Analysis of the Floristic Biodiversity of the Afghan Mountain Boutaleb Massif South of Sétif Algeria

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Abstract

One of the most important Highlands located in Setif, is the forest block of Djebel Boutaleb. The latter considers the main mass in the eastern part of the brood chain. It is located in Djebel Boutaleb, between the high plains of Setif in the north and El-Hodna basin in the south. Its height ranges from 980 to 1886 m at the highest peak (Afghan Summit). The area is located with its rugged terrain, even with its semi-humid climate and cold winters. The forest wealth varies greatly in this region. We find Atlantic cedar, Aleppo pine, oak, juniper, wreath, wormwood. in this study, we conducted a first survey of the floristic diversity at Afghane Mountain.

The floristic analysis based on the method of Braun-Blanquet with a minimum surface of 100 m^2 allowed us to draw up a study of the Biological diversity of the Afghan Summit of 238 species distributed over 40 families, Classified into multiple biological and chorological types. Among these species, we find 22 endemic species. In the Mountain, the overall Shannon-Wiener diversity was 3.02 and index of Pielou of woody species was 0.88, indicating that the diversity in the Mountain is relatively high.We conclude that Afghane Mountain has a unique vegetation structure, and the area qualifies for conservation as a high value area for biodiversity and conservation of global significance.

Key words: Biodiversity, Boutaleb, Afghan Mountains , chorological, families.

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Introduction

Mediterranean forests have a very high heritage value. They constitute important reserves of genetic, specific and functional diversity which should be best conserved with a view to the sustainable management of this biological heritage and these potential resources (Quézel and Médail, 2003)

The Algerian forest with its biological diversity, presents an essential element of the ecological, climatic and socio-economic balance of different regions of the country. Its current situation is one of the most critical in the Mediterranean region (Ikermoud, 2000). The forest of Boutaleb It administratively belongs to the constituency of Ain Oulmen, and occupies the Djebel Boutaleb. This forest extends over an area of 2800 ha and the highest peak at an altitude of 1830 m. The physical structure of the forest is mountainous, characterized an E-O direction orography. The forest is located in a semi-arid bioclimatic floor in cool winter, with a rainfall of 200 mm/year concentrated in the winter and spring. La forêt présente plusieurs types de formations végétales sous forme de forêt, matorral, pelouse et steppe. Three main species dominate the Boutaleb Forest, Alep Pine, Holm Oak and Atlas Cedar (Zerroug , 2022).

The Boutaleb massif was the subject of many works. The first works were based on the geology of the massif (Brossard, 1866 ; Peron, 1870 ; Cotteau *et al.*, 1884 ; Ficheur, 1893 ; Savornin, 1920 ; Bertraneu, 1952 et 1955).

The studies that are interested in the flora and vegetation of this region were less important than those of geological studies. Initially, these studies were limited to the discovery of some species endemic or not reported in Algeria, the time of the first prospections of this massif (Battandier, 1892 ; Maire, 1928 ; Quézel et Santa, 1962).

It was during a study on the vegetation of Djebel Boutaleb in the context of the management of these forests, carried out by (Kanev, 1972) that more in-depth work on the vegetation of the region appeared. Subsequently, a phytoecological study was carried out (Le Houerou *et al.*, 1975). At the same time, phytosociological studies have been carried out by (Merikhi, 1987 and 1995). Finally, a study of medicinal plants was carried out by (Laouer, 1995).

Furthermore, this study aims to assess the plant list and gain a better understanding of plant distribution in the Afghan Mountain Boutaleb massif.

Materials and Methods

Afghan location

The Afghan Mountains forest area is situated in the central part of the Boutaleb State Forest, specifically on the North Slope axis. It spans an area of 150 hectares and is located 6 kilometers away from the nearest village. The region experiences a semi-arid climate characterized by cold winters. The highest point within the Boutaleb forest is found at Afghan, reaching an altitude of 1886 meters.

The Afghan Mountains forest is bordered by various features:

- To the north, it is bordered by a mixed forest composed of Aleppo pine, oak, and cedar.
- The northwest boundary is adjacent to an area called Ain Lassker.
- The southern boundary is defined by the ridge line.
- The eastern boundary is demarcated by the Rasfa-Hamma asphalt road.
- Finally, to the west, there is a maquis vegetation dominated by holm oak.

These boundaries and features provide a description of the limits and surroundings of the Afghan Mountains forest area within the Boutaleb State Forest.figure 1.

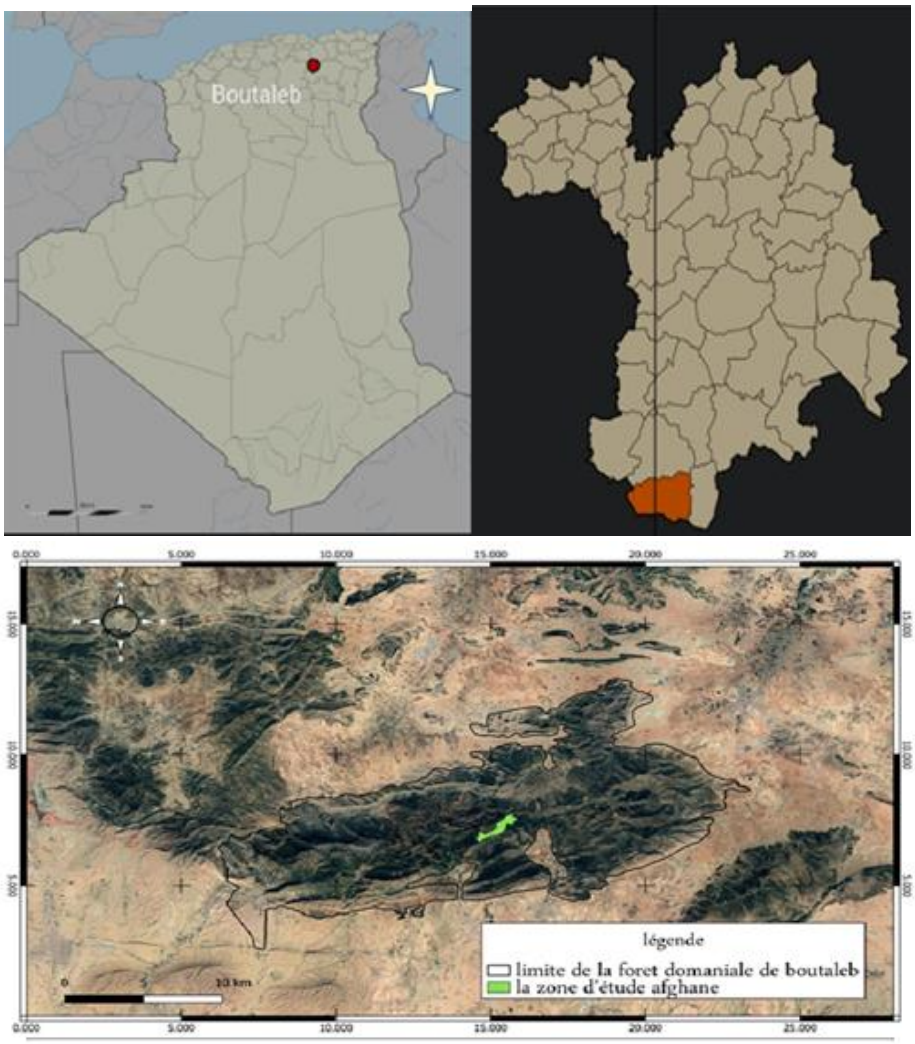

Figure 1: Map of the location of the study area (Afghan). (District of Ain Oulmene)

Work methodology

We conducted field sorties during the months of March, May of the year 2022 to study the floristic diversity of trees and shrubs of the Boutaleb region, Wilaya of Setif precisely the Afghan area. Through the use of different herbal tools .

Herbal tools

• All-terrain vehicle (ATV) to facilitate travel between study stations.

• Global Positioning System (GPS) is a satellite navigation system designed to provide position, speed, and time anywhere on or near the Earth's surface.

• Notebook and pencil; to take notes and mark different species, stations and coordinates.

• A mobile phone (smartphone) to take photos.

• Professional camera (Nikon), to take photos to create a digital herbarium.

• Picking tools: a gardener's knife, a good folding knife and pruning shear for collecting samples, a small spade for uprooting plants.

• Paper bags and clear plastic bags of different sizes to collect different species and separate them from station to station.

• Blotting paper and newspapers for botanical press.

• Botanical press consisting of two 45 cm 35 cm rectangular plywood sides and 12 mm thick and here are some tools we used (Figure 2).

Figure 2: Herbal tools.

Identification et détermination des espèces

Identification and determination of species

- For the classification of species, we have used the following works: Flora of North Africa (Maire, 1952-1987).
- New Flora of Algeria and southern desert regions (Quézel & Santa, 1962-1963).

Sampling methods

Systematic and random sampling was carried out

Results and discussion

Number of taxa

The floristic inventory conducted in the Afghan Mountains has yielded a global list of 238 different taxa or plant species. These taxa belong to 40 different families. Additionally, it appears that the inventory was conducted in 20 different surveys or sampling locations, as indicated by Figure 3.

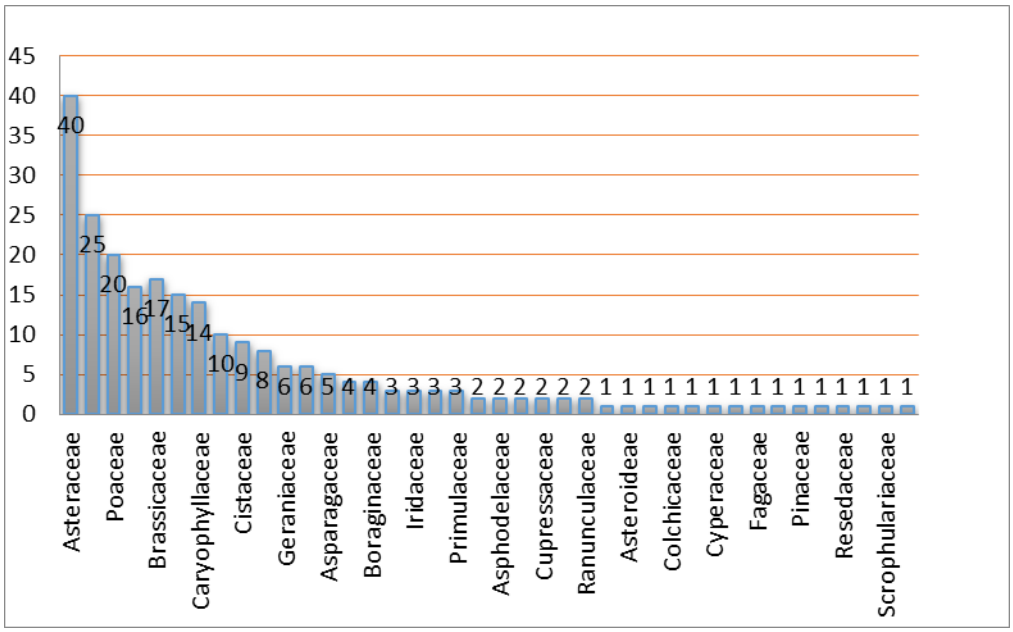

Figure 3 : Spectrum of the family composition of the flora of the Afghane Mountains

Wealth per family

The best represented families are Asteraceae with 40 species, Fabaceae with 25 species and Poaceae with 20 species, Brassicaceae and Apiaceae, Lamiaceae, Caryophyllaceae with 14 and finally Rubiaceae with 10, Other families have less than 10 species.

Biological spectrum

The analysis of the biological types of the flora in Figure 4. it appears that the dominant biological types in the study area are Therophytes and hemicryptophytes, which together make up 37% of the flora.

The dominance of Therophytes suggests that the environment has been subjected to disturbances such as overgrazing and drought. Therophytes are typically adapted to harsh conditions and are often the first plants to colonize disturbed areas.

The presence of Hemicryptophytes in abundance indicates a humid environment. Hemicryptophytes are plants that have buds or shoots located near the soil surface, and they are well adapted to regions with higher moisture levels.

Additionally, the analysis mentions the representation of other biological types. Chamephytes make up 10% of the taxa, indicating their significant presence in the study area. Chamephytes are low-growing perennial plants that are adapted to withstand cold climates and harsh conditions.

Geophytes, comprising 9% of the taxa, are plants that have underground storage organs, such as bulbs or tubers. They are often found in areas with fluctuating environmental conditions.

Finally, Phanerophytes make up 6% of the taxa. Phanerophytes are tall, woody plants, such as trees and shrubs, that have their buds and shoots located above the soil surface. Their representation suggests the presence of larger and long-lived plant species in the study area.

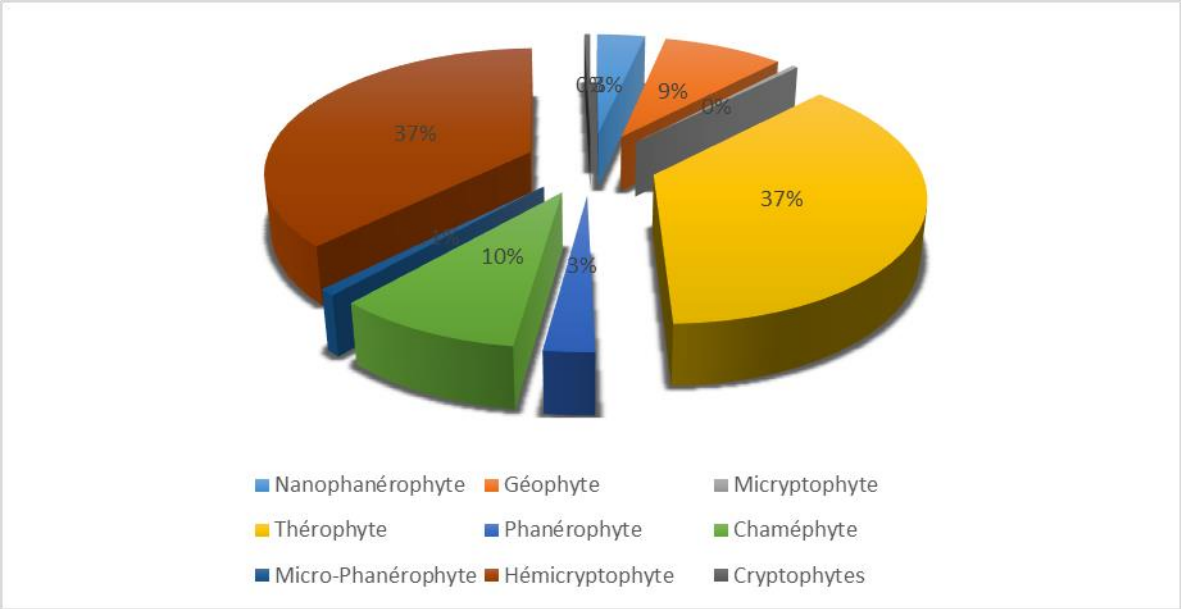

Figure 4 : Crude biological spectrum of the Afghane Mountains.

The entire studied formation is characterized by a dominance of therophytes. Authors such as Sauvage (1961), Gaussen (1963), Negre (1966), Daget (1980) and Barbo *et al.* (1988) present therophytia as a form of resistance to drought and high temperatures in arid environments. The extension of the therophytes is related to the degrees of opening of the medium.

Plant diversity

According to Quézel (2000), several Chorological elements contributed to the establishment of the flora of North Africa: element of southern (or tropical) origin, indigenous element (Mediterranean and mesogen) and northern element.

Examination of the main chorological types (Table.1) encountered in the study area confirms the abundance of the Mediterranean element for all North African countries This element is represented with 93 taxa, or 39.08% of the flora studied, followed by the pluriregional

element with 64 taxa, or 26.90%. The northern (northern) element includes 59 taxa, or 24.78%, and finally endemic taxa 22, or 9.24% (Figure 5).

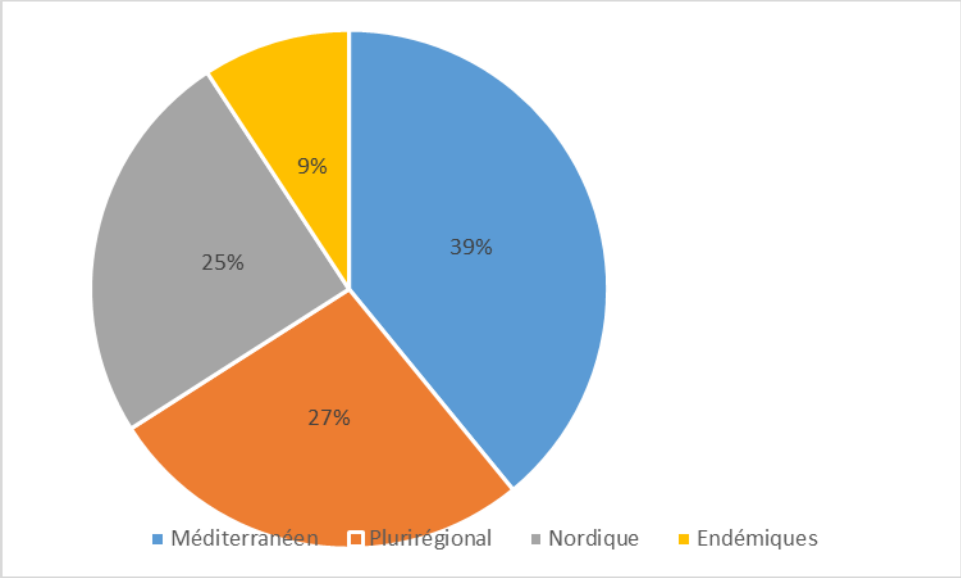

Figure 5 : Crude Chorological Spectrum of the Afghane Mountains

Tableau.1: Chorological types of Afghan mountains

Types chorologiques	Nombre de taxons
✓ Taxon endémiques	
End. Nord-africains	14
Endémiques	5
End. algéro-tunisien	2
End.algéro-marocains	1
Sous-total	22
✓ Taxons méditerranéens	
Méd	64
Ibéro-Maur et Maur	9
Méd-occidental	8
W-Méd	7
Oro-Méd	5
Sous-total	93
✓ Taxons nordiques	
Euras	15
Circum	11
Euro-Méridional	11
Euro	9
Euras-méridional	9

Paléo-temp	4
Sous-total	**59**
✓ **Taxons plurirégionaux**	
Euro-Méd	21
Cosm et Sub-cosm	8
Méd-Atlantique	7
Paléo-trop. Et Paléo-Subtrop	1
Autres	27
Sous-total	**64**
Total	**238**

In 1983, Quézel explains the importance of the biogeographic diversity of Mediterranean Africa by the climatic changes hard suffered in this region since the Miocene leading to migrations of a tropical flora. This same author in 1991 stresses that a phytogeographic study is an essential basis for any attempt to conserve biodiversity.

The Mediterranean element

The largest sub-element within this classification is the Mediterranean, which includes 64 taxa and represents 68.82% of the total. Following that, there is the Ibero-Maur sub-element with 9 taxa, accounting for 9.68% of the total.

The remaining sub-elements, namely Western Meds, W-Meds, and Oro-Meds, have fewer taxa and are poorly represented in this classification. Western Meds has 8 taxa, W-Meds has 7 taxa, and Oro-Meds has 5 taxa. Each of these sub-elements represents less than 9 taxa, as mentioned in Figure 6.

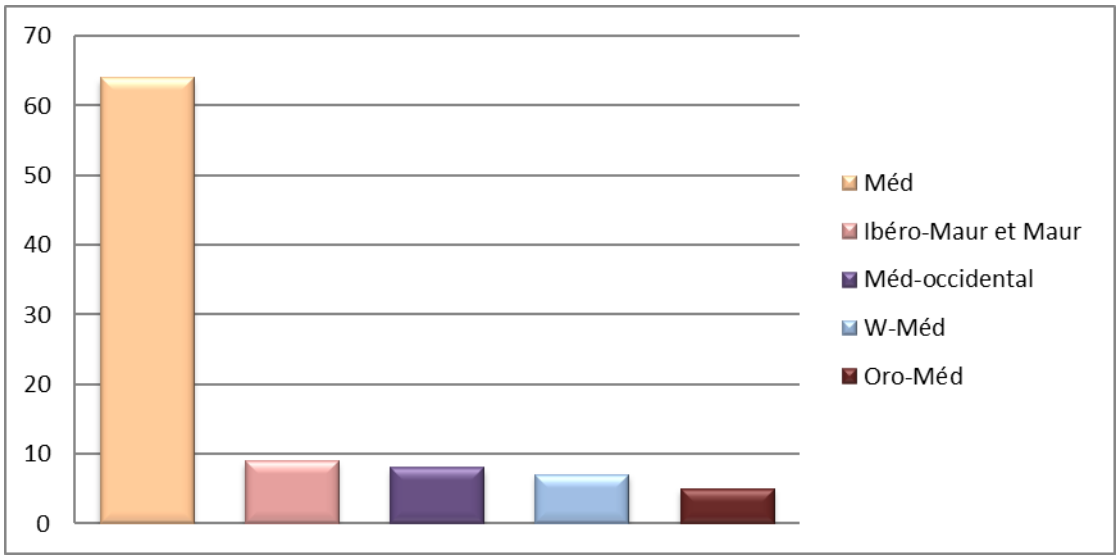

Figure 16: Spectrum of the Mediterranean area of the Afghane Mountains.

The northern element

The northern element refers to a group of sub-elements that are found in the northern regions. These sub-elements include the Eurasian sub-element with 15 species, and the Euro-southern and circumboreal sub-elements with 11 species.

According to Maire (1928), the northern element has been introduced to North Africa during wet periods that occurred before the Quaternary period. Mayor suggests that there were two migration routes through which the northern element reached North Africa. The first route is known as the Iberian route or the Amalour-Rifian bridge, which connected the Iberian Peninsula to North Africa. The second route is called the Italian route or the Sicilio-Tunisian bridge, which connected Sicily to Tunisia.

The multi-regional elements

Cosmopolitan and tropical elements are mentioned as weakly represented, with 8 and 1 taxa, respectively. This suggests that there are relatively few species classified as cosmopolitan or tropical within this ensemble.On the other hand, there are transitional elements between the Mediterranean ensemble and neighboring chorological ensembles. The Euro-Mediterranean ensemble is represented by 21 species, indicating a relatively higher number of taxa associated with this category. The Med-Atlantic ensemble follows with 7 species, suggesting a lesser representation compared to the Euro-Mediterranean.Lastly, there are other sets that encompass 27 taxa..

The endemic element

The 238 taxa recorded in the massif, 22, or approximately 9.25%, are considered endemic. Endemic species are those that are found exclusively in a specific geographic region and are not found anywhere else.Furthermore, within the 22 endemic taxa, 5 are specifically considered strictly endemic to Algeria, which means they are found only in Algeria and nowhere else. This accounts for approximately 2.10% of the total taxa recorded in the massif.The remaining endemic taxa are classified as regional endemics. Among them, there are 14 taxa that are specific to North Africa (presumably including Algeria), 1 taxon that is shared between Algeria and Morocco, and 2 taxa that are shared between Algeria and Tunisia Figure 7.

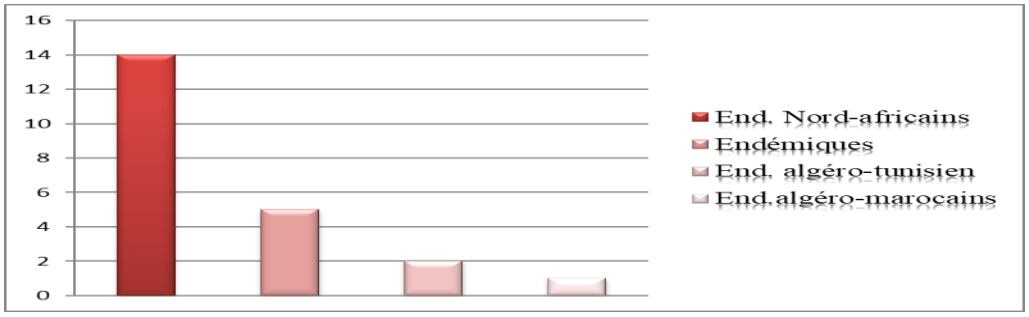

Figure 7: Spectrum of the endemic of the Afghane Mountains.

- L'Indice de perturbation

This index allows the assessment of the state of degradation of individualized groups. It is formulated by the relationship of Loisel & Gomila (1993) in Merioua *et a*l., (2013) as follows:

IP = [(N Chamephytes + N Therophytes)/Total species N]*100

IP = [(24 +37)/238]*100

IP = 35.63

To better illustrate the vulnerability of these environments, we tried to introduce the disturbance index. The calculation of this index shows the degree of therophitization of a medium. Disturbances caused by humans and their herds are numerous and correspond to two severe situations ranging from matorralization, steppisation to desertification (Barbero *et al.*, 1990).

The value of the disturbance index depends largely on the dominance of therophytes, which is directly related to the degree of openness of plant formations (Loisel et Gamila, 1993; Hébrard *et al.*, 1995; Belhacini *et al.*, 2016). In the Maghreb, this opening of vegetation is currently due to disturbances of anthropogenic origin (Quézel et Barbero, 1990).

Alpha diversity

As per Peet (1974), species richness is defined by thefunction:E(S) = f (k, N)where, E(S) = Expected value for number of species,

N = Number of individuals,

N = **238**

Pecies richness index

Total number of species (S) present in the community is called species richness index. Several indices have been developed by different workers to determine diversity of species in a habitat.

S = 40

Shannon – Wiener's index

One of the most widely used diversity indices is Shannon – Wiener index proposed by Claude Shannon in 1948. Shannon's index was originally developed for communication systems and is based on information theory that any message can be transmitted using a binary code (Shannon, 1948). Most of the popular texts only mention the formula for Shannon's index without explaining the logic behind it. In this paper Shannon's index is explained from its basics for purpose of understanding by biologists

$$H = -\sum pi\ 2 \log pi.$$

$$H' = -\sum pi.\ Ln\ pi$$

pi = proportional abundance or percentage of species importance, calculated as follows:

pi = ni/N; S = total number of species;

ni = number of individuals of a species in the sample;

N = total number of individuals of all species in the sample

H=3, 02

Simpson's Dominance Index (D)

Another widely used index for community analysis isSimpson's index proposed by Edward Hugh Simpson (1949).

$$D = \sum Pi^2$$

D=0, 064

The regularity index of Pielou (1966), also called equitability, reflects the quality organization of a community: it is 0 when only one species is present and 1 when all species have the same abundance:

Index of Pielou (E)

The Shannon index is often accompanied by the Piélou equitability index (E) (1966), also called the equidistribution index (Blondel, 1979), which represents the ratio between the theoretical maximum specific diversity of Shannon and the logarithm of specific richness. The formula for this index is:

E= H' / logS

E= H' / H (max)

H' = index Shannon

E = **3, 02/3, 68 = 0.88**

This index can range from 0 to 1: it tends to 0 when almost all numbers are concentrated on one species; it is 1 when all species have the same abundance. (Barbault 1993).

Index Simpson

Simpson's Index measures the probability that two randomly selected individuals belong to the same species:

$$D = \Sigma Ni(Ni-1)/N(N-1)$$

Ni: number of individuals of the given species.

N: total number of individuals.

This index will have a value of 0 to indicate the maximum diversity, and a value of 1 to indicate minimum diversity. In order to obtain "more intuitive" values ", the Simpson diversity index represented by

$$ES = 1-D$$

$$ES = 1-0, 064 = .0936$$

Diversity being represented by value 1, and minimum diversity by value 0 (Schlaepfer and Bütler, 2002)

Conclusion

The analysis of floristic diversity, based on data from the catalogue that was carried out on the flora of the Afghane Mountains forest consists of a quantitative and qualitative analysis of this flora through significant parameters: chorology and biological type. This flora show a great

floristic richness of this ecosystem estimated 238 species, representing 7.6%, of the flora of Algeria (3139 species).
The floristic analysis of the zone allowed to shift the predominance of certain families, namely Asteraceae, Fasbaceae, Poaceae, Brassicaceae and Apiaceae. The biological spectrum is a typical spectrum of the semi-arid bioclimatic atmosphere, with a percentage of 37% for the Therophytes, 37% for the hemoglobophytes, 10% for the chamephytes, 9% for the geophytes and 7% for the Phanerophytes.
Examination of the main chorological types encountered in the study area confirms the abundance of the Mediterranean element for all North African countries This element is represented with 93 taxa, followed by the pluriregional element with 64 taxa, The northern element with 59 taxa, and finally endemic with 22 taxa.

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Famille	**Espèce**	**N-Nom**	**Chorologie**	**Type Biologique**
Asparagaceae	*Ornithogalum umbellatum*	*Ornithogalum kochii parl*	Circum	Géophyte
Asparagaceae	*Urginea fugax*	*Drimia fugax*	Corso-sarde	Géophyte
Asphodelaceae	*Asphodelus microcarpus*	*Asphodelus ramosus*	Méd-Occidental	Géophyte
Asteraceae	*Catananche caerulea*	*Catananche caerulea*	Méd	Hémicryptophyte
Asteraceae	*Catananche lutea*		Méd	Hémicryptophyte
Caprifoliaceae	*Valerianella carinata*	*Valerianella locusta f. Carinata*	Méd	Thérophyte
Cistaceae	*Helianthemum pilosum*		Méd	Chaméphyte
Colchicaceae	*Colchicum autumnale*	*Colchicum lusitanum*	Euro-Temp	Cryptophytes
Cupressaceae	*Juniperus oxycedrus*	*Juniperus oxycedrus*	Méd-Atlantique	Phanérophyte
Fabaceae	*Astragalus armatus*	*Astragalus spinosus*	End.N.A	Chaméphyte

Fabaceae	*Calicotome spinosa*	*Calicotome spinosa*	Méd-Occidental	Phanérophyte
Fabaceae	*Coronilla minima*		Euro-Méridional	Chaméphyte
Fabaceae	*Genesta microcephala*		Euras-Méd	Chaméphyte
Fabaceae	*Trifolium pratense*	*Trifolium pratense*	Euras	Hémicryptophyte
Fabaceae	*Vicia Onobrychioides*	*Visit onobrychioides*	Euro-Méd	Micryptophyte
Fagaceae	*Quercus rotundifolia*	*Quercus ilex subps*	Méd-Occidental	Phanérophyte
Lamiaceae	*Thymus ciliatus*	*Thymus munbyanus*	End.N.A	Chaméphyte
Liliaceae	*Gagea granatelli*	*Gagea chabertii*	End	Géophytes
Pinaceae	*Cedrus atlantica*		Introduit (Manheb)	Phanérophyte
Plantaginaceae	*Antirrinium orontium*		Euro	Thérophyte
Plantaginaceae	*Plantago coronopus*		Euras	Hémicryptophyte
Plantaginaceae	*Veronica praecox*		Méd	Thérophyte
Poaceae	*Ampelodesma mauritanicum*		Méd-Occidental	Hémicryptophyte
Poaceae	*Catapodium tenellum*		Euro-Méd	Thérophyte
Poaceae	*Poa nemoralis*	*Poa nemoralis*	Circum	Hémicryptophyte
Poaceae	*Trisetaria flavescens*	*Trisetum flavescens*	Circum	Hémicryptophyte
Poeceae	*Bromus hordaceus*		Euras	Thérophyte

Primulaceae	*Androsace maxima*		Euras	Thérophyte
Primulaceae	*Asterolinum stellatum*		Méd	Thérophyte
Ranunculaceae	*Ranunculus spicatus*	*Ranunculus subsp*	End.N.A	Géophyte
Rosaceae	*Crataegus laevigata*		Euro-Méd	Micro-Phanérophyte
Rosaceae	*Rosa micrantha*	*Rosa sicula tratt*	Euro-Méd	Nanophanérophyte
Rubiaceae	*Callipeltis cucullaria*		S-Méd	Thérophyte
Rubiaceae	*Crucianella angustifolia*	*Crucianella angustifolia*	Euro-Méd	Thérophyte
Rubiaceae	*Galium pusillum*	*Galium atlanticum ball*	Euras	Hémicryptophyte
Rubiaceae	*Galium tunetanum*		Euras-Méd	Thérophyte
Saxifragaceae	*Saxifraga veronicifolia*	*Saxifraga duchotoma willd*	Circum	Thérophyte

Floristic catalogue of the Afghane Mountains

Station 1 : altitude 1462 m

N 35° 44' 36,2" E 05° 20' 59,0"

Station 2: Altitude 1470 m

Famille	Espèce	N-Nom	Chorologie	Type Biologique
Apiaceae	*Eryngium campestre*		Euro-Méd	Hémicryptophyte
Apiaceae	*Thapsia villosa*		Méd	Hémicryptophyte
Apiaceae(Ombellifères)	*Carum montanum*	*Selinopsis montana coss*	End	Géophytes
Asteraceae	*Bellis sylvestris*	*Bellis sylvestris cirillo*	Circum	Hémicryptophyte
Asteraceae	*Santolina chamaecyparissus*	*Santolina africana*	End.N.A	Chaméphyte
Caprifoliaceae	*Scabiosa*	*Scabiosa*	Euro-	Hémicryptophyte

	columbaria	*ochroleuca*	méridional	
Caprifoliaceae	*Knautia arvensis*	*Knautia mauritanica*	Euras	Hémicryptophyte
Caryophyllaceae	*Cerastium brachypetalum*	*Cerastium brachypetalum subsp*	Paléo-Temp	Thérophyte
Caryophyllaceae	*Dianthus caryophyllus*	*Dianthus sylvestris*	Euro-Méd.	Hémicryptophyte
Caryophyllaceae	*Silene italica*	*Silene patula*	Méd	Thérophyte
Cistaceae	*Cistus salviifolius*	*Cistus salviifolius*	Euras-Méd	Chaméphyte
Euphorbiaceae	*Euphorbia falcata*	*Euphorbia falcata*	Macar-Méd	Phanérophyte
Fabaceae	*Astragalus sesameus*	*Astragalus sesameus*	W-Méd	Thérophyte
Fabaceae	*Genesta quadrifla*		End.N.A	Nanophanérophyte
Fabaceae	*Medicago lupina*		Euro-méd	Thérophyte
Rosaceae	*Rosa canina*	*Rosa pouzinii tratt*	Oro-Méd	Nanophanérophyte
Rubiaceae	*Galium aparine*	*Galium spurium*	Paléo-Temp	Thérophyte

N 35° 44' 34,339 " E 05° 20' 53,574"

Station 3 : Matorral De Chêne V Altitude 1466 m

Famille	**Espèce**	**N-Nom**	**Chorologie**	**Type Biologique**
Amaryllidaceae	*Allium roseum*	*Album roseum*	Méd	Géophytes
Apiaceae	*Torilis arvensis*		Pléo-Temp	Thérophyte
Asparagaceae	*Asparagus albus*		W-Méd	Chaméphyte
Asteraceae	*Sonchus tenerrimus*	*Sonchus bourgeaui*	Méd	Thérophyte
Caryophyllaceae	*Arenaria grandiflora*	*Arenaria grandiflora goramica*	Oro-Méd	Hémicryptophyte
Lamiaceae	*Salvia argentea*	*Salvia argentea*	Méd	Hémicryptophyte
Poaceae	*Aegilops triuncialus*		Méd-Irano-Tour	Thérophyte
Poaceae	*Arrhenatherum elatius*	*Arrhenatherum album*	Atl-Sahr	Hémicryptophyte

N 35° 44' 34,819 " E 05° 20' 51,950"

Station 4 : Matorral Altitude 1534 m

N 35° 44' 30,2 " E 05° 20' 45,7"

Famille	Espèce	N-Nom	Chorologie	Type Biologique
Amaryllidaceae	*Allium moly*	*Allium massaessylum Batt. & Trab*	Méd	Géophytes
Apiaceae	*Eryngium triquetrum*	*Eryngium triquetrum Vahl subsp. triquetrum*	N.A-Sicile	Thérophyte
Asteraceae	*Carthamus lanatus*	*Carthamus lanatus subsp. montanus (Pomel) Jahand. & Maire*	Euro-Méd.	Thérophyte
Asteraceae	*Filago germanica*	*Filago pyramidata*	Euro-Méd	Thérophyte
Boraginaceae	*Cynoglossum cheirifolium*	*Cynoglossum cheirifolium*	Méd	Thérophyte
Caryophyllaceae	*Minuartia tenuifolia*	*Minuartia hybrida (Vill.) Schischk.*	Euro-Méd	Thérophyte
Caryophyllaceae	*Paronychia argentea*	*Paronychia argentea Lam*	Méd	Hémicryptophyte
Cistaceae	*Cistus villosus*	*Cistus creticus*	Méd	Phanérophyte
Cistaceae	*Fumana laevipes*		Euro-Méd	Chaméphyte
Cistaceae	*Helianthemum helianthemoides*	*Helianthemum helianthemoides (Desf.) Grosser*	Méd	Chaméphyte
Cistaceae	*Helianthemum racemosum*	*Helianthemum violaceum subsp. subobtusatum (Maire) I. Soriano*	Euro-Méd	Chaméphyte
Crassulaceae	*Sedum tenuifolium*	*Sedum amplexicaule subsp. tenuifolium (Sm.) Greuter*	Oro-Méd	Hémicryptophyte
Fabaceae	*Trigonella gladiata*		Méd	Thérophyte
Geraniaceae	*Geranium lucidum*	*Geranium lucidum*	Méd-Atlantique	Thérophyte
Iridaceae	*Iris unguicularis*	*Iris unguicularis Poir*	Méd-oriental	Géophytes
Iridaceae	*Romulea bulbocodium*	*Romulea bulbocodium subsp. apollinis (Maire) Maire*	Circum	Géophytes

Station 5 : Altitude 1560 m

N 35° 44' 30,710 " E 05° 20' 45,760"

Famille	Espèce	N-Nom	Chorologie	Type Biologique
Asteraceae	*Scorzonera laciniata*	*Podospermum laciniatum DC*	Sub-Méd-Sib	Hémicryptophyte
Asteraceae	*Senecio vulgaris*		Sub-Cosm	Thérophyte
Brassicaceae	*Sinapis pubescens*	*Sinapis pubescens*	W-Méd	Hémicryptophyte
Geraniaceae	*Géranium rotundifolium*	*Geranium rotundifolium*	Euro	Thérophyte
Lamiaceae	*Ballota hirsuta*	*Pseudodictamnus hirsutus (Willd.) Salmaki & Siadati*	Ibéro-Maur	Thérophyte

Station 6 : régénération de cèdre Altitude 1616 m

N 35° 44' 10,5 " E 05° 20' 50,7"

Famille	Espèce	n-nom	Chorologie	Type Biologique
Asteraceae	*Cirsium echinatum*		W-Méd	Hémicryptophyte
Asteraceae	*Filago minima*		Euro-Sib	Thérophyte
Asteraceae	*Sonchus oleraceus*	*Sonchus oleraceus*	Cosmo	Thérophyte estivaux, Hémicryptophyte bisannuel
Cistaceae	*Helianthemum cinereum*	*Helianthemum cinereum subsp. rotundifolium (Dunal) Greuter & Burdet*	Euro-méd	Chaméphyte

Station 7 : Altitude 1641 m

N 35° 44' 9,711 " E 05° 20' 49,765"

Famille	Espèce	n-nom	Chorologie	Type Biologique
Asteraceae	*Senecio leucanthemifolius*	*Senecio leucanthemifolius Poir*	W-Méd	Thérophyte
Lamiaceae	*Satureja alpina*	*Acinos alpinus subsp. meridionalis (Nyman) P.W. Ball*	Ibéro-Maur	Hémicryptophyte
Lamiaceae	*Teucrium polium*	*Teucrium aureo-candidum Andr*	Euro-Méd	Hémicryptophyte

Station 8 : Altitude 1619 m

N 35° 44' 6,484 " E 05° 20' 58,746"

Famille	Espèce	n-nom	Chorologie	Type Biologique
Brassicaceae	*Thlaspi arvensis*		Euras	Thérophyte

Station 9 : Altitude 1636 m

N 35° 44' 7,559 " E 05° 20' 54,081"

Famille	Espèce	N-Nom	Chorologie	Type Biologique
Plantaginaceae	*Plantago lagopus*	*Plantago lagopus subsp. lagopus*	Méd	Thérophyte
Poaceae	*Avena bromoides*	*Helictochloa bromoides (Gouan) Romero Zarco*	Méd	Thérophyte

Station 10 : Humide Altitude 1515 m

N 35° 44' 04,9 " E 05° 20' 01,10"

Famille	Espèce	N-Nom	Chorologie	Type Biologique
Apiaceae	*Bunium alpinum*	*Bunium atlanticum (Maire) Dobignard*	Méd	Géophytes
Apiaceae	*Smyrnium olusatrum*		Méd	Hémicryptophyte
Asteraceae	*Senecio lividus*	*Senecio lividus*	Euro-Méd	Thérophyte
Cyperaceae	*Carex halleriana*	*Carex halleriana Asso*	Méd	Hémicryptophyte
Fabaceae	*Trifolium stellatum*		Méd	Thérophyte
Lamiaceae	*Phlomis herba-venti*	*Phlomis herba-venti subsp. pungens (Willd.) Maire ex DeFilipps*	Méd	Hémicryptophyte
Rosaceae	*Potentilla recta*	*Potentilla recta*	Euras-méridional	Hémicryptophyte
Rosaceae	*Rubus ulmifolius*	*Rubus bollei Focke*	Euro-Méd	Nanophanérophyte

Station 11 : Altitude 1769 m

N 35° 43' 44,358 " E 05° 20' 9,020"

Famille	Espèce	N-Nom	Chorologie	Type Biologique
Apiaceae	*Ammoides verticillata*		Méd	Thérophyte

Apiaceae	*Balansaea glaberrima*	*Conopodium glaberrimum (Desf.) Engstrand*	End.N.A	Géophytes
Asteraceae	*Anthemis pedunculata*		Ibéro-Maur	Hémicryptophyte
Asteraceae	*Hyoseris radiata*	*Hyoseris lucida*	Méd	Hémicryptophyte
Asteroideae	*Anacyclus clavatus*	*Anacyclus ×inconstans Pomel*	Méd-Occidental	Thérophyte
Boraginaceae	*Myosotis collina*	*Myosotis discolor Pers*	Méd.	Thérophyte
Brassicaceae	*Alyssum serpyllifolium*	*Alyssum serpyllifolium Desf*	Orophyte méd	Hémicryptophyte
Brassicaceae	*Alyssum simplex*	*Alyssum simplex Rudolphi*	Euro-méridional	Thérophytes
Brassicaceae	*Arabis alpina*	*Arabis alpina subsp. caucasica (Willd.) Briq*	Arctico-alpin	Hémicryptophyte
Brassicaceae	*Arabis pubescens*	*Arabis pubescens subsp. decumbens Ball*	End.N.A	Hémicryptophyte
Brassicaceae	*Diplotaxis virgata*	*Diplotaxis virgata (Cav.) DC*	Ibéro-Maur	Thérophyte
Brassicaceae	*Hirschfeldia incana*	*Hirschfeldia incana Lagr.-Foss. subsp. incana*	Méd	Thérophyte
Brassicaceae	*Sisymbrium thalianum*	*Arabidopsis thaliana Heynh*	Cosmo	Thérophyte
Campanulaceae	*Legousia falcata*	*Legousia falcata subsp. castellana (Lange) Jauzein*	Méd	Thérophyte
Caryophyllaceae	*Dianthus caryophyllus*	*Dianthus caryophyllus*	Euro-méridional	Hémicryptophyte
Caryophyllaceae	*Stellaria media*	*Stellaria media Vill*	Cosmo	Thérophyte
Crassulaceae	*Sedum acre*	*Sedum acre*	Euro	Chaméphyte
Fabaceae	*Trifolium pratenspraten*		Euras	Hémicryptophyte
Fabaceae	*Vicia tenuifolia*	*Vicia tenuifolia Roth*	Euro-méridional	Hémicryptophyte
Poaceae	*Bromus madritensis*	*Anisantha madritensis*	Méd-	Thérophyte

		Nevski	atlantique	
Poaceae	*Poa annua*	*Poa annua*	Cosmo	Thérophyte
Primulaceae	*Anagallis arvensis*	*Lysimachia arvensis U. Manns & Anderb*	Cosmo	Thérophyte
Rubiaceae	*Galium tunetanum*	*Galium tunetanum Lam*	End.N.A.	Hémicryptophyte

Station 12 : Altitude 1774 m

N 35° 43' 44,712 " E 05° 20' 4,921"

Famille	**Espèce**	**N-Nom**	**Chorologie**	**Type Biologique**
Asteraceae	*Carduus nutans*	*Carduus platypus subsp. granatensis (Willk.) Nyman*	Euro	Hémicryptophyte
Boraginaceae	*Cynoglossum creticum*	*Cynoglossum creticum Mill*	Méd	Hémicryptophyte
Brassicaceae	*Erysimum grandiflorum*	*Erysimum teppneri Polatschek*	Oro-Méd	Hémicryptophyte
Brassicaceae	*Rapistrum rugosum**	*Rapistrum rugosum subsp. linnaeanum (Coss.) Rouy & Foucaud*	Cosmo	Thérophyte
Geraniaceae	*Geranium molle*	*Geranium molle*	Euras	Thérophyte
Lamiaceae	*Lamium garganicum*	*Lamium garganicum subsp. longiflorum (Ten.) Kerguélen*	Orophyte méridional	Hémicryptophyte
Plantaginaceae	*Linaria viscosa*	*Linaria bordiana Santa & Simonn*	Méd	Hémicryptophyte
Poaceae	*Cynosurus echinatus*	*Cynosurus coloratus Lehm. ex Nees*	Méd	Thérophyte
Poaceae	*Dactylis glomerata*	*Dactylis glomerata subsp. juncinella (Bory) Stebbins & D. Zohary*	Euras-méridional	Hémicryptophyte
Poaceae	*Deschampsia flexuosa*	*Deschampsia flexuosa Trin.*	Circum	Hémicryptophyte
Poaceae	*Koeleria vallesiana*	*Koeleria vallesiana (Honck.) Gaudin*	Euras-méridional	Hémicryptophyte
Poaceae	*Poa bulbosa*	*Poa perligularis H. Scholz*	Euras	Hémicryptophyte

Rubiaceae	*Asperula hirsuta*	*Asperula hirsuta Desf*	W-Méd	Hémicryptophyte
Rubiaceae	*Galium mollugo*	*Galium lucidum All*	Euras-méridional	Hémicryptophyte

Station 13 : Altitude 1783 m

N 32° 43' 43,709 " E 05° 20' 3,464"

Famille	**Espèce**	**N-Nom**	**Chorologie**	**Type Biologique**
Aspleniaceae	*Asplenium ceterach*		Euras-méridional	Hémicryptophyte
Asteraceae	*Carlina lanata*		Méd	Thérophyte
Asteraceae	*Centaurea parviflora*		End.Alg.Tun	Chaméphyte
Asteraceae	*Picris aculeata*	*Helminthotheca aculeata subsp. maroccana (Sauvage) Greuter*	Sicile-A.N	Hémicryptophyte
Asteraceae	*Senecio gallerandianus*	*Jacobaea gallerandiana (Coss. & Durieu) Pelser*	End	Hémicryptophyte
Papaveraceae	*Papaver pinnatifidum*		Méd-central	Thérophyte
Poaceae	*Festuca atlantica*	*Festuca atlantica subsp. oxyphylla (Litard. & Maire ex Maire) Romo*	End.Alg.Mar	Hémicryptophyte
Rubiaceae	*Scherardia arvensis*		Euras-méridional	Thérophyte

Station 14 : Altitude 1806 m

N 35° 43' 42,376 " E 05° 20' 3,370"

Famille	**Espèce**	**N-Nom**	**Chorologie**	**Type Biologique**
Apiaceae	*Torilis arvensis*	*Torilis africana Spreng*	Pléo-Temp	Thérophyte
Asteraceae	*Scorzonera undulata*	*Pseudopodospermum undulatum subsp. deliciosum (Guss.) Bartolucci, Galasso & F. Conti*	Méd	Hémicryptophyte
Asteraceae	*Taraxacum officinale*		Euro	Hémicryptophyte
Asteraceae	*Urospermum*		Méd	Hémicryptoph

	dalechampii			yte
Asteraceae	*Xeranthemum inapertum*	*Xeranthemum inapertum Mill*	Méd-eury	Thérophyte
Brassicaceae	*Alyssum montanum*	*Alyssum atlanticum Desf*	Euro-méridional	Hémicryptophyte
Caryophyllaceae	*Velezia rigida*		Méd	Thérophyte
Papaveraceae	*Papaver rhoeas*	*Papaver rhoeas*	Euro	Thérophyte
Rubiaceae	*Galium aparine*	*Galium spurium*	Euras-méridional	Thérophyte

Station 15 : Altitude 1846 m

N 35° 43' 40,866 " E 05° 20' 4,774"

Famille	**Espèce**	**N-Nom**	**Chorologie**	**Type Biologique**
Asparagaceae	*Muscari comosum*		Méd	Géophyte
Asphodelaceae	*Asphodeline lutea*		Euro-Med	Géophyte
Asteraceae	*Helichrysum stoechas*	*Helichrysum conglobatum (Viv.) Steud*	Méd-atlantique	Chaméphyte
Asteraceae	*Hertia cheirifolia*		End.Alg.Tun	Hémicryptophyte
Asteraceae	*Micropus bombycinus*	*Bombycilaena discolor (Pers.) M. Laínz*	Circum	Thérophyte
Caryophyllaceae	*Minuartia verna*	*Minuartia kabylika (Pomel) Dvoráková*	Arctico-alpin	Hémicryptophyte
Fabaceae	*Anthyllis tetraphyllala*		Méd	Thérophyte
Geraniaceae	*Erodium cicutarium*	*Erodium cicutarium L'Hér*	Cosmo	Thérophyte
Malvaceae	*Malva sylvestris*	*Malva sylvestris*	Euro	Hémicryptophyte
Rosaceae	*Alchemilla arvensis*	*Aphanes floribunda (Murb.) Rothm*	Euro-méridional	Thérophyte

Station 16 : Altitude 1843 m

N 35° 43' 40,413 " E 05° 20' 5,751"

Famille	Espèce	N-Nom	Chorologie	Type Biologique
Asteraceae	*Calendula arvensis*	*Calendula stellata Ca*	Euro-méridional	Thérophyte
Brassicaceae	*Sinapis pubescens*	*Sinapis pubescens*	Méd	Hémicryptophyte
Caryophyllaceae	*Paronychia arabica*	*Paronychia arabica subsp. cossoniana (J. Gay ex Batt.) Batt*	Euro-Méd	Hémicryptophyte
Cupressaceae	*Juniperus phoenicea*	*Juniperus phoenicea*	Méd	Micro-Phanérophyte
Lamiaceae	*Sideritis montana*	*Sideritis montana*	Méd	Thérophyte
Liliaceae	*Tulipa sylvestris*	*Tulipa sylvestris subsp. australis (Link) Pamp*	Euro	Géophyte
Rosaceae	*Sanguisorba minor*		Euras	Hémicryptophyte

Station 17 : Altitude 1730 m

N 35° 43' 40,518 " E 05° 20' 14,780"

Famille	Espèce	N-Nom	Chorologie	Type Biologique
Apiaceae	*Scandix pecten-veneris*		Euro-méridional	Thérophyte
Asteraceae	*Carduncellus pinnatus*	*Carthamus lucens (Ball) Greuter*	Sicile-A.N	Hémicryptophyte
Asteraceae	*Centaurea acaulis*	*Centaurea oranensis Greuter & M.V. Agab*	Méd	Hémicryptophyte
Caryophyllaceae	*Silene atlantica*		End	Hémicryptophyte
Cistaceae	*Fumana ericoides*	*Fumana ericoides subsp. montana (Pomel) Güemes &Muñoz Garm*	Méd-central	Chaméphyte
Fabaceae	*Coronilla scorpioides*	*Coronilla scorpioides W.D.J. Koch*	Euro-méridional	Thérophyte
Fabaceae	*Hedysarum*		End	

	perraldrianum			
Fabaceae	*Lotus corniculatus*	*Lotus corniculatus*	Euras-méridional	Hémicryptophyte
Fabaceae	*Melilotus indicus*	*Melilotus indicus*	Méd-Asiatique	Thérophyte
Geraniaceae	*Geranium robertianum*	*Geranium purpureum Vill.*	Circum	Thérophyte
Malvaceae	*Malope malacoides*	*Malope malacoides subsp. stipulacea (Cav.) Baker f*	Méd	Hémicryptophyte
Papaveraceae	*Papaver dubium*	*Papaver dubium*	Euras-méridional	Thérophyte
Polygonaceae	*Rumex thyrsoides*	*Rumex intermedius DC*	Méd-Occidental	Hémicryptophyte
Resedaceae	*Reseda alba*	*Reseda decursiva Forssk.*	Méd	Hémicryptophyte

Station 18 : Altitude 1570 m

N 35° 44' 24,594 " E 05° 20' 44,926"

Famille	**Espèce**	**N-Nom**	**Chorologie**	**Type Biologique**
Apiaceae	*Bupleurum spinosum*	*Bupleurum spinosum Gouan*	Ibéro-Maur	Chaméphyte
Apiaceae	*Ferula communis*	*Ferula communis*	Méd	Hémicryptophyte
Apiaceae	*Thapsia garganica*	*Thapsia garganica*	Méd	Géophyte
Asteraceae	*Andryala sinuata*	*Andryala integrifolia*	Méd	Thérophyte
Asteraceae	*Atractylis humilis*		Méd-Occidental	Géophyte
Asteraceae	*Centaurea pullata*	*Centaurea pullata subsp. pullata*	Méd	Hémicryptophyte
Asteraceae	*Pallenis spinosa*	*Pallenis spinosa Cass. subsp. spinosa*	Méditerranéen eury	Hémicryptophyte
Asteraceae	*Santolina chamaecyparissus*	*Santolina africana Jord. & Fourr*	Méd	Chaméphyte
Brassicaceae	*Erysimum semperflorens*	*Erysimum semperflorens (Schousb.) Wettst. subsp. semperflorens*	End.N.A	Thérophyte
Brassicaceae	*Hornungia petrea*		Euro-Méd	Thérophyte

Caryophyllaceae	*Silene muscipula*	*Silene muscipula subsp. deserticola Murb*	Méd	Hémicryptophyte
Convolvulaceae	*Convolvulus canthabrica*		Méd	Hémicryptophyte
Fabaceae	*Genista tricuspidata*	*Genista tricuspidata Desf*	End.N.A	N.Ph
Fabaceae	*Lotus ornithopodioides*		Méd	Thérophyte
Fabaceae	*Medicago ciliaris*	*Medicago intertexta subsp. ciliaris Ponert*	Méd	Thérophyte
Fabaceae	*Melilotus indica*		Méd-Asiatique	Thérophyte
Fabaceae	*Ononis aragonensis*	*Ononis reuteri Boiss*	Oro- Méd	N.Ph
Fabaceae	*Ononis natrix*	*Ononis angustissima subsp. polyclada Murb*	Méd	Chaméphyte
Lamiaceae	*Ajuga iva*	*Ajuga iva Schreb*	Méd	Hémicryptophyte
Lamiaceae	*Satureja granatensis*	*Satureja alpina Scheele subsp. Seridionalis*	Ibéro-Maur	Hémicryptophyte
Lamiaceae	*Thymus hirtus*	*Thymus willdenowii Boiss*	Maur	Chaméphyte
Liliaceae	*Asphodelus microcarpus*	*Asphodelus aestivus Brot*	Canar-Méd	Géophyte
Poaceae	*Aegilops ventricosa*	*Aegilops ventricosa Tausch*	Méd-Occidental	Thérophyte
Poaceae	*Bromus rubens*		Paléo-Subtrop	Thérophyte

Station 19 : Altitude 1496 m

N 35° 44' 30,649 " E 05° 20' 49,958"

Famille	**Espèce**	**N-Nom**	**Chorologie**	**Type Biologique**
Apiaceae	*Turgenia latifolia*		Euras	Thérophyte
Lamiaceae	*Salvia verbenaca*	*Salvia verbenaca*	Méd-atlantique	Hémicryptophyte
Papaveraceae	*Papaver hybridum*		Méd	Thérophyte
Plantaginaceae	*Plantago lanceolata*	*Plantago pilgeriana Hassemer*	Euras	Hémicryptophyte
Ranunculaceae	*Ranunculu bulbosus*		Circum	Géophyte
Rosaceae	*Rosa micrantha*	*Rosa micrantha Borrer ex Sm*	Euro-Méd	N.Ph

Station 20 : Altitude 1455 m

N 35° 44' 36,356 " E 05° 20' 58,969"

Famille	**Espèce**	**N-Nom**	**Chorologie**	**Type Biologique**
Apiaceae	*Bunium fontanesii*	*B.mauritanicum Batt*	End.N.A	Thérophyte
Asparagaceae	*Asparagus acutifolius*		Méd	N.Ph
Asteraceae	*Filago pyramidata*	*F. spathulata Presl*	Méd	Thérophyte
Asteraceae	*Inula montana*	*Pentanema montanum D. Gut.Larr., Santos-Vicente & al*	W-Méd Sub. Atl	Hémicryptophyte
Asteraceae	*Silybum marianum*	*Silybum marianum Gaertn*	Méd	Hémicryptophyte
Asteraceae	*Tragopon porrifolius*		Méd-atlantique	Hémicryptophyte
Brassicaceae	*Arabis verna*	*Arabis verna R. Br*	Méd	Thérophyte
Caryophyllaceae	*Silene vulgaris*	*Silene vulgaris (Moench) Garcke subsp. vulgaris*	Euras	Hémicryptophyte
Fabaceae	*Ebenus pinnata*		End.N.A	Chaméphyte
Geraniaceae	*Geranium tuberosum*	*Geranium tuberosum. subsp. tuberosum*	Méd	Géophyte
Iridaceae	*Gladiolus segetum*	*Gladiolus italicus Mill.*	Méd	Géophyte
Lamiaceae	*Ballota nigra*	*Ballota nigra*	Euro	Hémicryptophyte
Lamiaceae	*Lamium mauritanicum*		End.N.A	Thérophyte
Lamiaceae	*Teucrium chamaedrys*	*Teucrium chamaedrys subsp. gracile (Batt.) Rech. f*	Euro-méridional	Chaméphyte
Linaceae	*Linum aristidis*	*Linum corymbiferum subsp. aristidis (Batt.) Batt*	End.N.A	Thérophyte
Poaceae	*Lolium perenne*	*Lolium multiflorum Lam*	Circum	Hémicryptophyte
Scrophulariaceae	*Verbascum nigrum*		Euras	Hémicryptophyte
Brassicaceae	*Draba hispanica*		Ibéro-Maur	Hémicryptophyte
Boraginaceae	*Rochelia disperma*		Méd	Thérophyte
Plumbaginaceae	*Armeria alliacea*		Ibéro-Maur	Hémicryptoph

				yte
Poaceae	*Lagurus ovatus*		Méd-atlantique	Thérophyte
Cistaceae	*Helianthemum ledifolium*		Méd	Thérophyte

List of endemic taxa

Familles	Espèces	Types d'endémisme
Apiaceae	*Bunium fontanesii*	End.N.A
	Balansaea glaberrima	End.N.A
	Carum montanum	End
Asteraceae	*Hertia cheirifolia*	End.Alg.Tun
	Senecio gallerandianus	End
	Centaurea parviflora	End.Alg.Tun
	Santolina chamaecyparissus	End.N.A
Brassicaceae	*Erysimum semperflorens*	End.N.A
	Arabis pubescens	End.N.A
Caryophyllaceae	*Silene atlantica*	End
Fabaceae	*Ebenus pinnata*	End.N.A
	Genista tricuspidata	End.N.A
	Hedysarum perraldrianum	End
	Genesta quadrifla	End.N.A
	Astragalus armatus	End.N.A
Lamiaceae	*Lamium mauritanicum*	End.N.A
	Thymus ciliatus	End.N.A
Liliaceae	*Gagea granatelli*	End
Linaceae	*Linum aristidis*	End.N.A
Poaceae	*Festuca atlantica*	End.Alg.Mar
Ranunculaceae	*Ranunculus spicatus*	End.N.A
Rubiaceae	*Galium tunetanum*	End.N.A.