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Research Article

DIVERSITY, DISTRIBUTION AND CURRENT STATUS OF BUTTERFLIES IN MOUNT KORHOGO AREA (NORTHERN COTE D'IVOIRE)

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ABSTRACT

Butterflies are affected both by abiotic and biotic factors so that they are considered very important ecological indicators. The diversity, the distribution and the status of butterflies of Mount Korhogo area were studied from August to December 2018. Butterflies were captured at 5 sites following a 100m transect at each site from 09 am to 11 am and 03 pm to 05 pm (local time) with a sweep net. The frequency of occurrence of the species has been determined. During this study, 24 taxa of butterflies belonging to 12 Genus and 3 Families were harvested. Pieridae and Nymphalidae were the most diverse families. Five taxa were ubiquitous. They were harvested in all the sites. These were the African migrant *Catopsilia florella* (Fabricius), the common grass yellow *Eurema hecabe solifera* (Butler), the angled grass yellow *Eurema desjardinsii regularis* (Butler), the hilara dotted border *Mylothris hilara hilara* (Karsch) and the dancing acraea *Acraea serena serena* (Fabricius). Three species were very frequent at all sites. These were *Catopsilia florella Eurema hecabe solifera* and *Acrea serena serena*. Based on their abundance, *Catopsilia florella* was the very common specie. The highest value of Shannon index and Pielou Equitability were obtained in the family Pieridae. On the other hand, family Nymphalidae recorded the highest Margalef Richness and Berger-Parker Dominance Indices. The butterfly settlement of the different sites, therefore, has a high degree of similarity.

Keywords: Diversity, Mount Korhogo area, Butterflies, Urbanization.

INTRODUCTION

Lepidoptera is the second largest and most diverse order of class Insecta (Benton, 1995). Butterflies have been studied systematically since early 18th century. Butterflies serve as an important plant pollinator, environmental indicator and have great commercial and aesthetic value (Ahsan & Iqbal, 1975). Butterflies are very important ecological indicators, since the majority of butterflies are sensitive to various environmental changes and their number in most cases is directly proportional to the ecological state of areas inhabited by them. Butterflies are affected both by abiotic and biotic factors (Pollard, 1988) so that they are considered very important ecological indicators (Ivinskis, 1998). The distribution of butterflies depends upon the availability of their host plants. Owing to habitat destruction for developmental activities in urban areas and unscientific management of natural resources, much of our native butterflies are fast disappearing and at present, their survival is under threat. Habitat fragmentation and deterioration quality are two of the major threats to biodiversity (Rosin *et al*., 2012). These threats can be narrowed down to human dominated landscape which forms a substantial and ever increasing amount of the earth's land surface (Ramesh *et al*., 2010). However, even a minor change in the ecosystem may affect their survival and many species are likely to become extinct. It has been stated that extinction of a single species may trigger the extinction of several other species that are related to it. Very few Lepidopteran studies have been conducted in Côte d'Ivoire. As such, there is a need to study the Lepidopterans present in Korhogo Mount area in order to

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fully appreciate the Lepidopteran diversity of the Northern region of the country. The main objectives of the present investigation were to determine the distribution and the status of butterflies in the Mount Korhogo area.

MATERIALS AND METHODS

Study Area

The study was undertaken in the Mount Korhogo area situated in the city of Korhogo (9° 27'41 " N ; 5° 38'19 W) (Figure 1) in the northern region of Côte d'Ivoire. The Mount Korhogo is located at 9° 27' N and 5° 39'W with an elevation of 567m. Korhogo region is characterized by a tropical climate which includes two seasons: a rainy season from June to October and a dry season from November to May. Annual rainfall varies between 1000 and 1200mm on average.

Data collection

Butterflies were collected by Sweep sampling method from August 2018 to December 2018. Five sites were chosen in the mount area. Butterflies were sampled along a transect with a length of 100 m. They were captured during sunny days from 09 am to 11am and 03 pm to 05 pm (local time) when butterflies were more active (Rajagopal *et al*., 2011). They were indentified follow the guide of (Larsen, 2005; Penney, 2009; Woodhall, 2012). The occurrence percentage (OF) was calculated using the following formula: OF= (Ni/Nts)×100, with Ni = number of samples containing a given species i, and Nts = total number of samples collected. The OF was used to classify species following (Dajoz, 2000): OF>50: very frequent species; 25<OF ≤50: frequent species; OF≤25: rare species. The observed butterflies were categorized in five groups on the basis of their abundance in the Mount Korhogo area : VC - very common (> 100 sightings), C - common (50–100 sightings), NR - not rare (15–50 sightings), R - rare (2–15 sightings), VR - very rare (1–2 sightings) (Tiple *et al*., 2005). The distribution of the species was done using Primer 5 software based on their abundance. We Ignored species those were very low abundance. K-dominance curves were plotted for the comparison of species composition at the study sites using Primer 5.0.

Statistical analysis

To calculate the diversity of the butterflies, 3 indices were used namely Shannon - Wiener Diversity index (H) (Shannon & Weaver, 1949) along with its equitability component, Berger-Parker Dominance Index (Berger & Parker, 1970) and Margalef Richness Index (d) (Margalef, 1958). The different indices were calculated in the families Pieridae and Nymphalidae. That of Papilionidae was not concerned because only one specie belonging to this family has been collected. Similarity index was calculated according to Henderson *et al*. (1988).

RESULTS AND DISCUSSION

During this study, 24 taxa of butterflies belonging to 12 Genus and 3 Families were harvested. The families were Pieridae, Nymphalidae and Papilionidae. The most diversified Genus was *Acraea* (5 taxa) followed by *Eurema* (4 taxa) and *Junonia* with 3 taxa (Table 1). Pieridae and Nymphalidae were the most diverse families while the family Papilionidae had only one specie. The calculated values of different diversity indices are in Table 3. Shannon index (H) was highest in the family Pieridae (1.82). The highest value of Shannon's Equitability was obtained in family Pieridae. The calculated value of Berger-Parker Dominance Index ranged from 0.39 (Pieridae) to 0.66 (Nymphalidae). Nymphalidae had the highest Margalef Richness Index (2.15). The Sorensen similarity index showed that site S2 and site S4 were strongly similar (QS=89.66) (Table 4). This index revealed that there was a minimum similarity between site S3 and S5. The K-dominance curves of the different sites (Figure 4) indicate the existence of several butterflies' communities in these sites. These curves have similar profiles. The dominance species curves of site S3 and S5 are located above the dominance curves of the other three sites (S2, S4 and S1). The arrangement of these two curves shows that these two sites recorded the highest dominance and the lowest diversity. Conversely, site S1 had the lowest dominance and the highest diversity.

Table 2 shows the percentage of the very frequent, frequent and rare taxa at the five sites. The percentages of very frequent taxa varied between 11.11 % to 30 %. Those of frequent taxa varied between 10 % to 44.44 %. Regarding rare taxa, they were the most numerous at all sites with percentages ranging from 33.33% to 72.22%. Five taxa were ubiquitous. They were harvested in all the sites. These were the African migrant *Catopsilia florella* (Fabricius), the common grass yellow *Eurema hecabe solifera* (Butler), the angled grass yellow *Eurema desjardinsii regularis* (Butler), the hilara dotted border *Mylothris hilara hilara* (Karsch) and the dancing acraea *Acraea serena serena* (Fabricius) (Table 1). Among them, *Catopsilia florella* and *Acraea serena serena* had a high occurrence (of ≥50). *Catopsilia florella*, *Eurema hecabe solifera*, *Mylothris hilara hilara* and *Acraea serena serena* have been harvested at all sites. *Catopsilia florella* was abundant in sites S2 and S4. *Eurema hecabe solifera* was very abundant in sites S2, S4 and S5. The abundance of *Mylothris hilara hilara* and *Acraea serena serena* was higher in site S4 and site S4 with site S5 respectively. The African albatross *Appias epaphia epaphia* (Cramer) and the citrus swallowtail *Papilio demodocus demodocus* (Esper) were very abundant in site S4. The diverse albatross white *Appias epaphia contracta* (Butler) and the white-barred acraea *Acraea encedon encedon* (Linnaeus) appear to be very abundant in site S1. As for the fragile dotted border *Mylothris yulei* (Butler) and *Eurema desjardinsii regularis*, they were very abundant in sites S2 and S5 respectively (Figure 3).

The species collected around Mount Korhogo are divided into 5 categories according to their abundance

(Table 1). Among these species, 9 (38%) were very rare, 8 (33%) were rare, 4 (17%) were not rare, 2 (8%) were common and 1 (4%) was very common (Figure 2). *Catopsilia florella* was the very common specie (Table 1). During this study, 24 taxa of butterflies belonging to 12 Genus and 3 Families were harvested. The families were Pieridae, nymphalidae and Papilionidae. The most diversified Genus was *Acraea* (5 taxa) followed by *Eurema* (4 taxa) and *Junonia* with 3 taxa. The family *Pieridae recorded* the maximum species richness, comprising of 12 species, followed by the family Nymphalidae. Previous studies have considered the family Nymphalidae as the most important in terms of species richness (Elanchezhyan *et al*., 2017; Hopkins *et al*., 1999). The predominance of Pieridae could be due to environmental and climatic conditions that would be favorable to them. Even though family Pieridae and Nymphalidae exhibited maximum species diversity. These families recorded maximum species abundance respectively. The reason for their abundance in the study area may be due to the dominance of larval food plants (Balasubramanian *et al*., 2001). The preference of butterflies for particular habitats is associated with the availability of larval host plants and adult nectar plants. The species richness observed during the study is 24 taxa. These species are represented by 386 individuals. Compared with previous studies (Elanchezhyan *et al*., 2017), these values were low. This situation could be due to the fact that our study was carried out during 5 months unlike that of the author which took place in 6 months. Similarly, the vegetation of the Mount Korhogo area has been destroyed to the detriment of urbanization. This phenomenon was also responsible for the low richness and abundance recorded during this study.

Table 1. Species composition, frequency of occurrence and statut of butterflies of Mount Korhogo area.

Taxa	Sampling sites					Statut
	S1	S2	S3	S4	S5	
Pieridae						
Catopsilia florella	***		**›	**›	**›	**› VC
Eurema hecabe solifera	**		**›	**	**	**› C
Eurema desjardinsii regularis	*		*	*	**	* NR
Eurema senegalensis	*					* R
Eurema floricola leonis	*					R
Belenois calypso calypso	*					VR
Belenois zochalia connexiva					*	VR
Mylothris yulei	*		*		*	* R
Mylothris hilara hilara	*		*	**	*	** NR
Nepheronia buqueti buquettii	**		*	**	**›	R
Appias epaphia epaphia			*	**	*	* NR
Appias epaphia contracta	*		*	*	*	R
Nymphalidae						
Precis octavia octavia	*					VR
Acrea serena serena	***	***	***	***	***	C
Acraea caecilia caecilia	*					VR
Acraea egina egina		*				VR
Acraea pseudegina	*					VR
Acraea encedon encedon	**	**		*	*	NR
Junonia chorimene	*				*	R
Junonia hierta cebrene		*		*		VR
Junonia sophia sophia		*				VR
Phalanta phalanta aethiopica		*		**		R
Hypolimnas misippus	*					VR
Papilionidae						
Papilio demodocus demodocus	*	**	*	***		R
Total	18	15	9	14	10	

*** Very Frequent (% OF>50); ** Frequent (25 <% OF ≤50);* Rare (% OF ≤25).
VC: very common; C: common, NR: not rare, R: rare, VR: very rare.

Table 2 Percentage of the different categorie of frequency of occurrence at the five sites.

Sites	Very Frequent (%)	Frequent (%)	Rare (%)
S1	11.11	16.67	72.22
S2	20.00	13.33	66.67
S3	22.22	44.44	33.33
S4	28.57	21.43	50.00
S5	30.00	10.00	60.00

Table 3. Diversity indices of Nymphalidae and Pieridae families.

Indices	Nymphalidae	Pieridae
Shannon_H	1.18	1.82
Equitability_J	0.50	0.73
Margalef	2.15	1.96
Berger-Parker	0.66	0.39

Table 4. Sorensen similarity index of Butterfly communities recorded in the different sites.

	S1	S2	S3	S4	S5
S1		60.61	59.26	62.50	64.29
S2			75.00	89.66	64.00
S3				78.26	42.11
S4					66.67
S5					

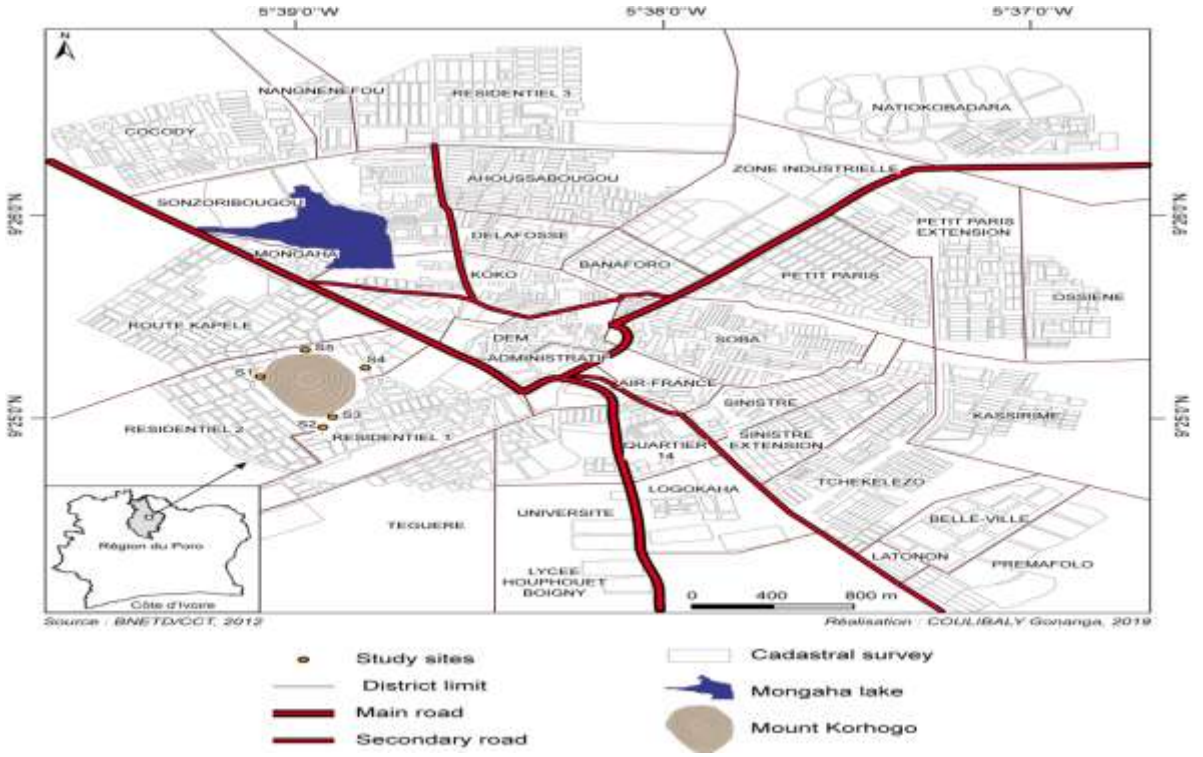


Figure 1. Location of the study sites.

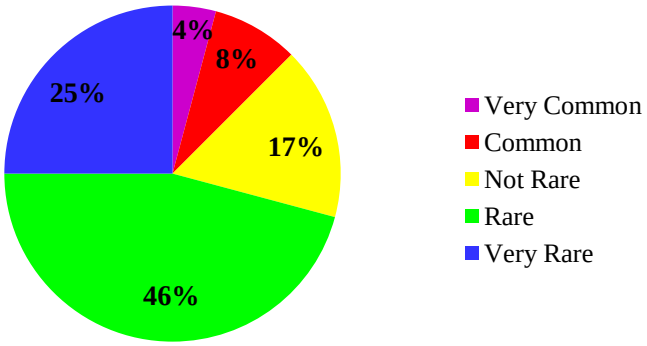
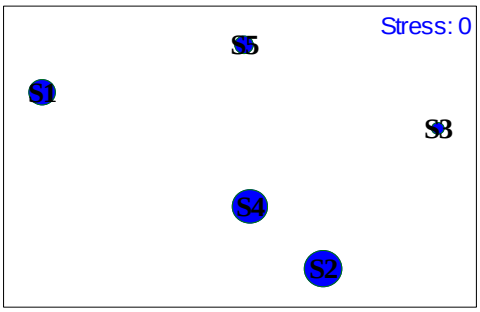
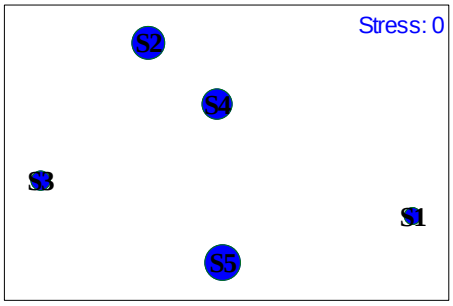


Figure 2. Abundance Status of Butterflies in Mount Korhogo area.

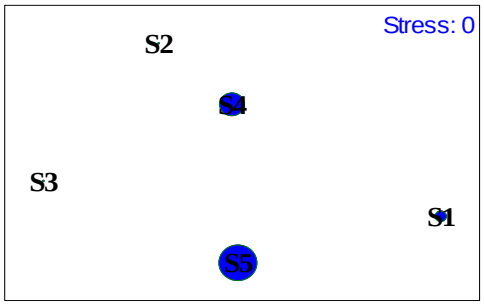
Catopsilia florella



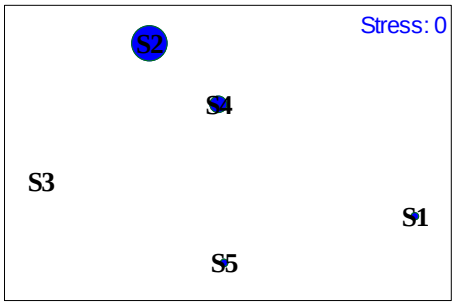
Eurema hecabe solifera



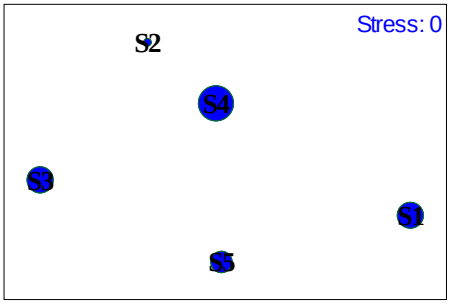
Eurema desjardinsii regularis



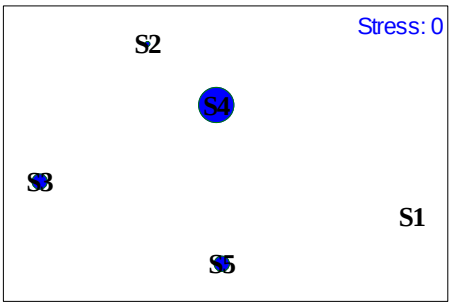
Mylothris yulei



Mylothris hilara hilara



Appias epaphia epaphia



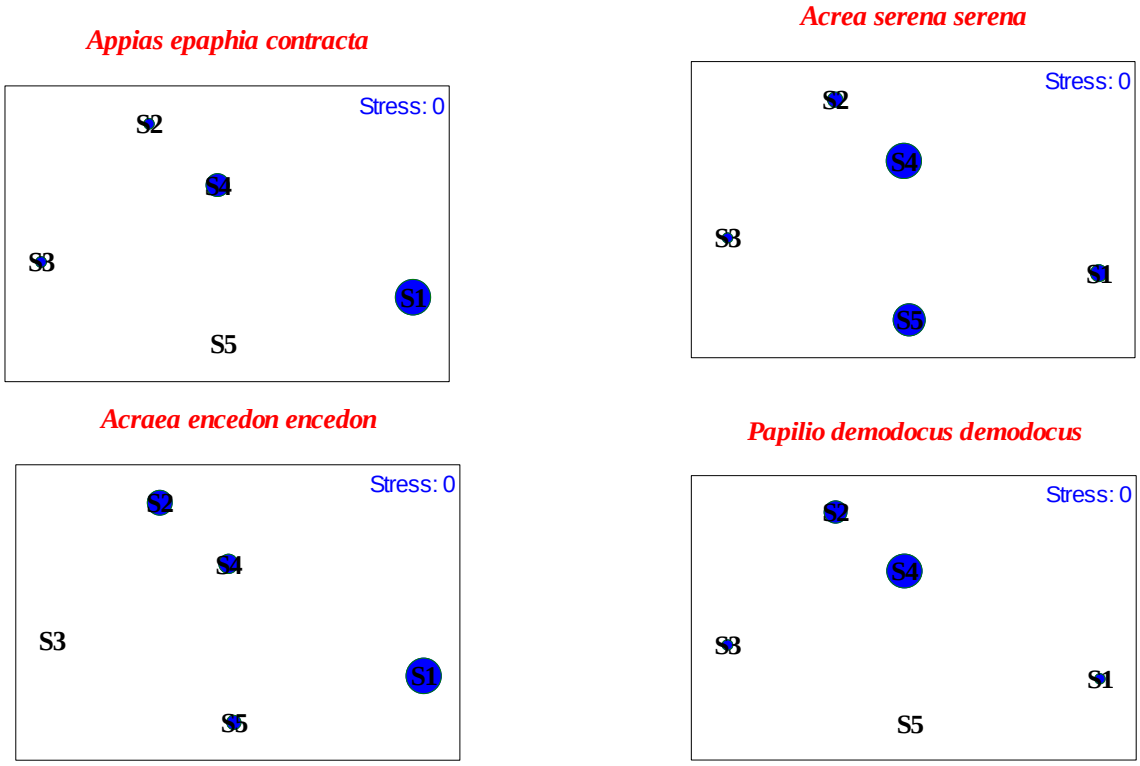


Figure 3. Distribution of the main species in the different sites, the diameter of the round is related to the abundance. The larger the diameter, the more abundant the species.

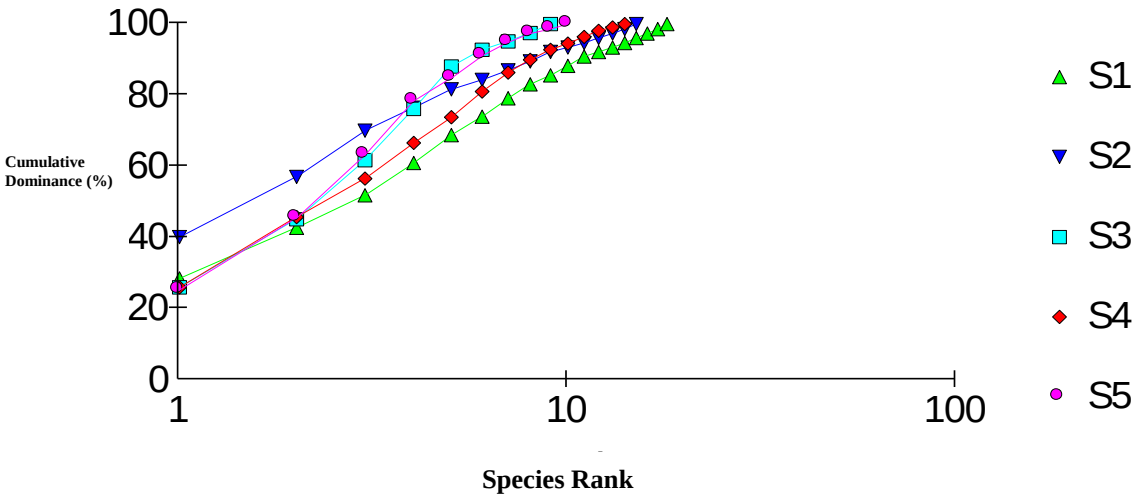


Figure 4. K-dominance curves of five study sites.

In addition to urbanization, agricultural activities have been developed in the savannah relic of Mount Korhogo. These activities caused the destruction of the vegetation cover. All these anthropogenic activities would greatly affect the biodiversity of this area. According to Rosin *et al*., (2012), habitat fragmentation and deterioration quality are two of the major threats to biodiversity. According to Tiple *et al*., (2005), only *Catopsilia florella* was very common with an abundance above 100 individuals. The predominance of this species is thought to be due to the presence of a *Cassia* tree among the host plants. The species richness and abundance recorded in the site S3 site are low. This observation would be due to the fact that in this site was a field of corn. The owner uses plant protection products to spray his crops. These products could pollute the environment which would not be favorable for the development of butterflies. This pollution could be a hindrance to butterflies activity. The distribution of taxa shows that 5 taxa were common to all sites. They have a wider distribution. These taxa would be ecologically less demanding. In addition, 11 taxa or 45.83% of inventoried taxa are found in at least four sites. The butterfly settlement of the different sites therefore has a high degree of similarity. Indeed, the similarity index of Sorensen calculated between the different sites confirms this result. The recorded values are high. About 90% of the calculated Sorensen index values fluctuate between 60% and 90%. The taxonomic composition of butterfly at the different sites would therefore be similar. This strong similarity between these sites is explained by the fact that they were subject to the same conditions. Shannon's Equitability component showed that the butterfly fauna were well distributed in the Pieridae family.

CONCLUSION

Butterfly fauna of Mount Korhogo is rich and varied with several species. But, the specie richness and abundance of butterflies collected were low. This situation is due to the destruction of vegetation to the detriment of the construction of human habitats. Urbanization could therefore be considered as a factor influencing the diversity of butterflies in Mount Korhogo area. Indeed, butterfly distribution and population abundance can be related to food plant availability and scarcity, which may be affected by their habitat alteration due to urbanization. This phenomenon must be curbed in order to preserve the vegetation of the Mount Korhogo area for the welfare of the butterflies. A more intensive investigation is required to enable monitoring of environmental conditions at Mount Korhogo area and in order to better manage the savannah area at this site.

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