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Research Article

The floristic composition, morphometric and the adaptation of a new species: *Malva subovata* in the matorral of Algeria (Djbel fellaoucen)

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Abstract

This study is based on a ruderal species: *Malva subovata* = *Lavatera maritima* which should normally grow in the littoral, under maritime influence. Its presence in the matorrals is highlighted for the first time. as it has been found far from its natural habitat.
The comparison of the different biological and morphological spectra shows the importance of the therophytes that confirms the phenomenon of degradation. This degradation shows a depletion of the floristic procession, especially concerning sylvatic species which have given way to ephemeral therophytes and chamæphytes. Despite the presence of a shrubby layer, it is no longer a question of a forest ecosystem but of a pre-forest ecosystem. To better understand the characteristics of this Malvaceae in terms of resistance and adaptation in matorrals, we often use the phytomass of all anthropozoic formations and more specifically the phytomass of the species that characterize this group. In our case, this is *Malva subovata*. The results of the morphometric study constitute a basic element for the evaluation of the adaptive potential of our Lavatère against the degradation factors.

Keywords: floristic procession; *Lavatera maritima*; *Malva subovata*; matorrals; morphometric; ruderal

Introduction

This article deals with the knowledge of plant biodiversity related to plant groups in Tlemcen region. It is based on the phytoecological and physiological aspects of these formations with an inventory of the vegetation carried out in the Djbel fellaoucen station and supported by random sampling. We also conducted a morphometric study of *Malva subovata*.

In order to reach our goal, it was first necessary to know the flora, by carrying out an inventory of the species and thus, an herbarium to identify our floristic procession in our study area.

Since these species are morphologically affected by different ecological constraints, we were able to conduct self-ecological studies on the latter.

Plant morphology is the part of botany which consists in describing the extreme forms and the internal structure of plants and their organism. It allowed us to evaluate parameters that do not exist in the scientific

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literature, especially for species considered endemic. However, the shapes and characters can change depending on the environment where the plant species is found. The study of these variations requires the use of this morphology, which provides information on the polymorphism of species, their states of degradation and adaptations to different conditions (Barka, 2016).

Coastal Malvaceae species were also found to be more developed at Matorral Station, this species has been protected as conditions favor the development of these strains due to the difficult access because it is located in the summit of Djbel fellaoucen. To emphasize these parameters, a statistical analysis called "correlation" is required.

This study takes part of the knowledge, location and inventory of the flora of the matorrals of the Tlemcen region; it also aims to explore the biogeographical, biological significance of taxa and also a morphometric study of *Malva subovata*.

Materials and Methods

Presentation of the study area

The study station is located in the Djbel fellaoucen Plains, part of the Central Traras Mountain Range north of Tlemcen Wilaya (Table 1, Figure 1). The boundaries of Djebel Fellaoucene are:

✓West by Nedroma.

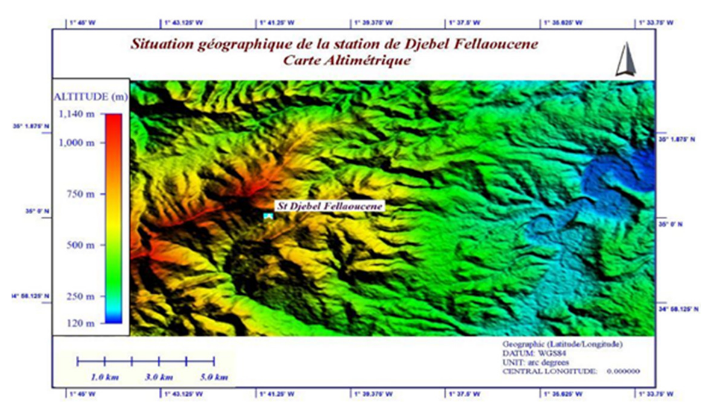
✓ East of Zenata and Ouled Riah.

✓ North of Beni Oursous.

✓ South of Aîn Fettah.

Table 1. Geographical location of Djbel fellaoucen

Station	Longitude	Latitude
Djbel fellaoucene	1°41’00.00” W	35° 00’00.00” N



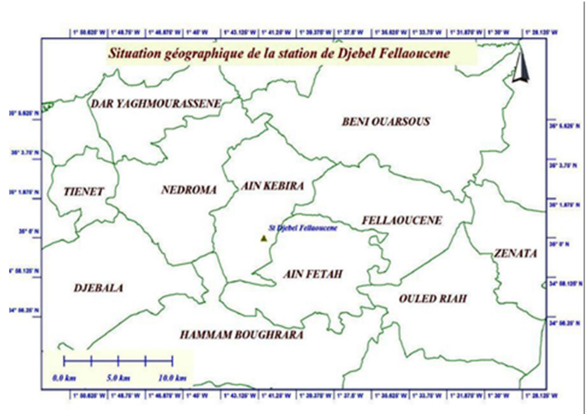


Figure 1. Map of the geographical location of the Djbel fellaouecen

Presentation of Malva subovata = Lavatera maritima

Lavatera maritima is a species that characterizes the coastline, it is well developed, the appearance of young plants from March, their growth and flowering begin in May. The seeds ripen in August (Figure 2).

This plant grows in the cracks of the most arid rocks, on the shores of the Mediterranean, in the kingdom of Valence, in Roussillon, in La Clape near Narbonne, in Mirevalprés Montpellier, in Toulon on the rocks behind the city, between Nice and Alassio (M. de Candolle, 1815).

Figure 2. Flower and fruit of *Malva subovata* (Ghalem, 2020)

Sampling method

The analysis of the plant structure considers the method of floristic surveys which boils down to an exhaustive list of all the plant species present. This floristic list changes from one station to another, from one year to another in the same station (Chamouri, 2017).

Amplification remains an important process, as most biometric decisions are based on rigorous sampling. The generality and validity of conclusions depends on the value of this sampling. It is the only method allowing the study of large-scale phenomena, such as vegetation, soil and possibly their relationships. (Barka, 2016).

In order to have a broad knowledge of the diversity of plant formations, we carried out several floristic surveys. They were carried out during spring, a season considered optimal. Each of these statements includes ecological characters of station order: The place and the date, The altitude (M), The exposure, The slope, The covering. The statements or the floristic data boil down to an exhaustive list of all the species presented in the area of the study.

The flora used to identify the collected taxa are:

- The New Flora of Algeria and the Southern Desert Regions. Quezel et Santa (1962-1963)
- Mediterranean flora (Paccalet, 1981)
- The flora of the Sahara. Ozenda (1963-1977)
- The herbarium of the botanical laboratory managed by Professor Mr.MERZOUK

Methodology for the morphometric studies

For our measurements we used a decameter when the clump is large. Knowing that the human and environmental impact influences the morphology of the species. In our situation, only the double meter was used.

Measurements were randomized and reported in multiple (32) localized chunks. The variables measured are:

Height (length) (cm);

Diameter (cm);

leaf width and length (cm);

For the morphometric parameters studied (length, width, diameter), the data collected were combined in order to calculate *Malva subovata* means for each variable.

We tried to apply the measurement technique to our species in the matorral station since the latter is a species that characterizes the coast to know its adaptation and this is done by several samplings per month and several samples, from March 2019 until in August 2019 and this to obtain raw results statistically processed by ANOVA (MINITAB 16) in order to highlight the impact of several environmental factors on its growth in width and length.

This treatment method is widely used in the field of biological research and experimental studies. It allows us to compare our species in the different study stations. Thus, we have determined the effect of stationary ecological factors and the factors anthropogenic influences on the development of these species. (Benmchta, 2022).

In this study, our objective is to highlight the relationships that exist between the parameters measured between them on the one hand and the biotope on the other hand (Kebbas, 2016).

Results

For all species, morphological types, biological types and types of phytogeographic distributions were considered in the overall analysis (Table 2; Figure 3).

Table 2. Floristic inventory of the study area

Taxa	Family	Morphological types	Biological types
Arisarum vulgare	Araceae	H.v	Ge
Allium subvillosum	Liliaceae	H.v	Ge
Ampelodesma mauritanicum	Poaceae	L.v	CH
Avena sterilis	Poaceae	H.a	Th
Anacamptis coriophora	Orchidaceae	H.v	Ge
Antirrhinum majus	Plantaginaceae	H.v	He
Anagallis arvensis	Primulaceae	H.a	Th
Asphodelus microcarpus	Liliaceae	H.v	Ge
Asparagus stipularis	Liliaceae	H.v	Ge
Ballota hirsuta	Lamiaceae	H.v	He
Brachypodium sylvaticum	Poaceae	H.a	Th
Bromus scoparius	Poaceae	H.a	Th
Bituminaria bituminosa	Fabaceae	H.v	He
Chamaerops humilis	Palmaceae	L.v	Ch
Catananche caerulea	Astéraceae	H.a	Th
Centaurea pullata	Astéraceae	H.a	Th
Convolvulus althaeoides	Convolvulaceae	H.a	Th
Convolvulus tricolor	Convolvulaceae	H.a	Th
Coronilla scorpioides	Fabaceae	H.a	Th
Chrysanthemum coronarium	Astéraceae	H.a	Th
Chrysanthemum segetum	Astéraceae	H.a	Th
Clematis cirrhosa	Renonculaceae	L.v	Ch
Clematis flammula	Renonculaceae	L.v	Ch
Cistus villosus	Cistaceae	L.v	Ch
Dactylis glomerata	Poaceae	H.v	He
Daucus carotta L	Apiaceae	H.v	Th
Daucus carota subsp. maximus	Liliaceae	H.v	He
Erodium ciconium	Géraniaceae	H.a	Th
Eruca vesicaria	Brassicaceae	H.a	Th
Echium vulgare	Boraginaceae	H.a	He
Euphorbia nicræensis	Euphorbiaceae	H.v	He
Ferula communis	Apiaceae	H.v	Ch

Ferula Lutea	Apiaceae	H.v	He
Fedia cornucopiae	Valérianaceae	H.a	Th
Fumaria capreolata	Papavéraceae	H.a	Th
Gladiolus italicus Mill = Gladiolus segetum	Iridaceae	H.v	Ge
Galactites duriaei	Astéraceae	H.a	Th
Umbilicus rupestris	Crassulaceae	H.v	He
Hordeum murinum	Poaceae	H.a	Th
Hordeum vulgare	Poaceae	H.a	Th
Iris xiphium	Iridaceae	H.v	Ge
Pallenis spinosa	Astéraceae	H.v	He
Pistacia lentiscus	Anacardiaceae	L.v	Ph
Pistacia terebinthus	Anacardiaceae	L.v	Ph
Poa annua	Poaceae	H.a	Th
Quercus ilex	Fagaceae	L.v	Ph
Sedum sediforme	Crassulaceae	H.v	He
Sedum album L. subsp. *gypsicolum*	Crassulaceae	H.v	He
Stachys ocymastrum	Lamiaceae	H.a	Th
Scolymus hispanicus	Astéraceae	Hv	He
Sonchus asper	Asteraceae	H.a	Th
Sinapis alba	Brassicaceae	H.a	Th
Sinapis arvensis	Brassicaceae	H.a	Th
Silene gallica	Caryophyllaceae	H.a	Th
Silene vulgaris	Caryophyllaceae	H.a	Th
Thapsia garganica	Apiaceae	H.v	He
Thymus ciliatus	Lamiaceae	L.v	Ch
Trifolium campestre	Fabaceae	H.a	Th
Urginea maritima	Liliaceae	H.v	Ge
Lavatera maritima	Malvaceae	L.v	Ch
Lavendula dentata	Lamiaceae	L.v	Ch
Leucanthemum paludosum	Astéraceae	H.a	Th
Lobularia maritima	Brassicaceae	H.a	Th
Valeriana tuberosa	Valérianaceae	H.v	He
Vicia faba	Fabaceae	H.a	Th
Viburnum tinus subsp. *tinus*	Capripholiaceae	L.v	Ph
Withania frutescens	Solanaceae	L.v	Ch
Rhamnus alaternus L. subsp. alaternus	Rhamnaceae	L.v	Ch
Ranunculus spicatu	Renonculaceae	H.v	He
Rosa canina	Rosaceae	L.v	Ch

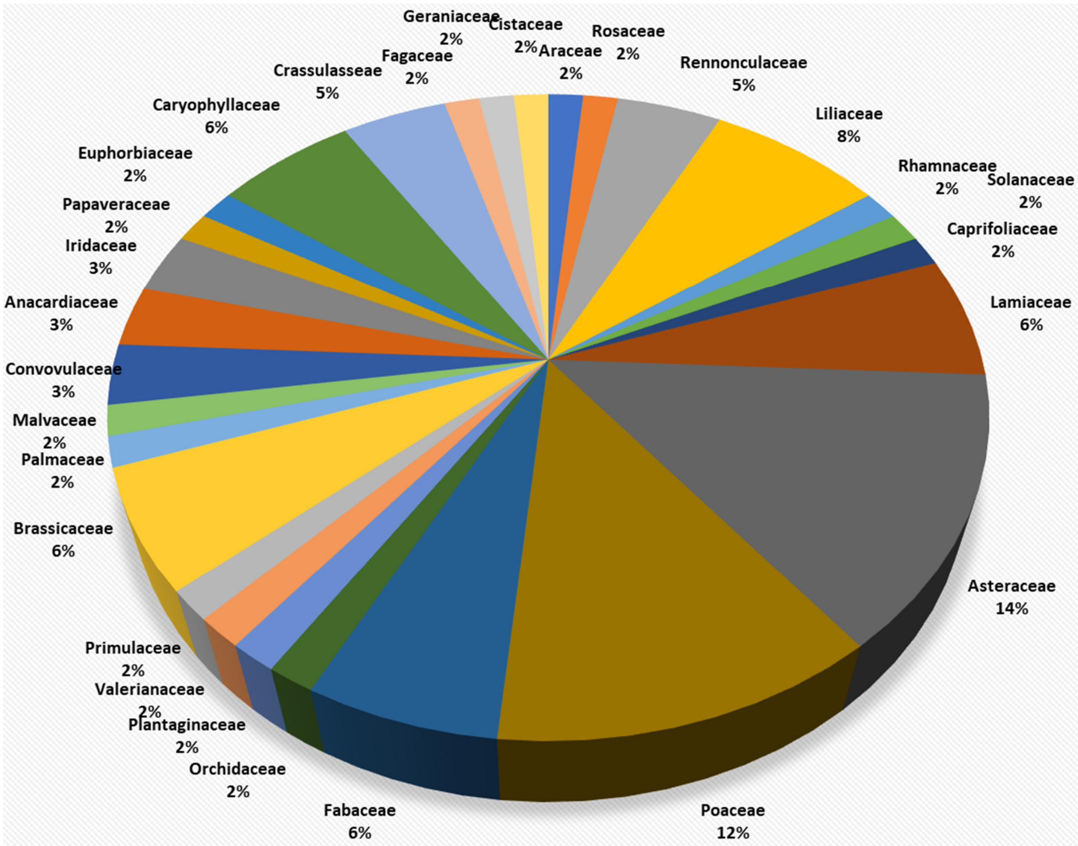


Figure 3. Distribution by families in the Djbel Fellaouecen resort

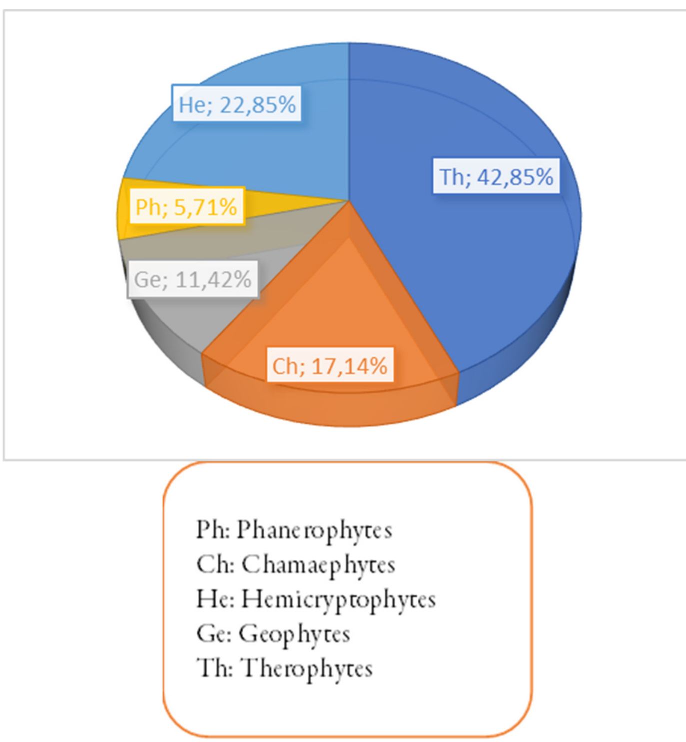


Figure 4. Biological types of the floristic procession of the station of Djebel Fellaoucen

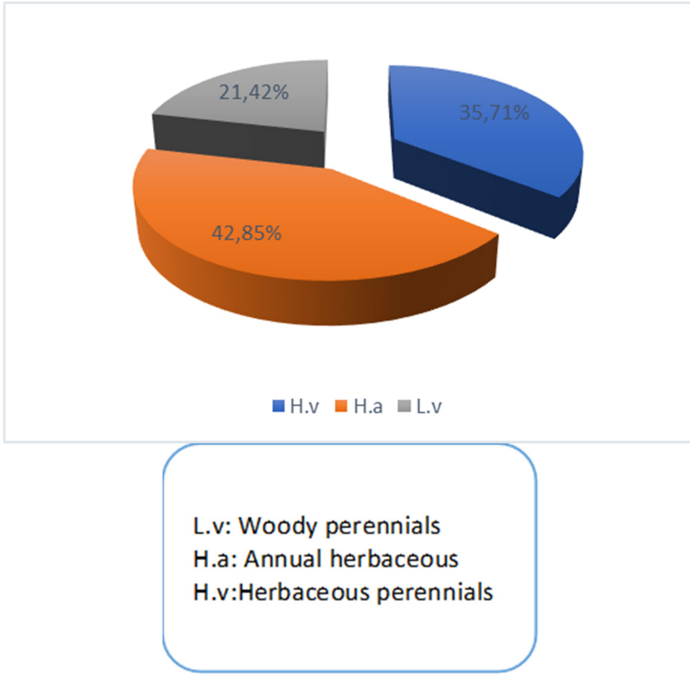


Figure 5. Percentage of morphological types of Djbel fellaoucen

The morphometric method allows us to compare our species in our study station. Thus, to determine the effect of stationary ecological factors and anthropogenic factors that influence the development of species.

Results obtained at the level of the study area were collected and presented in these tables and figures. They show a comparison of mean values for various measurement parameters.

1st date

The ANOVA has a single control factor grouping the length and the orientation shows a

presence of impact of the ecological factor Orientation with an F = 2.41 for a P = 0.088 and which is highly significant (Table 3; Figure 6).

Table 3. One-way ANOVA: Long stem versus orientation (Djbel fellaoucen station 1st date)

Source	DF	SS	MS	F	P
Orientation	3	3148	1049	2.41	0.088

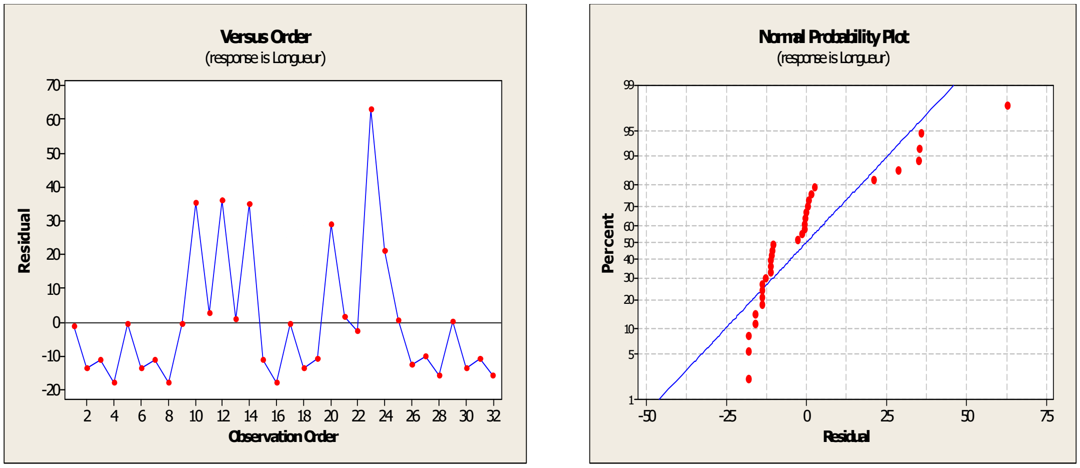


Figure 6. Effect of orientation on the growth of clumps in length in the Djbel fellaoucen station for the 1st date

Table 4. The Average according to orientation

Level	N	Mean	StDev
1	8	7.39	0.92
2	8	34.77	22.12
3	8	19.19	25.86
4	8	25.07	24.08

A significant growth is indicated at the level of the southern exposure followed by the western exposure then the eastern exposure and finally a weak exposure at the level of the northern exposure (Figure 7, Table 4).

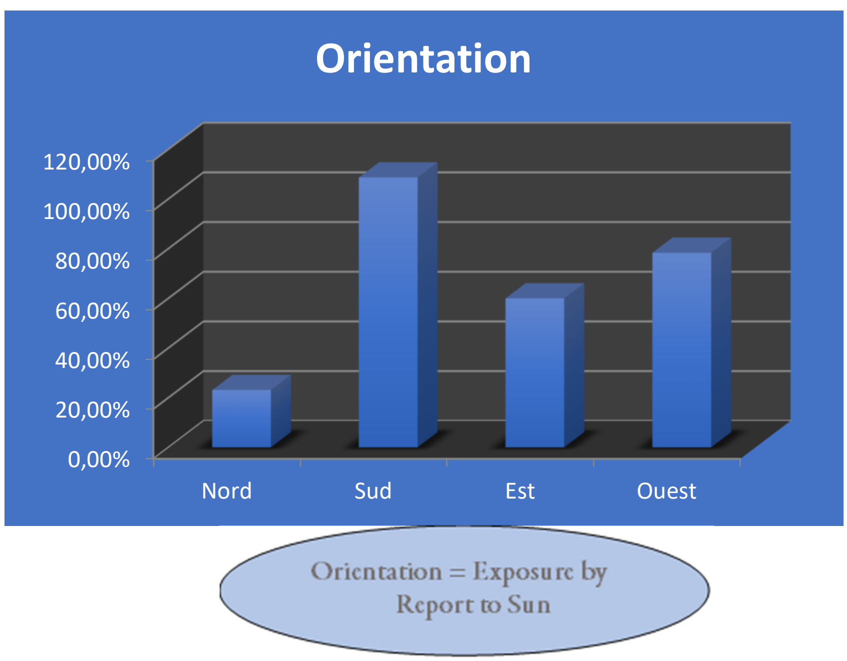


Figure 7. The average according to the orientation (the 1st date) for the station of Djbel fellaoucen

2nd date

The ANOVA with a single control factor combining the length and the orientation shows the presence of the impact of the ecological factor Orientation with F= 1.63 for P=0.204 and which is significant (Table 5; Figure 8).

Table 5. One-way ANOVA: Long Stem versus Orientation

Source	DF	SS	MS	F	P
Orientation	3	1265	422	1.63	0.204

A significant growth is indicated at the level of the southern exposure followed by the western exposure and finally a weak exposure at the level of the northern and eastern exposure. (Figure 9, Table 6).

Table 6. The average according to orientation

Level	N	Mean	StDev
1	8	12.80	14.38
2	8	27.45	17.32
3	8	12.69	6.21
4	8	22.08	22.08

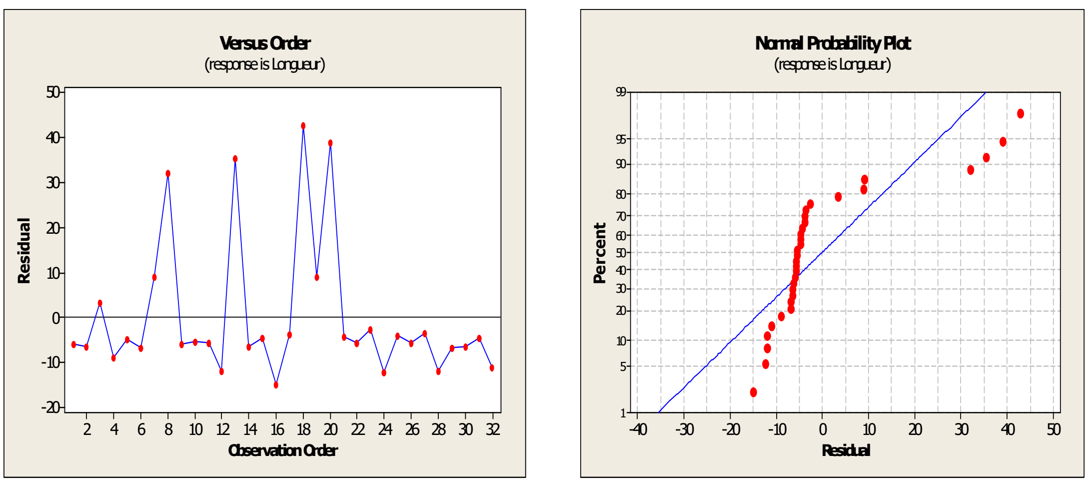


Figure 8. Effect of orientation on the growth of clumps in length in the Djbel fellaoucen station for the 2nd date

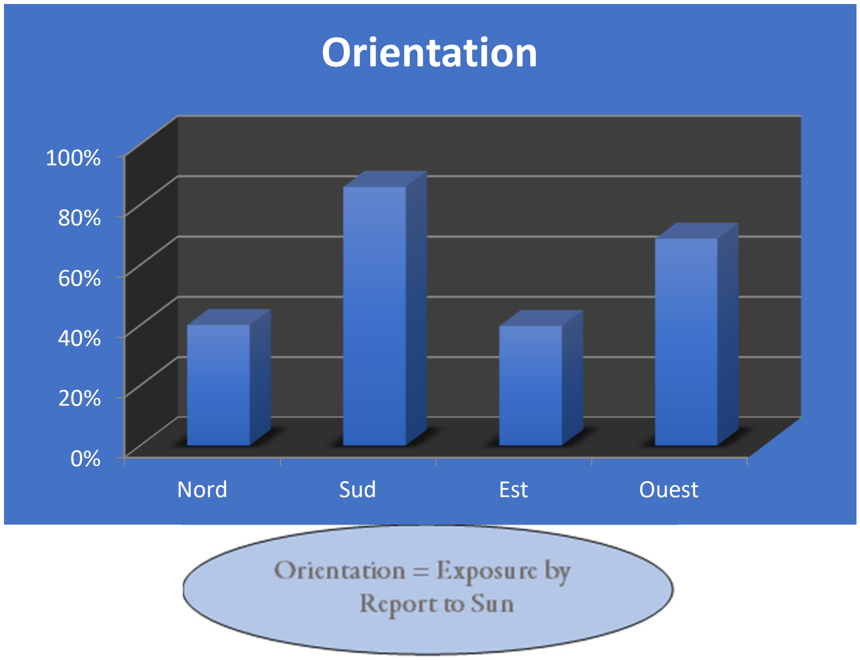


Figure 9. The average depending on the orientation (the 2nd date) for the station of Djbel fellaoucen

3rd date

The ANOVA with a single control factor grouping the length and the orientation shows the presence of the impact of the ecological factor orientation with F= 4.21 for P=0.014 and which is highly significant (Table 7, Figure 10).

Table 7. One-way ANOVA: Long Rod versus Orientation

Source	DF	SS	MS	F	P
Orientation	3	1452	484	4.21	0.014

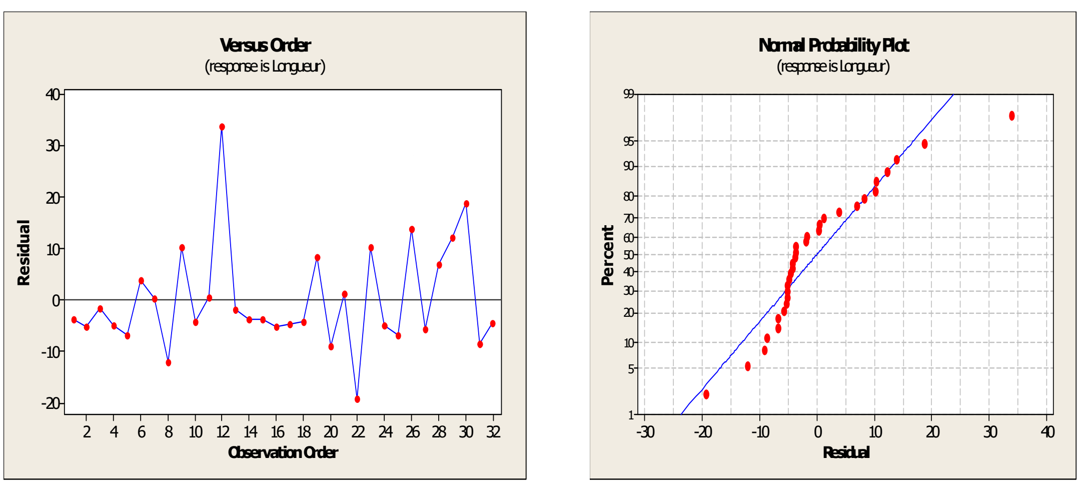


Figure 10. Effect of orientation on the growth of clumps in length in the Djbel fellaoucen station for the 3rd date

A significant growth is indicated at the level of the South exposure followed by the West exposure and finally a rather weak exposure at the level of the North and East exposure. (Figure 11, Table 9).

Table 9. The Average according to orientation

Level	N	Mean	StDev
1	8	9.74	7.44
2	8	26.16	11.98
3	8	9.64	6.55
4	8	16.05	14.77

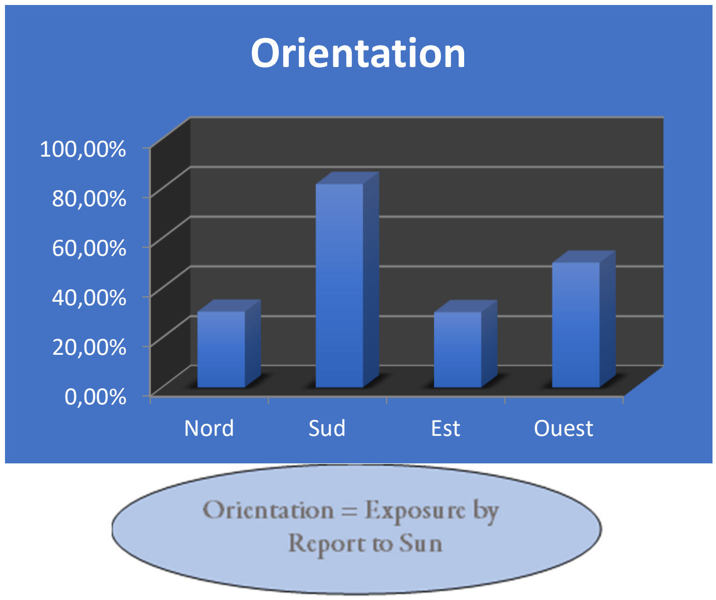


Figure 11. The average depending on the orientation (the 3rd date) for the station of Djbel fellaoucen

4th date

The ANOVA has a single control factor grouping the length and the orientation shows the presence of the impact of the ecological factor Orientation with F = 234.98 for P = 0.000 and which is worthy significant (Table 10. Figure 12).

Table 10. One-way ANOVA: Long Stem versus Orientation

Source	DF	SS	MS	F	P
Orientation	3	908.91	302.97	234.98	0.00

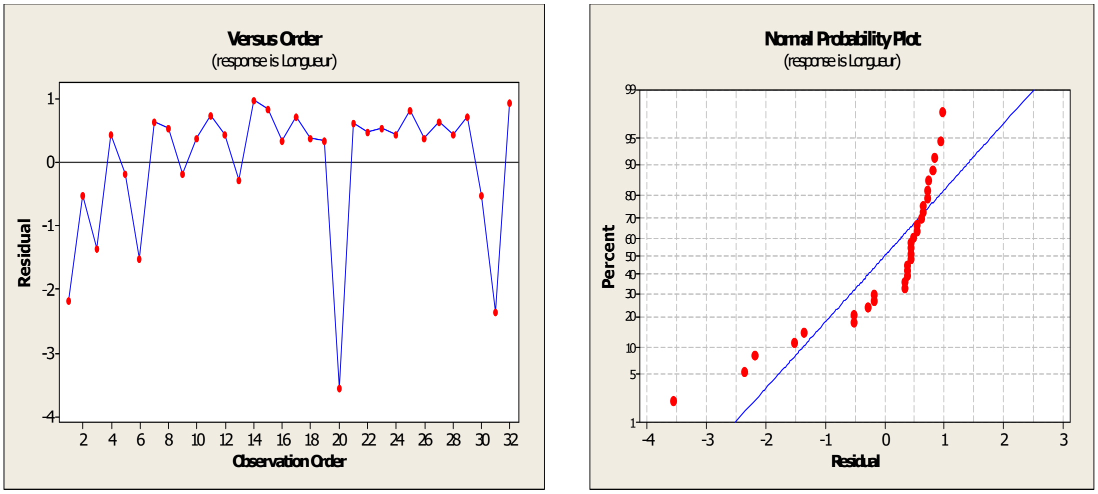


Figure 12. Effect of orientation on the growth of clumps in length in the Djbel fellaoucen station for the 4th date

A significant growth is indicated at the level of the southern exposure followed by the western exposure then the eastern exposure and finally a rather weak exposure at the level of the northern exposure. (Figure 13, Table 11).

Table 11. The average according to orientation

Level	N	Mean	StDev
1	8	8.188	0.999
2	8	21.525	0.800
3	8	9.363	1.189
4	8	10.563	1.451

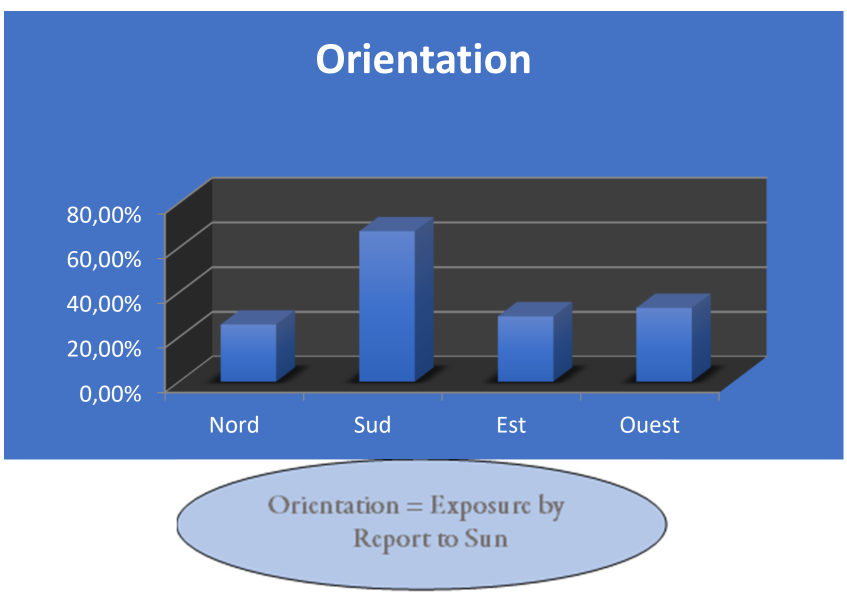


Figure 13. The average according to the orientation (the 4th date) for the station of Djbel fellaoucen

5th date

The ANOVA with a single control factor considering length and orientation shows the presence of the impact of the ecological factor Orientation with F= 1.40 for P=0.261 and which is significant (Table 12, Figure 14).

Table 12. ANOVA with one factor controlled: Long rod versus Orientation

Source	DF	SS	MS	F	P
Orientation	3	430	143	1.40	0.261

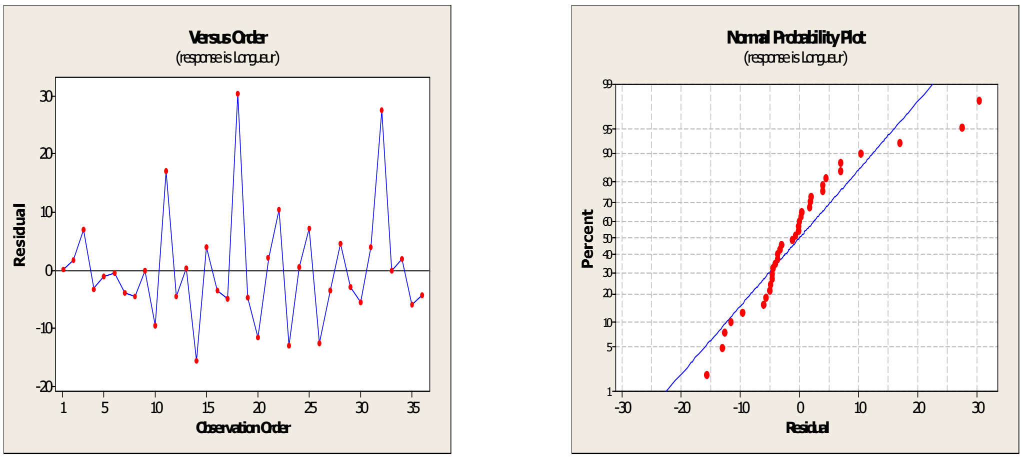


Figure 14. Effect of orientation on the growth of clumps in length in the Djbel fellaoucen station

A significant growth is observed at the level of the southern exposure followed by the eastern exposure then the western exposure and finally a weak exposure at the level of the northern exposure. (Figure 15, Table 13).

Table 13. The average according to orientation

Level	N	Mean	StDev
1	8	9.99	3.33
2	8	19.64	13.99
3	8	16.07	8.85
4	8	15.58	11.14

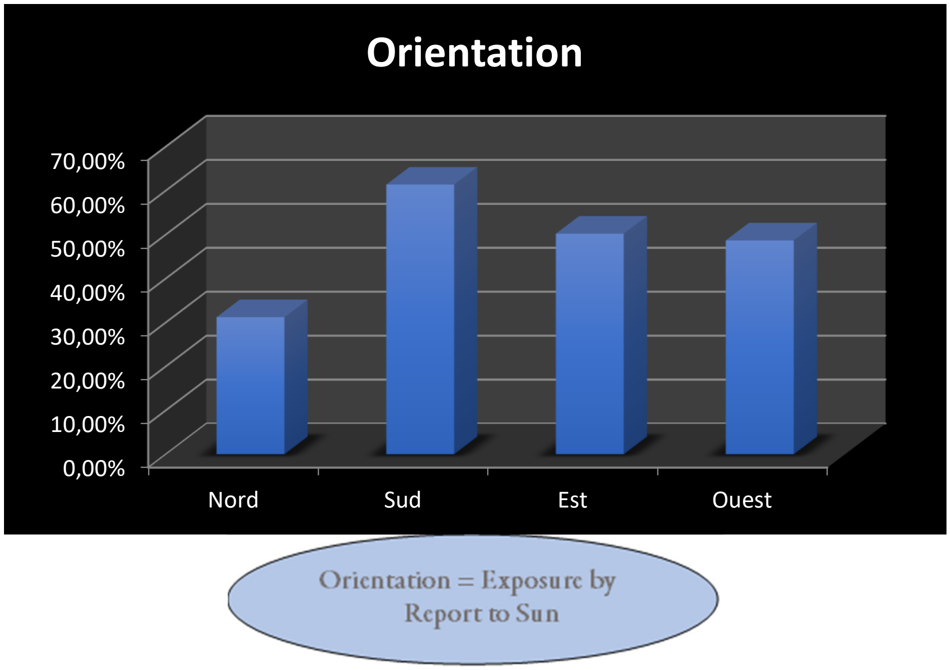


Figure 15. The average according to the orientation (the 5th date) for the station of Djbel fellaoucen

Discussion

According to (Bouayad, 2018), The floristic diversity and the distribution of species are expressed by adaptive strategies in the face of environmental constraints linked to the ecological conditions of the biotopes they colonize.

Therefore, site conditions play a fundamental role in the distribution of different species and the establishment of plant groups. Regarding this, any modification of the environment is followed by an immediate reaction of the vegetation whose sensitivity and fragility are very marked (disappearance of certain groups giving way to others more adapted).

According to Figures 3,4 and 5, the floristic procession in the studied station of Djbel Fellaouecen includes 70 species with the dominance of Asteraceae of 12.85% and Poaceae with the percentage of 11.42%, Liliaceae of 7.14%, Lamiaceae, Fabaceae, Apiaceae and Brassicaceae with a percentage of 5.71%, Ranunculaceae with 4.28%%, the other families have the same number with a very low rate. We also note that therophytes are the best represented with rate of 42 .85%, Hemicryptophytes with 22.85%, Chamaephytes 17.14%, Geophytes with a percentage of 11.42% and finally Phanerophytes with a very low percentage of 5.71%.

Floret and Pontanier (1982) point out that the more an ecosystem is influenced by man (overgrazing, cultivation), the more important therophytes become. This preponderance of therophytes is jointly linked to seasonal precipitation and by the action of man and the fires that characterize the Mediterranean zone.

Daget (1980) and Barbero *et al.* (1990), agree to present theophytia as being a form of resistance to drought as well as to the high temperatures of arid environments. The meaning of therophytia has been widely debated by these authors who attribute it:

*Either adaptation to the stress of winter cold or summer drought, or

*Disturbances of the environment by grazing, crops, etc.

Dahmani (1996) points out that geophytes are certainly less diversified in a degraded environment but they can, in certain cases of representation with a monospecific tendency (overgrazing, repeated fires), impose themselves by their covering.

Accordingly, this is also asserted by the harsh climatic conditions currently experienced by the study region and the structural instability of the soil favouring the development of species with a short life cycle, more or less demanding to water and trophic needs (Meziane, 2010).

According to (Benmcheta, 2022) who also worked on the same area, indicated that the latter is dominated by therophytes followed by Hemicryptophytes, Chamaephytes then Geophytes and Phanerophytes.

The phytoecological studies of a plant species pass above all by a morphometric study, this term morphometry or also biometry, was used by Bouazza (1990) for the study of the groups with *Stipa tenacissima*.

The results of Benmchata (2022) confirmed our hypothesis on the presence of Lavatera maritima in the Djebel fellaoucen station. The use of ANOVA showed the effect of stations with maritime influence (Djebel Fellaoucene and Rachgoun) on the good development of *Osyris lanceolata.*

From the morphological point of view, we have a dominance of annual herbaceous with a percentage of 42.85%, followed by perennial herbaceous with 35.71% and finally perennial woody with a percentage of 21.42% (Figure 5).

According to Babali (2014) Plant shape is one of the basic criteria for classifying species into morphological types. The phytomass is composed of perennial, woody, herbaceous and annual species. The state of physiognomy of a plant formation can be defined by the dominance and absence of species of different morphological types.

In conclusion, morphometric studies show that our species: *Lavatera maritima* grows in all directions on a regular basis. Field observations show that the stands of our species are well established. According to the results obtained of the correlation analysis; it appears that the morpho-metric parameters are correlated with each other and the growth in length and in width presents a very strong correlation.

In summary, *Lavatera maritima*, which is a species characteristic of limestone substrates and grows on rocky slopes, cliffs and generally develops in climates with a maritime influence, has also found its optimum in the high mountains, precisely in the matorrals of the station studied.

Conclusions

After several field trips and several samples, the results of the study reveal that our species is not only present on the coast but also in the matorrals and with very important populations and this is due to the maritime influence (humidity released) of the station studied because the air of the latter is loaded with water.

In addition, the annual herbaceous plants largely dominate the study area and we observed a regression of the plant cover, we can deduce that there is a therophytization of the environment.

The morphometric study of L. maritima allows us to highlight the relationships that exist between the different parameters. The calculation of the averages of the growth in length of the Lavatera in the station of study lead to variations which are important.

-The effect of orientation strongly influences the height of plants.
-The effect of the width strongly influences the height of the plants.
-The tuft factor is very essential as it shows the vigor of each tuft

Authors' Contributions

All authors read and approved the final manuscript.

Ethical approval (for researches involving animals or humans)

Not applicable.

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Conflict of Interests

The authors declare that there are no conflicts of interest related to this article.

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