35%	24	3.26%	49	1.85%	76	2.11%
Junonia	*Junonia oenone* Linné, 1758	0	0.00%	2	0.27%	51	1.93%	53	1.47%
Leptosia	*Leptosia nupta* Butler,1873	0	0.00%	3	0.41%	114	4.30%	117	3.24%
Pseudacraea	*Pseudacraea lucretia* Cramer, 1775	3	1.35%	43	5.84%	1	0.04%	47	1.30%
Sevenia	*Sevenia pechueli* Hecq & Peeters, 1992	7	3.15%	0	0.00%	29	1.09%	36	1.00%

Aa.: Absolute abundance; Ar: relative abundance

Species diversity and the sampling effort

Globally, a total of 3606 individuals were collected from the three sampling zones. The species richness observed varies from one locality to another. The mean theoretical species richness generated from data collected in the three localities, using eight non-parametric estimators indicated and estimation of 69 species at Akonolinga, 158 at Kikot and 307 at Obout (Table IV). Without site consideration, these values are superior to the observed species richness. For instances, the mean sampling effort varied between 57.86% at Akonolinga to 64.22 at Kikot and 70.64% at Obout. This means that supplementary efforts are needed to achieve the maximum diversity in each zone.

Table 4: Sampling effort obtained from non-parametric estimators of species richness

Site	Akonolinga	Kikot	Obout	Total
N	222	736	2648	3606
S	69	158	307	374
ACE	110.89 (62.22)	233.63 (67.63)	424.61 (72.3)	517.35 (72.29)
ICE	153.38 (44.99)	277.35 (56.97)	475.97 (64.5)	586.19 (63.8)
Chao 1	111.31 (61.99)	227.42 (69.47)	461.84 (66.47)	527.08 (70.96)
Chao 2	115.41 (59.79)	247.25 (63.9)	407.29 (75.38)	561.15 (66.65)
Jack 1	102.75 (67.15)	232.38 (67.99)	415 (73.98)	528 (70.83)
Jack 2	120.25 (57.38)	274.27 (57.61)	461.67 (66.5)	614.36 (60.88)
Bootstrap	84.21 (81.94)	191.1 (82.68)	357,51 (85.87)	442,8 (84.46)
MMMeans	155.75 (44.3)	284.72 (55.49)	471.19 (65.15)	570.98 (65.5)
Moyenne	**119.24 (57.86)**	**246.02 (64.22)**	**434.39 (70.67)**	**543.49 (68.81)**

Analysis of the rarefaction curve, (Figure 2), confirmed the conclusion that without site consideration, supplementary sampling efforts are needed.

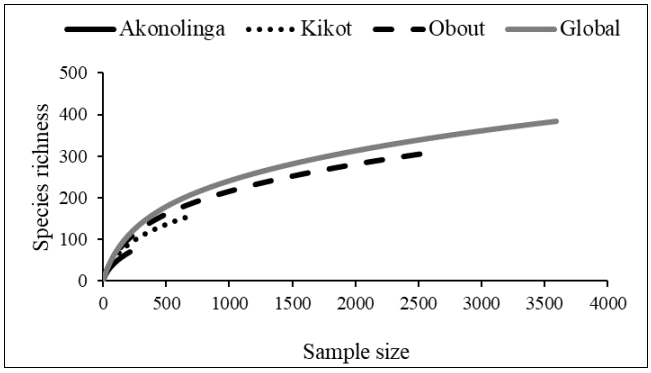

Fig 2: Evolution of the species richness in relation to sample size

Variation of species richness and Geographic distribution of species diversity

Considering geographic distribution, butterflies species identified were unevenly distributed between zones, with 69 species from 19 genera, nine subfamilies and three families from a sample of 222 individuals at Akonolinga, 158 species from 49 genera, 16 subfamilies and 5 families from a sample of 736 individuals at Kikot, 307 species from 73 genera, 20 subfamilies and five families from a sample of 2648 individuals at Obout (Appendix); it then appears that Obout, with the highest sample size, recorded the richest fauna at each taxonomic level.

Geographic variation in community composition in different sampling Zones.

In relation to geographic range, three groups may be distinguished the butterfly communities (Figure 3):

- The first group involved 253 species (67.65% of the global species richness) that were sampled in only one of the three localities and then, may be considered as site-exclusive species. This group involved 13 species (3.47 % of the group) at Akonolinga, 52 (13.90%) at Kikot and 188 (50.26%) at Obout (Figure 5).
- The second group concerned species shared by two of the three studied localities. This category includes 82 (21.92%) species: 02 (0.53%) at Akonolinga and Kikot, 15 (4.01%) at Akonolinga and Obout, and 65 (17.38%) at Kikot and Obout. In this second group, the greater abundance concerns the couple Kikot / Obout.
- The third category includes 39 species (10.43%) encountered in all the three localities, that may therefore consider as cosmopolitan species.

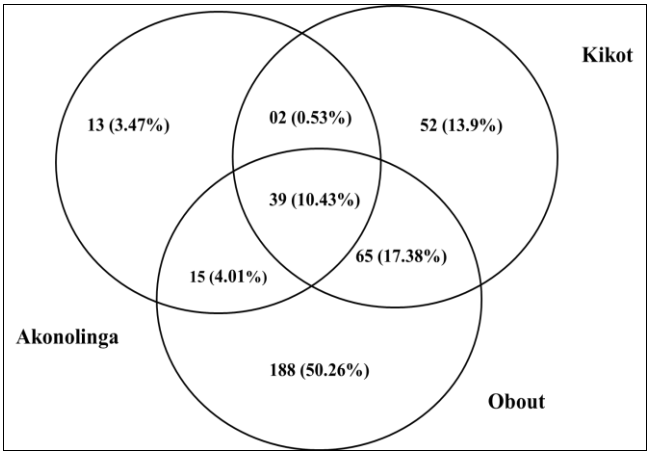

Fig 3: Venn diagram showing the number and percentage of shared and exclusive species between explored zones.

Papilionoidea community structure

Based on the AIC and BIC criteria procedures, the best theoretical model adjusted to the obtained data was, independently to the study site, the Zipf model (Figure 4). This model corresponded, for each zone, to the lowest values of AIC and BIC criteria, and characterized old communities, relatively stable, dominated by one or small number of species. The butterfly community in each zone were dominated by a small number of species, variable from one zone to another. For instance, at Obout the five most represented species included *Leptosia nupta*, *Elymniopsis bammakoo*, *Charaxes tiridates*, *Eurytela dryope* and *Acraea bonasia*, while at Kikot, it included *Pseudacraea lucretia*, *Charaxes tiridates*, *Cymothoe mabilei*, *Belenois theora*, *Nepheronia pharis* et *Hypolimnas anthedon* and at Akonolinga, we noted *Charaxes lucretius*, *Charaxes tiridates*, *Charaxes catachrous*, *Charaxes Cynthia* et *Belenois theora*.

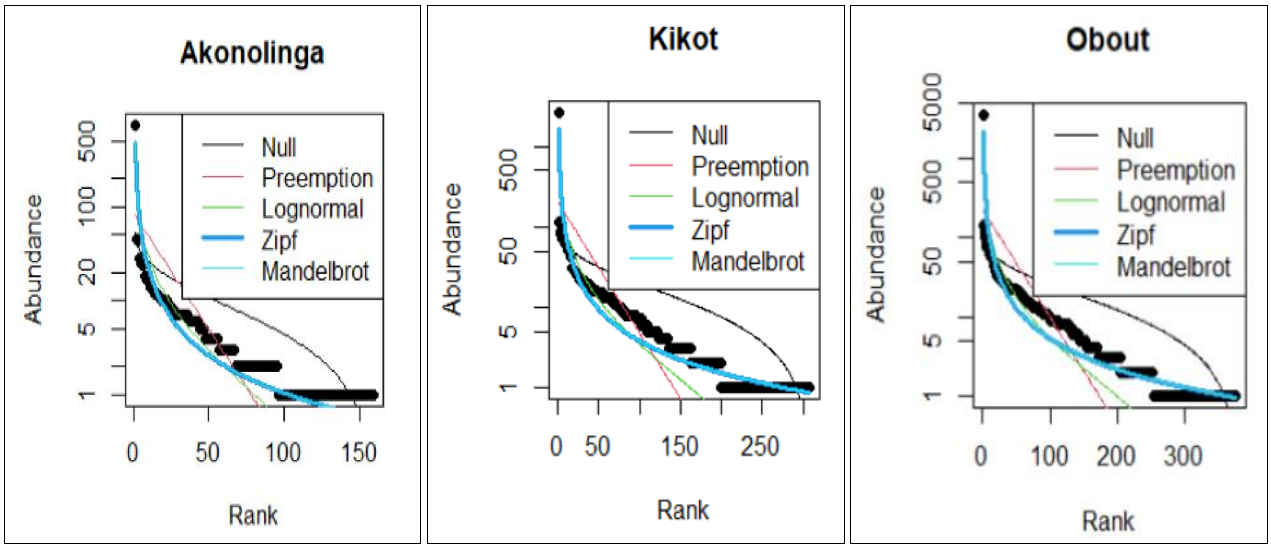

Fig 4: Rank-frequency diagrams showed the relation between species richness and Papilionoidea abundance in different sampling zones on the southern plateau of Cameroon

Discussion

The set of butterflies collected in the three localities provide a brief overview on the species composition and spatial distribution of Lepidoptera in the southern plateau of Cameroon. Data obtained allowed determining 374 species belonging to 80 genera, 22 subfamilies and five families. This appeared relatively low compared to 700 species and 630 species observed respectively on Mont Fébé and Mont Messa, (Libert, 1994) [17], but greater than the 170 species obtained on the Cameroon line (Libert, 1991) [18], 167 species obtained on Mont Bana by Amiet & Libert (1995)[19] or the 117 obtained by Maicher (2019)[20]. in the lowland rainforest of Mont Cameroon. Variation of species richness observed between zone could be linked to two main factors: firstly, differences in duration of the study periods that was two weeks (Akonoling and Kikot), and 16 (months at Obout) compared to one year at Mont Baba and 4 years at Mont Febe and Mont Messa respectively; secondly to the variation of the above sea level or regional climate.

The Nymphalidae family largely dominated the butterfly communities, in terms of number of species and number of individuals. This result is consistent with Larsen (2005) [12] who considered Nymphalidae among the most species-rich and numerically dominant African butterflies' families. This dominance could be explained by the fact that members of the Nymphalidae family are characterized by their high environmental plasticity as many species are perfectly adapted to different biotopes. Members of this family were highly represented in all the three zones (from the western border of the Congo basin to the eastern edge of the Atlantic Costal Plane). Their large geographical distribution may also be related to the large plasticity in host plant selection and indirectly to landscape physiography as stated by Koneri & Nangoy (2019) [21]. These authors suggested that, as polyphagous insects, butterfly larvae could feed and complete its life cycle on an alternative host even when the main host plant is not available (Helmann, 2002 [22].).

At the level of the species, differences observed in relation to study areas may be due to the fact that, the distribution of the butterflies is mainly determine by that of the host plant and the environmental parameters (Panjaitan, 2008)[23]. In the family Nymphalidae, many species may persist at any period of the year due to the diversity of their food items. They can feed from rotten fruits or animal urine, dungs or carrions (Sarma *et al*., 2012) [24]. This result is similar to that obtained in the Cyamudongo forest (Uwizelimana *et al*., 2021) [25]. However, the low number of recorded Lycaenidae and Hesperiidae might be due to their small size and some being canopy dwellers, which makes them difficult to observe (Vande Weghe, 2000) [11]. in the dense forest.

This result is consistent with those of van Nieukerken *et al*. (2011) [26] regarding the species richness of Nymphalidae, and that of Lycaenidae, but differs in the number of families as, they indicated seven families of Rhopalocera and the present study five. The butterfly's community worldwide consist of 18,768 described species belonging to seven families: Hesperiidae (4113 species), Papilionidae (570), Pieridae (1164), Lycaenidae (5201), Riodinidae (1532), Hedylidae (36) and Nymphalidae (6152). According to Larsen (2005) [21], the Lycaenid taxon appears to be the most diverse and numerically the most important. The lack of collection of Lycaenidae limits our results It's one of the reasons this taxon ranked second after the Nymphalids.

The number of species in each area is proportional to the sampling effort. Indeed, we sampled for 16 months at Obout (with about 307 species), two weeks at Kikot (158 species) and two weeks at Akonolinga (68 species). The number of butterfly species sampled at Obout represents 82.09% of the total sample, while the number of species at Akonolinga represents 18.45% and Kikot 42.25%.

There are 15 species common to Akonolinga and Obout against 65 species common to Kikot and Obout. Among factors that may explain dissimilarity in the species composition of different habitats, Kendeigh (1980) [27] reported that a reduced distance between the habitats may induced similarity in environmental conditions and similar composition of vegetation. The low number of common species between Kikot and Akonolinga, reflects geographical distance and are consistence to these suggestions. Contrarily, the high number of common species between Kikot and Obout may be related to the differences in sampling efforts between the two sites.

Concerning the distribution model, the best adjusted theoretical model is, without site consideration, the Zipf model that characterised communities with low abundance variations between species but dominated by a few number of species. these dominant species are *Ch. lucretius* and *Ch. Tiridates* at Akonolinga, *Ch. Tiridates Ch. lucretius* at Kikot and finally *Leptosia nupta* and *Ch. tiridates* at Obout. These species are known to fly mainly at medium and low altitudes along tracks and forest gaps for *Charaxes*, in open undergrowth with closed canopy for *Leptosia* (Pers obs).

Conclusion

In order to improve knowledge on the diversity of butterflies on the Southern Plateau of Cameroon, the present study was conducted in three localities in relation to anthropogenic pressure on the ecosystems. A total of 374 butterfly species unevenly distributed among five families, 22 sub-families and 80 genera were determinate. The family Nymphalidae was the most diversified. Globally, the species composition as well as abundances varied from one locality to another. Thought, the highest diversity and abundance were obtained at Obout (locality with the longest sampling period), then at Kikot, where the sampling period was similar to Akonolinga (the poorest community), but less anthropogenic pressures. This may be linked to the duration of the study on one hand, and the anthropogenic disturbances on the other.

References

1. Linder HP, de Klerk HM, Born J, Burgess ND, Fjeldså J, Rahbé K. The partitioning of Africa: statistically defined biogeographical regions in sub-Saharan Africa. J Biogeogr,2012:39(6):1189–205.
2. de la Estrella M, Cervantes S, Janssens SB, Forest F, Hardy OJ, Ojeda DI. The impact of rainforest area reduction in the Guineo-Congolian region on the tempo of diversification and habitat shifts in the Berlinia clade (Leguminosae). J Biogeogr,2020:00:1–13. doi:10.1111/jbi.13971.
3. Bergl RA, Oates JF, Fotso R. Distribution and protected area coverage of endemic taxa in West Africa's Biafran forests and highlands. Biol Conserv,2007:134(2):195–208.
4. Amiet JL. Le Cameroun : « toute l'Afrique en un seul pays ». In: Amiet JL, editor. Les Rainettes du

Cameroun (Amphibiens Anoures). Nyons, France: La Nef des livres, 2012, 18–30.
5. Grimm NB, Faeth SH, Golubiewski NE, Redman CL, Wu J, Bai X, *et al*. Global change and the ecology of cities. Science,2008:319(5864):756–60.
6. Dogmo MKA, Hanna R, Bonnebrake TC. Enhancing scientific and community capacity to conserve Central African Lepidoptera. Biol Conserv,2023:279:1099–1038.
7. Letouzey R. Notice de la carte phytogéographique du Cameroun au 1:500.000, V.3. SC: domaine de la forêt dense humide semi-caducifoliée. Toulouse: Institut de la Carte Internationale de la Végétation, 1985.
8. Suchel JB. Les climats du Cameroun. Thèse de Doctorat d'Etat, T3. Les régions climatiques du Cameroun. Saint-Etienne: Presses de l'Université de Saint Etienne, 1988, 793–1188.
9. Freitas AVL, Santos JP, Rosa AHB, Iserhard CA, Richter A, Siewert RR, *et al*. Sampling methods for butterflies (Lepidoptera). In: Freitas AVL, Wilson-Fernandes G, editors. Measuring Arthropod Biodiversity: A Handbook of Sampling Methods. Cham: Springer, 2021, XX-XX.
10. Darge P. Le Genre Charaxes Ochs (Lepidoptera Charaxidae Doherty). Compiègne, France: Sciences Nat, 1983, 1–136.
11. Vande Weghe GR. Les papillons du Gabon. Libreville: WCS, 2000, 1–426.
12. Larsen TB. Butterflies of West Africa. Stenstrup, Denmark: Apollo Books, 2005, 1–595.
13. Bouyer T, Zakharov E, Rougerie R, Vingerhoedt E. Les Charaxes du « groupe eupale »: description d'un nouveau genre, révision et approche génétique (Lepidoptera, Nymphalidae, Charaxinae). Entomol Afr,2008:3:1–32.
14. Levêque A, Pierre J. Etude des relations phylogénétiques au sein des Charaxini (Charaxes, Euxanthe, et Polyura) (Lepidoptera, Nymphalidae, Charaxinae). Anterior,2017:4(1):5–57.
15. Woodhall S. Field Guide to Butterflies of South Africa. South Africa: Bloomsbury Wildlife, 2020.
16. Williams. Genus Charaxes Ochsenheimer, 1816, Emperors, Envoys, Demons, Empresses and Princes. Afrotropical Butterflies, 2023. Available from: http://www.lepsocafrica.org/?p=publications&s=atb.
17. Libert M. Biodiversité : le peuplement en rhopalocères de deux collines de la région de Yaoundé, Cameroun (Lepidoptera). Bull Soc Entomol Fr,1994:99(4):335-55.
18. Libert M. Insularité continentale : le cas des lépidoptères rhopalocères de la dorsale camerounaise. Bull Soc Entomol Fr,1991:96(4):375-98.
19. Amiet JL, Libert M. Biodiversité et répartition spatiale des Lépidoptères Rhopalocères du Mt Bana. Bull Soc Entomol Fr,1995:100(3):221-40.
20. Maicher V. Biodiversity pattern of butterflies and moths on Mont Cameroon. PhD thesis. School of Doctoral Studies in Biological Sciences, University of South Bohemia, 2019, 229.
21. Koneri R, Nangoy MJ. Butterfly community structure and diversity in Sangihe Islands, North Sulawesi, Indonesia. Appl Ecol Environ Res,2019:17(2):2501-17.
22. Helmann JJ. The effect of an environmental change on mobile butterfly larvae and the nutritional quality of their hosts. J Anim Ecol,2002:71:925-36.
23. Panjaitan R. Distribution of butterflies (Superfamily Papilionoidea: Lepidoptera) in Minyambou, Manokwari Arfak mountains nature reserve, West Papua. Berk Ilmu Biol,2008:7:11-6.
24. Sarma K, Kumar A, Devi A, Mazumdar K, Krishna M, Mudoi P, *et al*. Diversity and habitat association of butterfly species in Foothills of Itanagar, Arunachal Pradesh, India. Zoology,2012:1:67-77.
25. Uwizelimana J, Nsabimana D, Wagner T. A preliminary butterfly checklist (Lepidoptera: Papilionoidea) for Cyamudongo tropical forest fragment, Rwanda. Metamorphosis,2021:32:93-103.
26. Van Nieukerken EJ, Kaila L, Kitching I, Zwick A. Order Lepidoptera Linnaeus, 1758. In: Zhang ZQ, editor. Animal biodiversity: An outline of higher-level classification and survey of taxonomic richness. Zootaxa,2011:3148(1):212-21.
27. Kendeigh SC. Ecology with Special Reference to Animal and Man. Urbana-Champaign: University of Illinois, 1980.