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Diversity of Lepidoptera (Rhopalocera) in natural and modified habitats of Bousaâda, Algeria

Saad Ahmed, Bounaceur Farid

Biological Conservation in Arid and Semi-Arid Landscapes. Laboratory of Agrobiotechnology and Nutrition in Semi Arid Zones, Faculty of Natural and Life Sciences, Ibn-Khaldoun University. 14000. Tiaret,Algeria

ABSTRACT

The aim of this study was to evaluate the contribution of both natural and human-modified sites to butterfly species richness in Boussaâda region, the study was carried out in the semi-arid conditions, where no data were collected and available on butterflies in this area.
Two locations were selected which were visited every month from Mars 2015 to December 2016, a total of 07 species , belonging to 03 families were collected, the most abundant family was Pieridae 61 (70.9 %). By sites, it was noted that Vanessa cardui (33.96 %), was the most abundant species in the natural sites however, in the agricultural sites Pieris rapae ranked first with 54.55 %.
The abundance in the agricultural site was found to be lower than that in the natural site due to heavy human land modification, use, and disturbance. The results of Shannon-Weaver index showed that diversity was much greater in the natural site with the value of (H = 1,505) and 6 species were identified in the modified habitat, with the value of (H = 1, 08) having 4 identified species.

Keywords: *Butterfly, Rhopalocerea ,Boussaada , Diversity, Natural ,Human modified , Species*

Corresponding author: Saad Ahmed
E-mail✉ saadahhmed @ yahoo.com
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INTRODUCTION

Butterflies (Rhopalocera) are graceful insects providing economic ecological benefits to the human society (Heppner,1998) This group has been regarded to be one of the best taxonomically studied group of insects (Marjorie et al., 1997).

Butterflies have relatively short life cycles and are at a low trophic level; consequently, they respond rapidly to subtle habitat and climatic changes in their environment (Griffis et al., 1999).

For more than two centuries, the butterfly fauna of Algeria has held the interest of scientists and naturalists (Samraoui ,1998) at the same time, the recent studies have been limited in the place as in northern east of Algeria (Samraoui ,1998) and in Mitidja (north Algeria) (Remini et al., 2015). However, no data have been available on the Rhopalocera fauna of many large areas; for example, there has been no information on Boussaâda butterflies.

Human activities such as agriculture transform the land surface and add or remove species in most of Earth's ecosystems, also the human use of land alters the structure and functioning of ecosystems(Vitousek et al., 1997).

Species composition of Rhopalocera in Semi-arid regions has never been studied in detail. The Present study therefore planned to study Rhopalocera population in two stations of Bousaâda district; the natural one and the other affected by human activities and pesticide wastes.

2.MATERIALS AND METHODS

2.1 STUDY AREA

Boussaâda is the first oasis met when one moves from Algiers towards the Algerian south, located at 245 km of this one, in the south of Chott El Hodna, 35°13' of northern latitude and 01°05' of Eastern longitude (Salmon, 2009) , this area is in contact with four structural sets: the Tellian Atlas in north, The High steppe Plains Algero-oranaises in the west, finally the Saharan Atlas in the south and the east (Kaabeche, 1996). (Figure 01).

The climate is continental, and influenced by the neighboring Saharan territory. Summer is hot and dry while winter is very cold, with low and irregular rainfall in the order of 100–250 mm/year(Houérou, 1995).

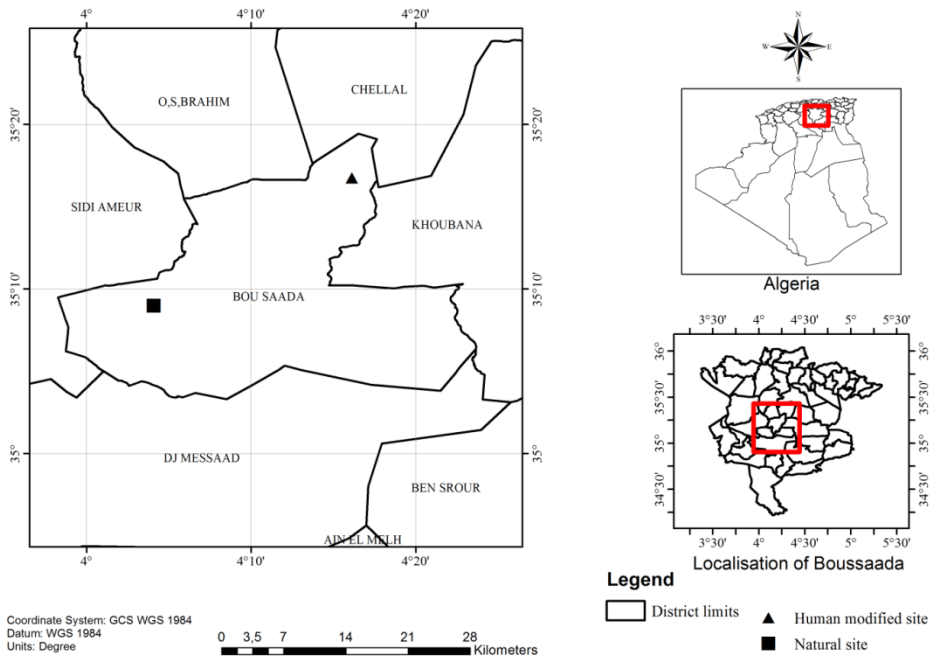

Figure 1. Location of the sampled area.

Butterflies were surveyed in 02 sites selected to be representative of the natural and human modified lands in Boussaâda region, the two localities are different by their characteristics (Table 01).

Surveys were conducted during 21 months (Mars 2015 to December 2016) during their active period (07 00 h to 18 00 h).

The transect lengths were 300 m , and the transects were traversed on foot within 30 min. The abundance data were collected when cloud cover was less than 70%(Bhardwaj et al., 2012).

Table 1. Characteristics of the two study sites

Study site	Habitat type	Sites Coordinates	Altitude (m)	Vegetation	
				Dominant species	Main component species
S1	Agricultural	35° 16'44.1'' 4° 16'08.2''	472 m	Lactuca sativa Beta vulgaris	Malva sylvestris
S2	Natural	35° 13' 26.9'' 4° 10'10.7''	561 m	Pinus halepensis Stipa tenacissima	Stipa tenacissima Astragalus armatus Artemisia herba alba Cleome Arabica Retama retam

Butterflies were collected randomly in different habitats by insect nets (Lien, 2015).

2.3 Data Analysis

To evaluate the species abundance and species diversity at each site, and the differences in community composition, the data of butterflies were analyzed using PAST software (Paleontological Statistics) Version 2.17.

The indexes used to examine butterfly community composition and structure at the two sites in Boussaâda region , were species richness (S), relative abundance (RA), occurrence frequency (O), dominance(D), Shannon's diversity index (H), and evenness (E).

3. RESULTS AND DISCUSSION

The present research was conducted at two sample sites in Boussaâda region , and collected a total of 07 species , belonging to 03 families , the most abundant families were Pieridae 61 (70.9 %) , Nymphalidae 23 (26.7%) .However Papilionidae was the least diversified families with the least number of individuals 2 (2.3%).

The Most abundant species was Pieris rapae 33 (38.37 %), followed by Vanesssa cardui21 (24.42%). While Iphiclides feisthamelii 2 (2.33%),Danaus chrysippus2 (2.33%) and Colias croceus1 (1.16 %) represented the minimum species collected. No endemic species or subspecies were found. It was observed that the majority of the recorded species were of palaearctic origin (4 species), Palaeotropical Eremic and Holarctic were weakly represented by one species each (Table 2)

Table 2. List of butterflies recorded from two stations with common name, status and flight period

Family	Common Name	Scientific Name	Status	Flight period
Nymphalidae (02)	Painted Lady	Vanessa cardui (Linnaeus, 1758)	Widespread	Autumn , Winter , spring
	Plain tiger	Danaus chrysippus (Linnaeus, 1758)	Local	Summer
Papilionidae (01)	Southern Scarce Swallowtail	Iphiclides feisthamelii (Duponchel,1832)	Widespread	Spring
Pieridae (04)	Greenish Black-tip	Euchloe charlonia (Donzel, 1842)	Widespread	Winter
	Cabbage White Butterfly	Pieris rapae (Linnaeus, 1758)	Common	All the year
	Bath White	Pontia daplidice (Linnaeus, 1758)	Widespread	All the year
	Clouded Yellow	Colias croceus (Fourcroy, 1785)	Widespread	Autumn

The number of butterflies per station varies between 53 (natural site) and 33 individuals (the agricultural site) with a difference in the number of species harvested at stations varied between 6 and 4; respectively.

Shannon–Weaver's index showed that the natural habitat (H= 1,505) was more diversified in terms of butterfly species than that of modified habitat with the value of (H= 1,08), the equitability value of the natural habitat was higher than that of the agricultural habitat that means that is the natural habitat which was the most balanced station in terms of butterfly numbers (Table 3).

Table 03. Ecological indices of day butterfly species in agricultural and human modified Habitats in Boussaada

Stations	Ind. No	S	Sm	H(bits)	Hmax	E
Natural habitat	53	6	0.3	1,505	1,47	0,8397
Agricultural habitat	33	4	0.2	1,08	2,01	0,7793

The results of our study showed that Pieridae was the most abundant butterfly family in the two sites in terms of individuals and species (33 individuals with 04 species) in the natural site, and (28 individuals with 02 species) in the agricultural site.

The most abundant species in the natural site was Vanessa cardui (33.96 %) followed by Pieris rapae (28.30 %), and the later species was Colias croceus with only (1.89 %). In the Agricultural site, Pieris rapae ranked first with 54.55 %, followed by Pontia daplidice with 30.30% (Table 04).

Table 04. Centesimal and Occurrence Frequencies of Species Harvested

		Natural			Agricultural		
Family	Species	Ni	F %	Fo	Ni	F %	Fo
Pieridae	Euchloe charlonia	7	13,21	28,57	/	/	/
	Pieris rapae	15	28,30	33,33	18	54,55	52,38
	Pontia daplidice	10	18,87	28,57	10	30,30	28,57
	Colias croceus	1	1,89	4,76	/	/	/
Nymphalidae	Vanessa cardui	18	33,96	52,38	3	9,09	9,52
	Danaus chrysippus	2	3,77	4,76	/	/	/
Papilionidae	Iphiclides feisthamelii	/	/	/	2	6,06	4,76

The abundance in the agricultural site was found to be lower than that in the natural site due to human disturbances detected in this site during the study period including mowing, fertilization, cultivation, also trampling by the use of herbicides.

The WATCH survey (Thomas,1983). revealed that herbicide use, along with drainage and chemical fertilizers, has indirectly reduced butterfly abundance .

Indirect effects may be through the reduced floral diversity of the field margin following herbicide activity leading to a reduction in nectar sources or larval food plants (Sparks et al., 1995).

The changes in some critical factors for butterflies (such as larval food plants and adult nectaring sources) may affect the distribution and abundance of individual species directly as well as indirectly by altering the microclimate (Blair et al., 1997).

As reported by (Kitahara et al., 2001), heavy human land modification, use, and disturbance of semi-natural grassland habitats greatly change the butterfly community structure and diversity. Furthermore, according to (Remini et al., 2015) "this distribution can be explained by the availability of food resources and abundance of host larval plants. (Bergman et al., 2004) have shown that the typical agricultural landscape today contains far less than 20% of habitat suitable for butterflies. The findings of this study supported this idea.

As shown in figure 02 , it has been found 02 groups due to the cluster analysis of species distribution among the two study stations that explained their affinity :first group which included Pieris rapae, Vanessa cardui and Pontia dapilidice as the most common species, and the second group which contained the rest of species.

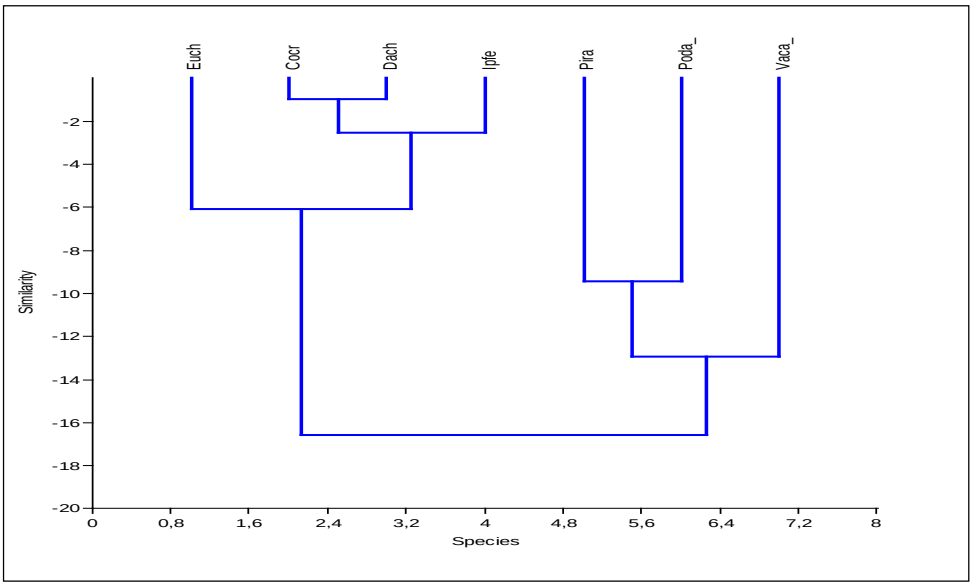

Figure 2. Hierarchical ascending classification of butterfly species distribution among the sampled sites

The results presented in Fig. 3 & 4 showed that the arrival timing of the first group was the same in the two study stations. Vanessa cardui was observed to arrive the earliest in the natural site, however, the tendencies of butterfly arrival at the agricultural site showed that Piries rapae arrived first followed by Pontia dapilidiceand Vanessa cardui.

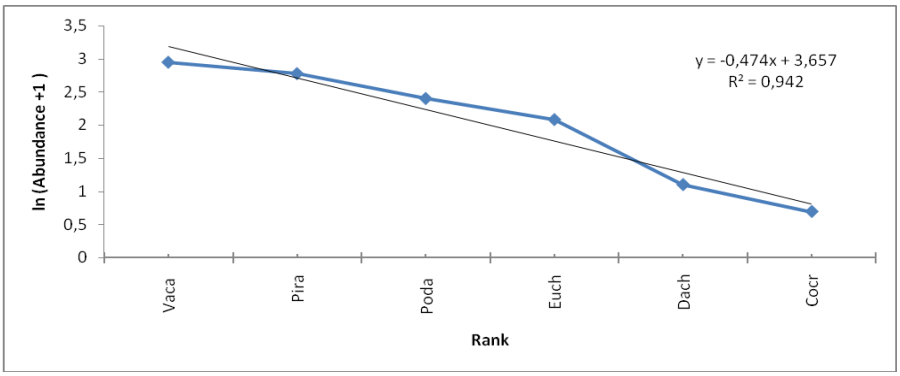

Figure03. Rank-frequency diagram of Butterfly species in the natural site

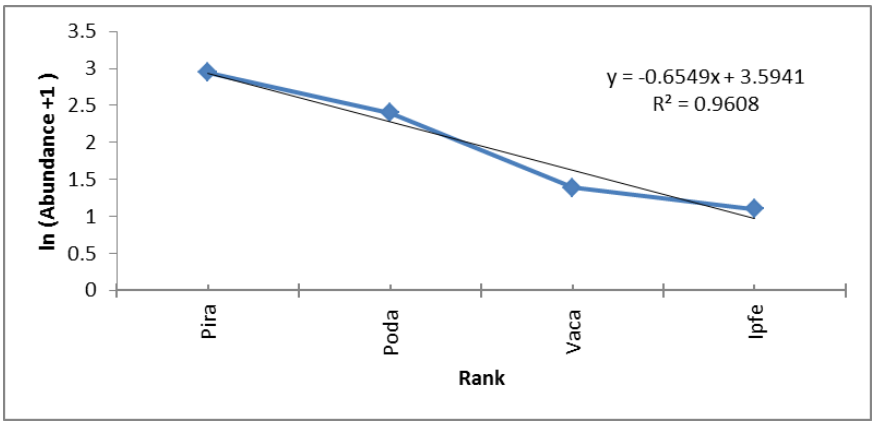

Figure 04. Rank-frequency diagram of butterfly species in the agricultural site.

4.CONCLUSION

The findings of this study showed the diversity of butterflies is predominant in the natural site. Based on the results, it can be concluded that the human land use and human practices damage the structure of butterfly community resulting in a decrease in the species and individuals due to the defragmentation of habitats.

The diversity of butterflies in the natural site using Shannon-Weaver index was much greater with the value of (H = 1,505), and 4 species were identified. On the other hand, in the modified habitat, it was much lesser with the value of (H = 1, 08) having 2 identified species. This study should be continued further for the availability of host plants both in Natural and modified habitats, to ensure the sustainability of butterflies all year round, and protect and conserve the host plants. Butterflies are host plant specific, and they have only short life span. With the availability of the host plant, butterflies will continuously pollinate flower plants.

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Conflict of interest

No conflict of interest were disclosed for this study.

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