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Diversity and richness of day Butterflies species (Lepidoptera: Rhopalocera) in the Chettaba Forest, Constantine, Northeastern Algeria

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Abstract. *Frahtia K, Attar MR, Diabi C. 2022. Diversity and richness of day butterflies species (Lepidoptera Rhopalocera) in the Chettaba Forest, Constantine, Northeastern Algeria. Biodiversitas 23: 3429-3436.* In order to balance the lack of data concerning lepidopteran fauna in the region of Constantine (northeastern Algeria), a preliminary inventory has been drawn up in that region. This work was led during the 2021 spring season at the Chettaba Forest, where three stations were chosen: The 'Aleppo pine forest', the low matorral and the high matorral. Data collection required one outing per week for each site, during which specimens were collected and/or enumerated. A total of 815 specimens from 15 species belonging to 3 families were recorded: Pieridae (6 species), Lycaenidae (5 species), and Nymphalidae (4 species). The low and the high matorrals were the richest stations, with 15 species for the former and 11 species for the latter, but only 10 species were observed in the 'Aleppo pine forest'. The highest centesimal and occurrence frequencies were recorded for *Pieris rapae* in all three stations. The low matorral proved to be the most diversified station (H´: 3.00 bits) because of an important heterogeneity and quality of the habitat due to the biological post-fire rise that makes it richer in nectar-bearing plants, which is important for butterfly concentration.

Keywords: Forest, habitat, heterogeneity, host plant, mattoral

INTRODUCTION

Butterflies are one of the most beautiful species that attract attention, and many are collected as ornaments because of their lovely and colorful patterns on their wings (Noerdjito and Aswari 2003; Koneri et al. 2019). Butterflies live in a variety of settings and have a wide range of distribution (Aguirre-Gutierrez et al. 2017). These insects are first-level consumers and prey for predators, and they play an important role in the food chain. Birds, frogs, monkeys, snakes, rodents, bats, spiders and beetles are all predators of butterflies (Miller and Hammond 2007). They are also involved in the pollination process (Abrol 2012; Patil et al. 2017; Martnez-Adriano et al. 2018) and serve as a strong bio-indicator of environmental quality and a true grid of ecosystem readings (Wiranti et al. 2019).

According to Kelly et al. (2019) and Koneri et al. (2019, 2020), these "insect tools" are the most exact indications for preserving the natural heritage because of many reasons: they are easy to survey and identify from a taxonomic and ecological standpoint (Kim et al. 2012). They react quickly to environmental changes and have high mobility and preference for specific habitats (Lee et al. 2014, 2015; Dennies et al. 2017). They are also a taxonomic group of choice for biodiversity monitoring in a wide range of terrestrial habitats due to their high diversity and diverse ecological requirements (Samal et al. 2021). As a result, the butterfly is one of the most researched invertebrate groups (Merckx et al. 2013). The abundance and diversity of butterflies in a habitat are heavily influenced by a variety of factors, including the abundance and availability of host and larval food flowering plants (Pe′er et al. 2011; Widhiono 2015; Filgueiras et al. 2016; Orlandin et al. 2019; Koneri et al. 2020), the complexity of vegetation structure, and predators (Patil et al. 2017). The number and diversity of butterflies will be impacted by habitat changes induced by numerous environmental damages caused by human activities, such as logging (Hill 1999; Serik 2018) and land-use change (Harmonis and Saud 2017).

A large number of studies in Algeria have focused on the Rhopalocera's biodiversity. Besides Tennent, who produced a systematic and ecological list of butterflies (1996), Samraoui (1998) inventoried butterflies occupying the most interesting habitats in North-eastern Algeria. Other investigations were made like those of Chakali et al. (2002); Frahtia (2005); Remini and Moulaï (2015); Saad and Bounaceur (2018); Kacha et al. (2017, 2020); Allache and Demnati (2020); Berkane et al. (2019, 2021) and recently Laref et al. (2022) in the Edough Forest Massif.

Except for the inventory carried out by Ouchen and Meskalji (2018) in Djebel Ouahch Forest in Northeastern Constantine, no other study has been realized in this area. This is the main reason why this work has focused on an inventory of local butterfly populations in order to address the lack of reliable data about Lepidoptera Rhopalocera in the Constantine area of northeastern Algeria. Facing the entomofauna variety's decline, inventories have become more important than ever (Berkane et al. 2019). However, these inventories must be supplemented, exploration areas

expanded, and lepidopterological variety used as a qualitative and quantitative evaluation of reforestation efforts, particularly in post-fire forest ecosystems. The primary goals were to investigate the spring dynamics of the Rhopalocerous Lepidopteran population in the Chettaba Forest, which is the most important ecosystem in the Constantine area (Djebaili and Taghribet 2020). While most butterflies are found in herbaceous habitats like grasslands and lawns (Börschig et al. 2013), they can also be found in forest environments due to the composition, structure, and variability of plant communities. Edges and herbaceous intra-forest settings (Clearings, forest roads and open stands) can thus act as refuges, providing not only favorable microclimatic conditions but also nectar resources and host plants (Laref et al. 2022). Forest environments, according to Dajoz (2007), are excellent biodiversity reservoirs, more biologically diverse than any other terrestrial ecosystem, and they provide numerous benefits for wildlife, both in terms of botanical diversity and the spatial-temporal distribution of different plant species, providing ecological resources that meet the vital needs of animals (Budiaman et al. 2016). Many animal species, many of which are bioindicator species of the health quality of the environment in which they inhabit, impact these plant interactions (Mensah et al. 2018).

MATERIALS AND METHODS

Study area

The study was carried out during the 2021's spring period (From February to June) on the Chettaba Forest (36°19'06.9"N, 6°28'35.8"E) in the Ain Smara area in the southwest of Constantine, northeastern Algeria, between 652 m and 1104 m of altitude (Djebaili and Taghribet 2020) (Figure 1). The area is composed of two dominant forest formations, Holm oak (*Quercus ilex*) and Aleppo pine (*Pinus halepensis*). Three stations were chosen according to their accessibility and their landscape diversity.

Station 1 (Elevation 846 m)

This 'Aleppo pine forest' is dominated by the tree layer mainly composed by Aleppo pine (*Pinus halepensis).* The shrub and herbs layers are composed by Strawberry tree *(Arbutus unedo),* Prickly juniper (*Juniperus oxycedrus),* Mastic tree *(Pistacia lentiscus),* Sage-leaved rock-rose *(Cistus salviifolius),* Mauritanian grass *(Ampelodesmos mauritanica). They are* characterized by a low recovery rate due to overgrazing.

Station 2 (Elevation 946 m)

This high mattoral is dominated by the herbs layer mainly composed by the plant association of *Pinus halepensis* like *Arbutus unedo, Juniperus oxycedrus, Pistacia lentiscus, Cistus salviifolius, Ampelodesmos mauritanica.*

Station 3 (Elevation 1078 m)

Apart from a few burned feet of *Pinus halepensis,* this low mattoral which was set on fire in 2019, is characterized by a rich and diversified shrub and herbs layers composed basically by flowering species like Aasteraceae, Oxeye daisy *(Leucanthemum vulgare),* Corn poppy (*Papaver rhoeas),* Algerian iris (*Iris unguicularis),* Milk thistle (*Silybum marianum),* Mauritanian grass *(Ampelodesmos mauritanica)* and Common Thyme (*Thymus algeriensis).*

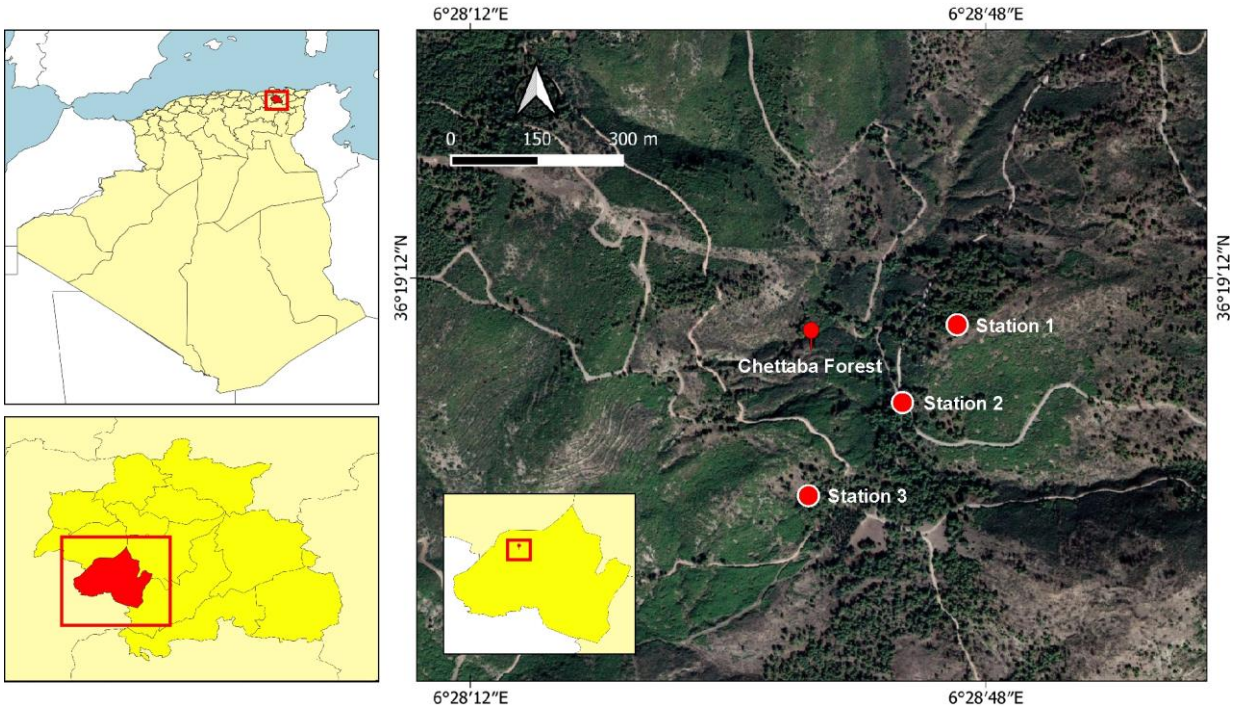

Figure 1. Study area in the Chettaba Forest, northeastern Algeria

Procedures

The linear transects obtained from a standardized technique for the Lepidoptera "Butterflies Monitoring Scheme" inventory were chosen for this inventory (Pollard 1977). The same observer counted individuals of every species observed twice a week, 900 meters per station, over a width of 5 meters, at a constant pace of 2 kilometers per hour. The majority of the butterflies were caught in a net and identified in the field before being released. When necessary, definitive catches were made for identification at the lab (Biosystematics and Ecology of Arthropods Laboratory at Frères Mentouri University, Constantine1). The species was determined with the help of Tolman and Lewington's guide (1999). Only if specified weather conditions were met, all outings were held in the morning for five hours, from 10 a.m. to 3 p.m. Temperatures should range between 13 and 17°C for a minimum of 60% sunshine, according to Carrière (2013), with no restriction on sunshine beyond 17°C except for the wind speed, which should never exceed 40 km/h.

Data analysis

Many ecological indices are used to analyze the butterfly's community composition and structure:

Abundance (N) is the total number of specimens taken or observed in a station. Species richness (S) refers to a station's total number of species.

Shannon-Weaver (H') diversity index is based on the specific richness of the stand and its structure, and it can be used to estimate the biodiversity of the stand. The following formula is used to estimate it: (H') = - å Pi $\log_2$ (Pi); (Pi=ni/N; ni: Number of individuals per specie; Ni: number of individuals of all species). Where H' <1.5: low diversity, 1.5< H' <3.5: moderate diversity, H'>3.5: high diversity (Magurran 1988; Koneri et al. 2020). According to Leps (2013), when all species are equally represented, this value can be interpreted as the number of species required to achieve diversity H′. For a monospecific community, H′ = 0; for a community of S equally represented species, H′ equals log S.

Equitability (E) which is the ratio between the maximum diversity (H'max) is represented as follows: E= H'/H'max (E: Equitability Index; H': Shannon-Weaver Diversity Index; H'max: Maximum diversity obtained by the following formula H'max= $\log_2$ (S) (S: Is the number of species forming the stand). The ability to compare the structures of insect stands is made feasible by fairness.

Centesimal frequency (Fc%) or relative abundance is expressed as follows: Fc%= (ni/N) x 100 (Fc%: Relative abundance of stand species; ni: Number of individuals of species; N: Total number of individuals of all species combined) (Berkane et al. 2021).

Occurrence frequency (Fo%) is the proportion of a given species occurrences to the total number of records N. The following formula is used to measure it: (Pi x 100)/N = Fo% (Fo%: Frequency of occurrence; Pi: Number of surveys containing the species under study; N: Total number of surveys carried out). According to Faurie et al. (2006) and Dajoz (2007), species are ubiquitous if Fo=100%, constant if 75%≤Fo<100%, regular if 50%≤Fo<75%, incidental if 25%≤Fo< 50%, accidental if 5% ≤ Fo< 25% and rare if Fo<5%.

Tables, sectors, and histograms are used to visualize all of the data in Microsoft Office Excel. Chao1 (Stot) is a method of estimating the number of species in a sample that are represented by only one or two individuals and calculated using this formula: Stot = Sobs + (a2/2b), where Stot is the predicted total species richness, Sobs is the observed number of species at a given sampling effort, a is the number of species represented by a single individual (Number of singletons), and b is the number of species represented by exactly two individuals (Number of doubletons). If the estimation is used to save time and effort in calculating absolute species richness, the savings should be as large as possible; thus, estimators that perform well with little sampling effort are of particular interest (Foggo et al. 2003).

RESULTS AND DISCUSSION

Taxonomic identification of individuals

During this study, 815 individuals at least belonging to 15 butterfly species were counted. Three families represent the Rhopalocera: Pieridae (6 species), Lycaenidae (4 species) and Nymphalidae (5 species) (Table 1).

Analysis of the composition of the Rhopalocerean stand

From tables 1 and 2, we can notice that the most important abundance and centesimal frequency characterize *Pieris rapae* (N: 345; Fc: 42.59%) followed by *Pontia daplidice* (N: 130; Fc: 16.17%), *Maniola jurtina* (N: 84; Fc: 10.62%), *Anthocharis belia* (N: 66; Fc: 8.40%), *Colias croceus* (N: 55; Fc: 6.79%), *Polyommatus icarus* (N: 51; Fc: 5.80%), *Vanessa cardui* (N: 36; Fc: 3.70%) and *Aricia agestis* (N: 25; Fc: 3.09%). On the other hand, the lowest abundance and Fc characterise *Lycaena phlaeas, Melanargia galathea* (with N: 6 and Fc: 0.74% both), *Gonepteryx cleopatra* (N: 5; Fc: 0.62%), *Coenonympha pamphilus* (N: 3; Fc: 0.37%), *Vanessa atalanta, Gonepteryx rhamni* and *Pararge aegeria* with only one individual and Fc: 0.12.

On the other hand, the highest occurrence frequencies were recorded for ubiquitous species: *Pieris rapae, Pontia daplidice, Colias croceus, Anthocharis belia, Gonepteryx cleopatra, Polymmatus icarus, Aricia agestis, Lycaena phlaeas* and *Vanessa cardui*, reaching 100%, followed by regular species: *Coenonympha pamphilus, Melanargia galathea* and *Coenonympha pamphilus* which present an Fo of 66.67%. The lowest Fo values (33.33%) characterized incidental species like *Gonepteryx rhamni, Vanessa atalanta* and *Pararge aegeria* reach.

Concerning the centesimal frequency, the highest one is for the *Pieris rapae* and was recorded in the three habitats, followed by *Pontia daplidice, Maniola jurtina, Anthocharis belia, Colias croceus, Polyommatus icarus, Cynthia cardui, Aricia agestis, Lycaena phlaeas, Melanargia galathea* and *Gonepteryx cleopatra*. However, the lowest Fc values characterized *Gonepteryx rhamni, Vanessa atalanta* and *Pararge aegeria* (Table 1).

Table 1. Abundance, centesimal and occurrence frequencies of each species of Rhopalocera inventoried

Families	Species identified	Common names	Abundance	Fc (%)	Fo (%)
Pieridae (74%)	*Pieris rapae*	Cabbage white	345	42.59	100 Ubi
	Pontia daplidice	Bath white	130	16.17	100 Ubi
	Gonepteryx rhamni	Brimstone	1	0.12	33.33 Inc
	Gonepteryx cleopatra	Cleopatra	5	0.62	100 Ubi
	Anthocharis belia	Moroccan orange tip	66	8.40	100 Ubi
	Colias croceus	Clouded yellow	55	6.79	100 Ubi
Lycaenidae (11%)	*Polyommatus icarus*	Common blue	51	5.80	100 Ubi
	Aricia agestis	Brown argus	25	3.09	100 Ubi
	Lycaena phlaeas	Small Copper	6	0.74	100 Ubi
	Coenonympha pamphilus	Small heath	3	0.37	66.67 Reg
Nymphalidae (15%)	*Cynthia cardui*	Painted lady	36	3.70	100 Ubi
	Vanessa atalanta	Red admiral	1	0.12	33.33 Inc
	Melanargia galathea	Marbled White	6	0.74	66.67 Reg
	Pararge aegeria	Speckled Wood	1	0.12	33.33 Inc
	Maniola jurtina	Meadow Brown	84	10.62	66.67 Reg

Note: Inc: incidental species; Reg: regular; Ubi: ubiquitous

Rhopalocera/habitat relationship

The results obtained show that the most important abundances were recorded at low mattoral with 355 specimens (Representing 43.6% of all the stand individuals). In comparison, the high mattoral is home to 274 individuals (33.6% of all the stand specimens). With 186 individuals, the 'Aleppo pine forest' is the least populated environment (Only 22.8% of the whole exists there) (Table 3).

We can notice a relatively balanced distribution in species richness in the high mattoral and the 'Aleppo pine forest' with respectively 10 and 11 species, while the most important richness is observed in the low mattoral with 15 species. Regarding Chao1 test, 24 predicted species are noted out in the three habitats.

The calculation of the Species Diversity (H') allowed us to characterize the low mattoral as the most diverse habitat due to its highest Shannon index relative to other habitats (H': 3.00 bits), followed by the high mattoral with an H' equal to 2.15 bits. However, the 'Aleppo pine forest is marked by low values of H' (1.99 bits). Regarding equitability, the most important value is recorded in the 'Aleppo pine forest' (E: 0.80), followed by the high mattoral (E: 0.77) and the low mattoral, where we recorded the lowest equitability value (E: 0.65) (Table 3).

The ecological indices calculated used to examine the butterfly's community composition and structure allowed us to characterize the low mattoral as the most crowded, richest and most diverse habitat because of its highest abundance (N: 355 individuals), Specific richness (S: 15 species) and Shannon index (H': 3.00 bits) compared to other habitats. It is followed by the high mattoral with an N: 274, S: 11 and H': 2.15 bits. However, the Aleppo pine forest is marked by low values of N: 186, S: 10 and H': 1.99 bits.

On the other hand, the most important Equitability is observed in the 'Aleppo pine forest' (E: 0.80) followed by the low mattoral (E: 0.77) and then the high mattoral (E: 0.65) (Figures 2 and 3).

Table 2. Average number and centesimal frequencies calculated for the butterflies at the three stations

Families	Species identified	Site 1 Aleppo pine forest		Site 2 High mattoral		Site 3 Low mattoral	
		n_i	Fc%	n_i	Fc%	n_i	Fc%
Pieridae	*Pieris rapae*	92	49.46	148	54.01	105	29.58
	Pontia daplidice	56	30.11	50	18.25	24	6.76
	Gonepteryx rhamni	0	0.00	0	0.00	1	0.28
	Gonepteryx cleopatra	1	0.54	1	0.36	3	0.85
	Anthocharis belia	8	4.30	11	4.01	47	13.24
	Colias croceus	5	2.69	19	6.93	31	8.73
Lycaenidae	*Polyommatus icarus*	15	8.06	13	4.74	23	6.48
	Aricia agestis	4	2.15	1	0.36	20	5.63
	Lycaena phlaeas	1	0.54	1	0.36	4	1.13
	Coenonympha pamphilus	1	0.54	0	0.00	2	0.56
Nymphalidae	*Cynthia cardui*	3	1.61	7	2.55	26	7.32
	Vanessa atalanta	0	0.00	0	0.00	1	0.28
	Melanargia galathea	0	0.00	2	0.73	4	1.13
	Pararge aegeria	0	0.00	0	0.00	1	0.28
	Maniola jurtina	0	0.00	21	7.66	63	17.75

Table 3. Abundance (N), richness (S), specific diversity index (H') and Equitability (E) of Rhopalocera inventoried

	Site 1 Aleppo pine forest	Site 2 High mattoral	Site 3 Low mattoral	Total number
N (Abundance)	186	274	355	815
S (Species richness)	10	11	15	15
H'(Diversity)	1.99	2 .15	3.00	-
E (Equitability)	0.80	0.65	0.77	-

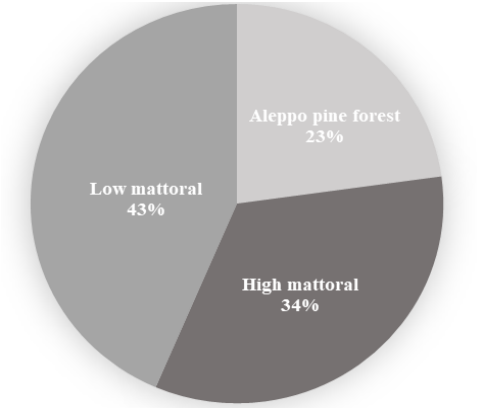

Figure 2. Rhopalocerous abundance composition for each habitat (in %)

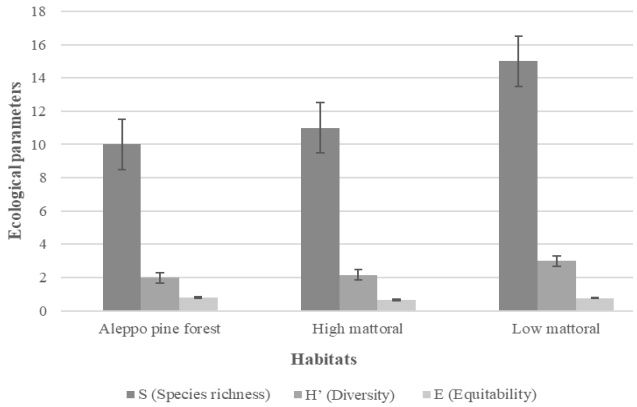

Figure 3. Richness (S), specific diversity index (H') and Equitability (E) of Rhopalocera inventoried

Table 4. Current Rhopalocera's list of the region of Constantine

Species	2018	2021
Pieris rapae	√	√
Pontia daplidice	√	√
Colias croceus	√	√
Anthocharis belia	√	√
Polyommatus icarus	√	√
Aricia agestis	√	√
Lycaena phlaeas	√	√
Coenonympha pamphilus	√	√
Cynthia cardui	√	√
Melanargia galathea	√	√
Pararge aegeria	√	√
Maniola jurtina	√	√
Carcharodus lavatherae	√	×
Gegenes pumilio	√	×
Euchloe tagis	√	×
Gonepteryx rhamni	×	√
Gonepteryx cleopatra	×	√
Vanessa atalanta	×	√

Discussion

Rhopalocera monitoring in three Chettaba Forest environments (Aleppo pine forest, high and low mattorals) allowed the identification of 815 individuals representing 15 species, representing approximately 12% of the Algerian rhopalfauna (120 species, according to Tennent 1996). *Colias croceus, Gonepteryx rhamni, Vanessa atalanta*, *Melanargia galathea* and *Polyommatus icarus* are five of the species included in this study that have protected status in Algeria (Berkane et al. 2021). Three families represent the Rhopalocera: The Pieridae family had the most species (Six species), followed by the Lycaenidae and Nymphalidae families, with four and five species respectively. Pieridae is the most prevalent family, accounting for 74% of all individuals in the stand, followed by Nymphalidae (15%) and Lycaenidae (11%).

According to Foggo et al. (2003), species richness is an important characteristic of any biotic community. Richness inventories, on the other hand, are expensive, time-consuming and require enormous resources in terms of taxonomic expertise. From a small number of replicate samples, a set of approaches has been established to extrapolate the species richness in a discrete assemblage, including the Chao 1 approach, which gave us a predicted species richness of the order of 24 species for the three habitats studied. Regarding the actual species richness, we discovered three new species compared to the survey made by Ouchen and Meskeldji (2018) in other habitats of Constantine. If we add the species that were not inventoried during this survey, the specific richness of Constantine will increase from 15 to 18 listed species (Table 4).

The content and structure of Rhopalocera from various habitats vary owing to their high needs, which limit their habitat selection (Frahtia 2005). The results suggest that the low mattoral (S: 5 species) has a higher Rhopalocera richness than the high mattoral (S: 11) and the 'Aleppo pine forest' (S: 11). This disparity is most likely due to the structural complexity and diversity of each habitat's floristic procession. Although rhopalocerean butterflies prefer open and prairial settings, the quantity of Rhopalocera is also influenced by the richness of the herbaceous stratum and the availability of Rhopalocera-specific host plants (Frahtia 2005).

In comparison to the other stations (E: 0.77 in the low mattoral and E: 0.65 in the high mattoral), the most

significant Equitability is found in the 'Aleppo pine forest' (E: 0.80), showing a very excellent distribution of populations among species. In this environment, the species are well distributed; a high value of this index refers to a species-rich stand with a balanced abundance distribution. This usually indicates a high level of stand complexity and maturity, as well as the complexity of environmental conditions.

In general, the Chettaba Forest is a degrading forest as a result of a combination of circumstances, including frequent fire and overgrazing (Djebaili and Taghribet 2020). Burned in 2019, and because of the biological post-fire rise, the low mattoral is characterized by significant variation and habitat quality. Because the richest stations of Rhopalocera in terms of species richness are those belonging to a diversified environment, these characteristics play a discriminant function in the persistence of rhopalocerean populations. The specific variety of stations, according to Dajoz (2007) is influenced by two elements: environmental stability and climatic parameters. Shannon's Diversity Index reveals that the low matorral station is the most balanced and diverse one, followed by the high mattoral. Some degraded ecosystems, such as the matorral, which is the result of the degradation of a Mediterranean forest (Sahar et al. 2018), are increasingly recognized as having significant biological importance for biodiversity. Indeed, degraded forest habitats provide renewal to plants by allowing more flowering species to thrive. More than a shelter in the bushy part with shrubs and trees, those two stations offer more in terms of environmental variability and wide spaces for flying and foraging than just a shelter in the bushy part with shrubs and trees. Berkane et al. (2021) underline that the high matorral reflects a pre-forest environment favorable to forest and nocturnal species (Lack and Lack 1951), but that daytime species has little sunny area save on the edge and around the two feet of *Pinus halepensis*. The 'Aleppo pine forest', on the other hand, is a poor ecosystem with a low recovery rate of the shrub and herb layers due to the grazing, which reduces the vegetative cover. Furthermore, this *Pinus halepensis*-dominated habitat does not permit the establishment of undergrowth or a floristic procession, both of which have a direct impact on Rhopalocera richness.

As a result, the variation of the environment's composition improves the diversity of Rhopalocera communities by allowing the provision of varied habitats (Ecological niches) and increasing the possibilities of trophic resource complementation (Fahrig et al. 2011). According to Roberts et al. (2017), one of the most important variables in preserving insect species in a habitat is feeding plants. Because the characterization of host plants is critical for understanding the existence and dynamics of Rhopalocera for a variety of reasons, the presence or absence of species may provide information on the host plant's availability (Tolman and Lewington 1999). The results show that the most common species use the three habitat types, which is explained by the fact that they fully match their feeding requirements (Saarinen et al. 2005). Pieridae have a large number of species, which feed on Rosaceae, Residaceae, Rhamnaceae, Fabaceae, Brassiceae and Tropaeloceae. Lycaenidae also feeds on several families of herbaceous plants (Lamiaceae, Fabaceae, Leguminaceae and Polygonaceae), as well as certain species of trees and shrubs. Nevertheless, Nymphalidae feed on Leguminaceae (Poaceae) and Urticaceae (Tennent 1996; Tolman and Lewington 1999). With the highest centesimal and occurrence frequencies recorded in the three habitats, *Pieris rapae* is considered as a generalist species. It is polyphagous on a very large number of plants from different families such as Brassicaceae, Capparaceae, Ericaceae, Fabaceae and Residaceae. On the other hand, *Gonepteryx rhamni*, *Vanessa atalanta* and *Pararge aegeria*, which have the lowest centesimal and occurrence frequencies, are considered as rare species that have already been reported in Constantine (Ouchen and Meskaldj 2018). According to Tolman and Lewington (1999), the rarity or location of species may match that of its host plant. Centesimal and occurrence Frequencies analysis allowed us to characterize *Coenonympha pamphilus*, *Melanargia galathea* and *Maniola jurtina* as regular species and *Pontia daplidice*, *Colias croceus*, *Gonepteryx cleopatra*, *Polyommatus icarus*, *Aricia agestis*, *Lycaenea phleas*, *Vanessa cardui* and *Anthocharis belia* as ubiquitous species which is endemic to Northwest Africa (Van Swaay et al. 2015a).

In conclusion, the monitoring of the Chettaba Forest's butterflies allowed us to count 815 individuals, representing 15 different species belonging to three families: Pieridae, Lycaenidae and Nymphalidae. *Pieris rapae* is the most constant and abundant specie in the three stations, while *Gonepteryx rhamni, Vanessa atalanta* and *Pararge aegeria* are the least represented. Fire and overgrazing are common in the three prospected environments. Low matorral has proven to be the most butterfly-rich station, perhaps because this open environment is richer in nectar-bearing plants and recovers quickly after fires, which is important for adult butterfly concentration (Frahtia 2005). We noted that the communities of butterfly species in the low and high matorrals are relatively close. These findings can be explained by the fact that both open stations provide similar circumstances for butterflies (direct sunshine and flowering). The Aleppo pine woodland has the least amount of butterfly species of all of the environments. It is most likely due to the station's high rate of tree layer recovery, which makes it less attractive to butterflies, which are heliophilic and thermophilic insects that prefer open spaces (Samal et al. 2021). Finally, we should point out that the list of Rhopalocera discovered during this study is far from being exhaustive. To fulfill the latter, more extensive monitoring over a longer period and over a larger range of situations is required. In addition to this scientific interest, it is essential to raise public awareness of the importance of preserving Rhopalocera as a natural heritage due to their high sensitivity to abiotic fluctuations, which allows them to serve as major bio-indicators of environmental quality and characterize the state of the environment in which they operate (Perović et al. 2015; Berkane et al. 2021).

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