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Biological, morphological and phytobiogeographic diversity of *Malva subovata* (DC.) Molero & J.M. Monts. (Malvales Malvaceae) in the Tlemcen region, Algeria

Sarra Ghalem*, Faiçal Hassani, Sid Ahmed Aouadj & Ibtissam Sarah Bouayed

Laboratory of Ecology and Management of Natural Ecosystems, Department of Ecology and Environment, Faculty of Nature and Life Sciences and Earth and Universe Sciences, Abou Bakr Belkaid University, Tlemcen, Algeria
*Corresponding author, email: sarah.ghalem@outlook.com

ABSTRACT The vegetation of the region of western Algeria presents a good example of the study of phyto-diversity. The method of floristic analysis is a main element in the knowledge of natural environments and its rich flora. In my two stations, we carried out floristic surveys, these are a set of observations on the environment and on the vegetation. The study presented is only a part of the objectives of the Laboratory of Plant Ecology focused on the floristic diversity of *Malva subovata* (DC.) Molero & J.M.Monts. (Malvales Malvaceae) on the mastery of the biological, morphological and phytobiogeographic capital of the two stations "Boussdra and Hammam Boughrara" in the Tlemcen region. From the treatment of biodiversity indices and the floristic surveys, we were able to conclude that the study area is undergoing a regressive dynamic of vegetation.

KEY WORDS Biology; *Malva subovata*; morphology; phytobiogeographic studies; Tlemcen.

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INTRODUCTION

Phytogeographic and chorological studies are a very important basis for any conservation and restoration attempt (Quezel, 1999; Aouadj et al., 2020a). They allow us to know the history of a given region and is a true model for interpreting the phenomena of regression (Aouadj et al., 2020b, c).

Aouadj et al. (2020d, e) report that: the floristic sectors and subsectors subdivision is a reflection of the narrow climate-vegetation dependence, based on the phytogeographic division of Barry et al. (1974). Vegetation plays a fundamental role in the structure and functioning of ecosystems, of which it constitutes an expression of the biological potential (Bouayed et al., 2019).

From an ecological point of view, the Mediterranean basin is considered a hotspot because of its very important biological diversity, including endemic plant species. The estimated plant richness is of 25000 species. Mediterranean-type forests account for about twice as many woody species as European-type forests (247 versus 135) (Barbero et al., 1990; Quézel & Medail, 1995; Medail & Quézel, 1999). This plant diversity varies from country to country depending on geographical location. The plant richness of the North Africa is estimated between 5000 to 5300 species, represents 15% of that of the Mediterranean basin (Quézel, 1999). This

wealth is represented by 3800 species, 900 of which are endemic to Morocco. According to Quézel & Santa (1962–1963 in Véla & Benhouhou, 2007), the Algerian flora comprises 3139 species (3744 taxa) including 464 endemic species.

In the assessment established by Medail & Quézel (1999) and Aouadj et al. (2020f), the Mediterranean forest is made up of approximately 247 woody species compared to European forests (13 species).

Mediterranean plant biodiversity is produced, for many, from a traditional and harmonious use of the environment by humans (Medail & Quézel, 1999). Despite the incessant attacks they have suffered for a millennium, the Mediterranean forests still offer, in places, appreciable development. There are many methods of studying vegetation. The choice of a technique generally depends on the nature of the vegetation and the object of the study (Kerzabi, 2017). Numerous research programs, through international publications, have underlined the major role of various regions of Tlemcen as an essential reservoir of plant biodiversity (Bouazza et al., 1996).

Mankind, in its nature, has always used its entourage, in particular its natural environment, to meet its needs. It is characterized by its size, density, growth, cultivation, construction, feeding, gathering and predation. All these functions have a negative effect on natural resources. Thus, it is the vital activities of populations that directly influence the components of the environment and generally modify it (Bensenane, 2015; Aouadj et al., 2020g).

In order to better understand the characteristics of plant formations, the study carried out is essentially based on the analysis of exhaustive inventories of the species encountered in the *Malva subovata* (DC.) Molero & J.M. Monts (=*Lavatera maritima* Gouan) (Malvales Malvaceae) (Fig. 1) formations in the 2 study stations, which are characterized by a count of the species, with an identification of their morphological and biological types, and their floristic characters. We will also get to know the study region, which has a very diverse flora and is closely linked to various disturbance factors through biodiversity indices (Ghalem et al., 2020).

Figure 1. *Malva subovata* (from Ghalem et al., 2020).

Figures 2, 3. Study areas.

MATERIAL AND METHODS

The analysis of the plant structure takes into ac-

count the method of floristic surveys, which requires us to list all the plant species present. This floristic list changes from one station to another, from one year to the next in the same station (Raunkiaer, 1934; Bouayad, 2017; Kerzabi, 2017).

Our surveys were carried out during the optimal vegetation period from March to May during the year 2019.

The coordinates of the stations were obtained using a GPS (Bousdra: 001°37 W - 34°42 N; Hammam Boughrara: 001°40 W - 34°52 N; Tlemcen, Algeria). Each of these readings includes the general characteristics linked to the station itself (Figs. 2, 3). These are: place and date; the altitude; slope; exposure t; plant cover.

Currently, the survey method is based on the Braun-Blanquet method (1952) known as Zuricho-Montpellier which consists in determining the smallest surface called "Minimum area" (Braun-Blanquet, 1952; Gounot, 1969).

RESULTS

The floristic composition (Bousdra station)

The floristic inventory of the study area allowed us to invent 36 taxa divided into 16 families and 20 genera (Table 1).

The floristic composition (Hammam Boughrara station)

The floristic inventory of the study area allowed us to invent 68 taxa divided into 26 families and 36 genera (Table 2).

DISCUSSION

Bousdra station

Our study area has about 36 species, they belong

Taxa	Family	Biological type	Morphol. type
Asteriscus maritimus	Asteraceae	Ch	L.v
Asperula hirsuta	Rubiaceae	Th	H.a
Avena sterilis	Poaceae	Th	H.a
Anarrhinum fruticosum subsp. *fruticosum*	Plantaginaeae	Ch	L.v
Ballota hirsuta	Lamiaceae	He	H.v
Campanula dichotoma	Campanulaceae	Th	H.a
Calycotome intermedia	Fabaceae	Ch	L.v
Centaurea involucrata	Asteraceae	He	H.v
Centaurea pullata	Asteraceae	He	H.v
Ceratonia siliqua	Fabaceae	Ph	L.v
Convolvulus althaoides	Convolvulaceae	Th	H.a
Convolvulus cantabrica	Convolvulaceae	He	H.v
Cistus villosus	Cistaceae	Ch	L.v
Echium vulgare	Boraginaceae	He	H.v
Eruca vesicaria	Brassicaceae	Th	H.a
Fagonia cretica	Zygophyllaceae	Th	H.a
Fumanathymifolia	Cistaceae	Ch	L.v
Galactites duriae	Asteraceae	Th	H.a
Genista tricuspidata	Fabaceae	Ch	L.v
Inula crithmoides	Asteraceae	Ch	L.v
Malva subovata	Malvaceae	Ch	L.v
Lavandula dentata	Lamiaceae	Ch	L.v
Lavandula stoechas	Lamiaceae	Ch	L.v
Lobularia maritima	Brassicaceae	Th	H.a
Nepeta multibracteata	Lamiaceae	He	H.v
Olea europea	Oleaceae	Ph	L.v
Quercus coccifera	Fagaceae	Ph	L.v
Sedum sediforme	Crassulaceae	Ch	H.v
Sedum acre	Crassulaceae	Ch	H.v
Stipa parviflora	Poaceae	Ch	H.v
Stachys ocymastrum	Lamiaceae	Th	H.a
Tetraclinis articulata	Cupressaceae	Ph	L.v
Pallenis spinosa	Asteraceae	He	H.v
Phylleria angustifolia	Oleaceae	Ph	L.v
Plantago albicans	Plantaginaceae	He	H.v
Pistacia lentiscus	Anacardiaceae	Ph	L.v

Table 1. Floristic composition of Bousdra station.

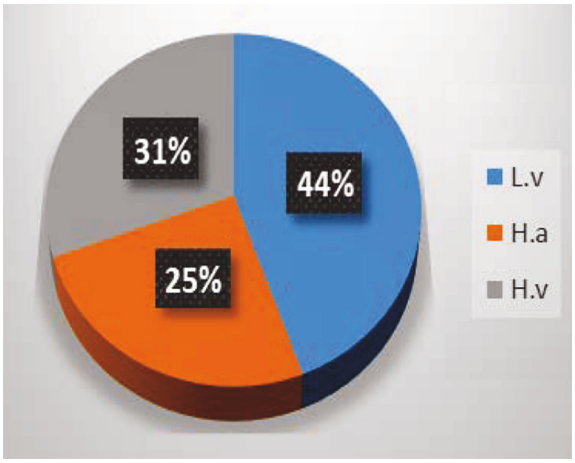

Figure 4. Percentage of morphological types of Bousdra station.

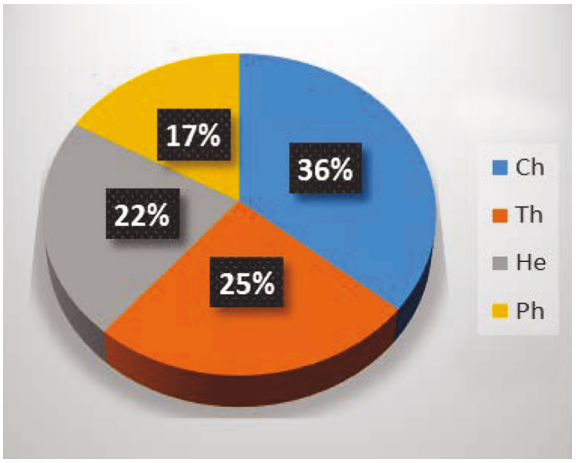

Figure 5. Biological types of the floral procession of Bousdra station.

to the subphylum Gymnosperms and Angiosperms with 18 families. The families most represented on a specific level are the Asteraceae with a percentage of 16.66%, the Lamiaceae with the percentage of 13.88%, the Fabaceae remain very little dominant with a percentage of 8.33% then the Cistaceae, Crassulaceae, Oleaceae, Brassicaceae, Poaceae and Plantaginaceae with the same percentage of 5.55, the other families have the same number with a very low rate (Figs. 4, 5).

On the morphological level, we notice that the perennial woody plants present the highest number in the station Bousdra station with a percentage of 44%, then the perennial grasses with 31% and finally the annual grasses with the percentage of 25%.

In this station we notice that the Chamaephytes are the best represented with a percentage of 36%, the Therophytes with 25%, the Hemicryptophytes 22%, the Phanerophytes with a low percentage of 17%. We also notice that there is a absence of Geophytes.

-The specific richness of the Bousdra resort: 18
-Total number of species: 36

D=S-1/lnN
D=18 – 1 / Ln 36 D=4.74

Simpson indices (Is):
Is=1/ $\sum$ Pi^2
Pi=ni/N = 0.982 —> Pi^2= 0.0782
Is=12.78

Equitability of the simpson index: Es=Is-1/S-1= 0.693

Shannon-Weaver indicator: H ’= - $\sum$pi log2 pi
H’= -0.982 log 0.982 H’= 0.0257

The equity index measures the distribution of individuals within species, regardless of species richness.

E=H’/log S=0.020 —> Abundance of individuals of each species are equal

Hammam Boughrara station

Our study area has about 68 species, they belong to the sub-phylum Gymnosperms and Angiosperms with 26 families. The families most represented on a specific level are the Asteraceae with a percentage of 20.58%, and the Poaceae with the percentage of 14.7%, then the Apiaceae 8.82%, the Fabaceae, Brassicaceae, Liliaceae, Cistaceae and Plantaginaceae with the same percentage of 4.47%, the other families have the same number with a very low rate (Figs. 6, 7).

Morphologically, we notice that annual herbs have the highest number in Hammam Boughrara station with a percentage of 47%, then perennial herbs with 44% and finally perennial woody with a percentage of 9%. In this station we notice that the Therophytes are the best represented with the same percentage of 49%, the Hemicryptophytes

Taxa	Family	Biological type	Morphol. type
Aegilops triuncialis	Poaceae	Th	H.a
Ajuga iva	Lamiaceae	Th	H.a
Allium porrum subsp. *polyanthum*	Alliaceae	He	H.v
Allium roseum	Alliaceae	He	H.v
Ammoides verticillata	Apiaceae	Th	H.a
Anacyclus vallentinus	Asteraceae	Th	H.a
Anagalis arvensis subsp. *latifolia*	Primulaeae	TH	H.a
Anagalis arvensis subsp. *phonicea*	Primulaceae	Th	H.a
Anthyllis tetraphylla	Fabaceae	Th	H.a
Arisarum vulgare	Araceae	Ge	H.v
Asphodelus microcarpus	Liliaceae	Ge	H.v
Asteriscus maritimus	Asteraceae	Ch	L.v
Asparagus acutifolius	Liliaceae	Ge	H.v
Atractylis carduus	Asteraeae	He	H.v
Atractylis concellata	Asteraceae	He	H.v
Avena sterilis	Poaceae	Th	H.a
Asparagus stipularis	Liliaceae	Ge	H.v
Ballota hirsuta	Lamiaceae	He	H.v
Bellis annua	Asteraceae	Th	H.a
Brachypodium distachyon	Poaceae	Th	H.a
Briza minor	Poaceae	Th	H.a
Bromus madritensis	Poaceae	Th	H.a
Bromus rubens	Poaceae	Th	H.a
Cakile maritima	Brassicaceae	Th	H.a
Calendula arvensis	Asteraceae	Th	H.a
Calendula suffruticosa	Asteraceae	Th	H.a
Carduus pycnocephalus	Asteraceae	Th	H.a
Carthamus coerulus	Asteraceae	Th	H.a
Convolvulus althaeoides	Convolvulaceae	Th	H.v
Convolvulus tricolor	Convolvulaceae	Th	H.a
Cynodon dactylon	Poaceae	Ge	H.v
Cytisus villosus	Fabaceae	Ch	L.v
DactyIis glomerata	Poaceae	Ge	H.v
Daucus carota subsp. *maximus*	Apiaceae	He	H.v
Echinophora spinosa	Apiaceae	Ch	H.v
Echinops spinosus	Asteraceae	He	H.v
Echium vulgare	Boraginaceae	He	H.v
Fagonia cretica	Zygophyllaceae	He	H.v
Ferula communis	Apiaceae	He	H.v
Ferula lutea	Apiaceae	He	H.v
Fumana thymifolia	Cistaceae	Ch	L.v
Galactites duriae	Asteraceae	Th	H.A
Helianthemum apertum	Cistaceae	Th	H.a
Helianthemum hirtum	Cistaceae	Th	H.a
Hordeum murinum	Poaceae	Th	H.a
Lagurus ovatus	Poaceae	Th	H.a
Lavandula multifida	Lamiaceae	Ch	H.v
Malva subovata	Malvaceae	Ch	L.v
Limonium sinuatum subsp. *eusinuatum*	Plumbaginaceae	He	H.v
Lobularia maritima	Brassicaceae	Th	H.a
Olea europaea	Oleaceae	Ph	L.v
Phagnalon saxatile	Asteraceae	Ch	H.v
Pallenis spinosa	Asteraceae	He	H.v
Papaver rhoeas	Paveraceae	Th	H.a
Paronychia argentea	Caryophyllaceae	He	H.v
Plantago albicans	Plantaginaceae	He	H.v
Plantago lagopus	Plantaginaceae	He	H.v
Plantago psyllium	Plantaginaceae	Th	H.a
Pistacia lentiscus	Anacardiaceae	Ph	L.v
Thapsia garganica	Apiaceae	He	H.v
Reseda alba	Resedaceae	Th	H.a
Rumex bucephalophorus	Polygonaceae	Th	H.a
Ruta chalepensis	Rutaceae	Ch	H.v
Sedum sediforme	Crassulaceae	He	H.v
Sonchus asper	Asteraceae	Th	H.a
Sinapis alba	Brassicaceae	Th	H.a
Ononis pubescens	Fabaceae	Th	H.a
Opuntia maxima = *O. ficus-indica*	Cactaceae	Ch	H.v

Table 2. Floristic composition of Hammam Boughrara station.

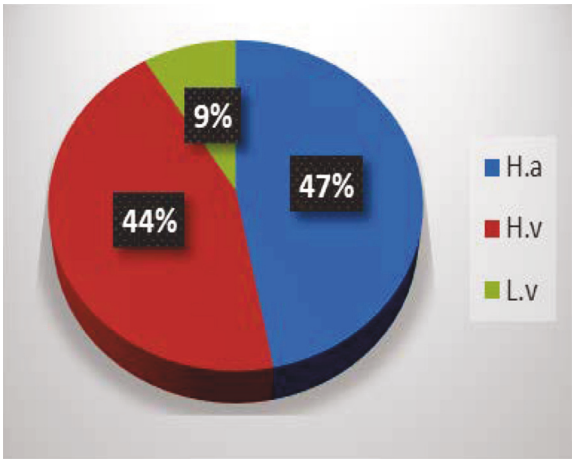

Figure 6. Percentage of morphological types of the Hammam Boughrara station.

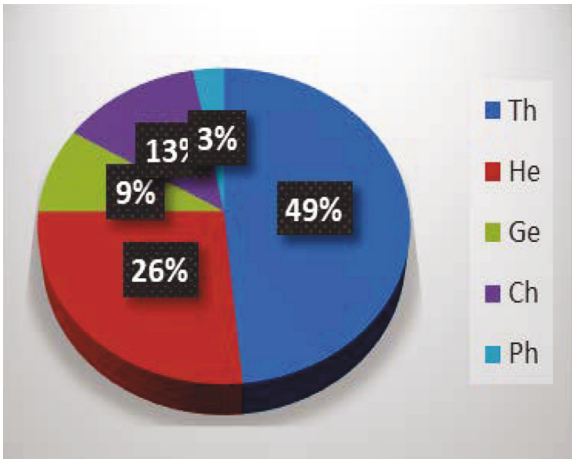

Figure 7. Biological types of the floral procession of the Hammam Boughrara station.

with 26%, the Chamaephytes with a percentage of 13%, the Geophytes 9% and finally we notice that there is a very low percentage of Phanerophytes of 3%.

Total number of species: 68

D=S-1/lnN —> D=26 – 1 / Ln 68 —> D=5.92

Simpson indices (Is):

Is=1/ ∑ Pi^2 —> Pi=ni/N = 0.987 —> Pi^2= 0.0872 —> Is=11.46

Equitability of the Simpson index:

Es=Is-1/S-1= 0.418

Shannon-Weaver indicator: H '= - ∑pi log2 pi

H'= -0.987 log 0.987 —> H'= 0.0186

So only one species is present.

The equity index measures the distribution of individuals within species, regardless of species richness.

E=H'/log S=0.013 —> Abundance of individuals of each species are equal

CONCLUSIONS

The exhaustive inventory carried out at the two study stations (Bousdra, Hammam Boughrara) enabled us to study the following characterizations: biological and morphological, followed by the distribution of families.

This study allowed us to bring out the following results:

dominance of perennial woody plants in the Boussdra resort and the dominance of annual herbaceous plants in the Hammam Boughrara resort from a morphological point of view;

importance of therophytes which confirms the phenomenon of therophytization in the Hammam boughrara station;

type vegetation: TH> He> Ch> Ge> PH for the Hamma boughrara station;

special attention is generally paid to the distribution of Therophytes, the proportion of which in the Mediterranean region is around 50%;

the rate of theophytes is linked, whatever the scale of the analysis and the level of perception adopted, to the openness of the vegetation and the overall humidity of the environment;

type vegetation: Ch> Th> He> Ph for the Bousdra station;

grazing favors the overall establishment of the Chamaephytes often refused by the herd;

we consider the Chamaephytes to be better adapted to low temperatures and aridity;

the most dominant families in the field for the two stations are: Asteraceae, Poaceae and Lamiaceae;

the biological types constitute indices of the life strategy of species.

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