Biodiv. Res. Conserv. 73: 13-22, 2024

BRC
www.brc.amu.edu.pl

DOI 10.14746/biorc.2024.73.2

Submitted 28.10.2023, Accepted 12.03.2024

Floristic diversity of vascular plants in the Mimouna Forest (north-western Algeria)

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Abstract. In arid and semi-arid areas, wild vegetation is a very important natural resource and provides various ecosystem services, such as environmental adjustment functions. It is therefore important to manage and protect plant diversity in these areas. We investigated the Mimouna Forest in the Algerian Saida Province, characterized by a Mediterranean-type climate with maximum average monthly temperature of 27.1°C, minimum of 8.3°C and annual rainfall of 345 mm. We described and analysed the species diversity of vascular plants in this area. The floristic inventory was carried out using a subjective sampling method. This allowed us to identify 93 species belonging to 80 genera and 33 botanical families. The major families were the Asteraceae (16%) and Poaceae (14%). The analysis of plant life-forms showed the dominance of therophytes (36%) and hemicryptophytes (28%). On the phytogeographic level, the prevailing chorological elements were of Mediterranean affinity (54% in total). Endemic taxa accounted for 9% of the flora. The Shannon index was moderately high (3.62) and 13% of the recorded species were rare, including 5 protected by Algerian law.

Key words: floristic analysis, plant diversity, vascular plants, Algeria, floristic inventory, Mimouna Forest

1. Introduction

The Mediterranean basin is one of the richest regions in the world in terms of plant diversity and endemism. This diversity is linked to the climatic diversity and the complexity of relief. With its high mountains, deserts, forests, and several thousand islands (Myers 1999), this region of the globe is now very seriously threatened. This is due to the strong decline of natural environments under human impact, but also because this region is one of the most exposed to global climate change (Sala *et al*. 2000; Hoekstra *et al*. 2005).

Like many countries in the Mediterranean basin, Algeria has one of the most diversified and original floras. It consists of 3139 vascular plant species of 150 botanical families, and approximately 12% of the species are endemic to Algeria (Véla & Benhouhou 2007; Radford *et al*. 2011). The high plant richness is caused by a great spatial heterogeneity of geomorphological and bioclimatic factors as well as of natural habitats (Quézel 1985).

In this context, we decided to study the vascular flora of the Mimouna Forest, administratively part of the Saida Province. This region illustrates the typical physical and bioclimatic characteristics of the Saida Mountains. These include altitudes above 900 m and the semi-arid Mediterranean climate with cool winters. This study focused on a floristic inventory of the wild vegetation of the Mimouna Forest, subsequently characterizing the vegetation in respect of systematics, Raunkiaer's plant life-forms and phytogeography, with particular reference to rare, threatened or endemic species.

2. Materials and methods

2.1. Study area

Covering an area of 233 ha, the Mimouna Forest is located 45 km north-east from the city of Saida (north-western Algeria). Located between 35°2'0''N and 35°8'0''N, and between 00°26'0''E and 00°32'0''E

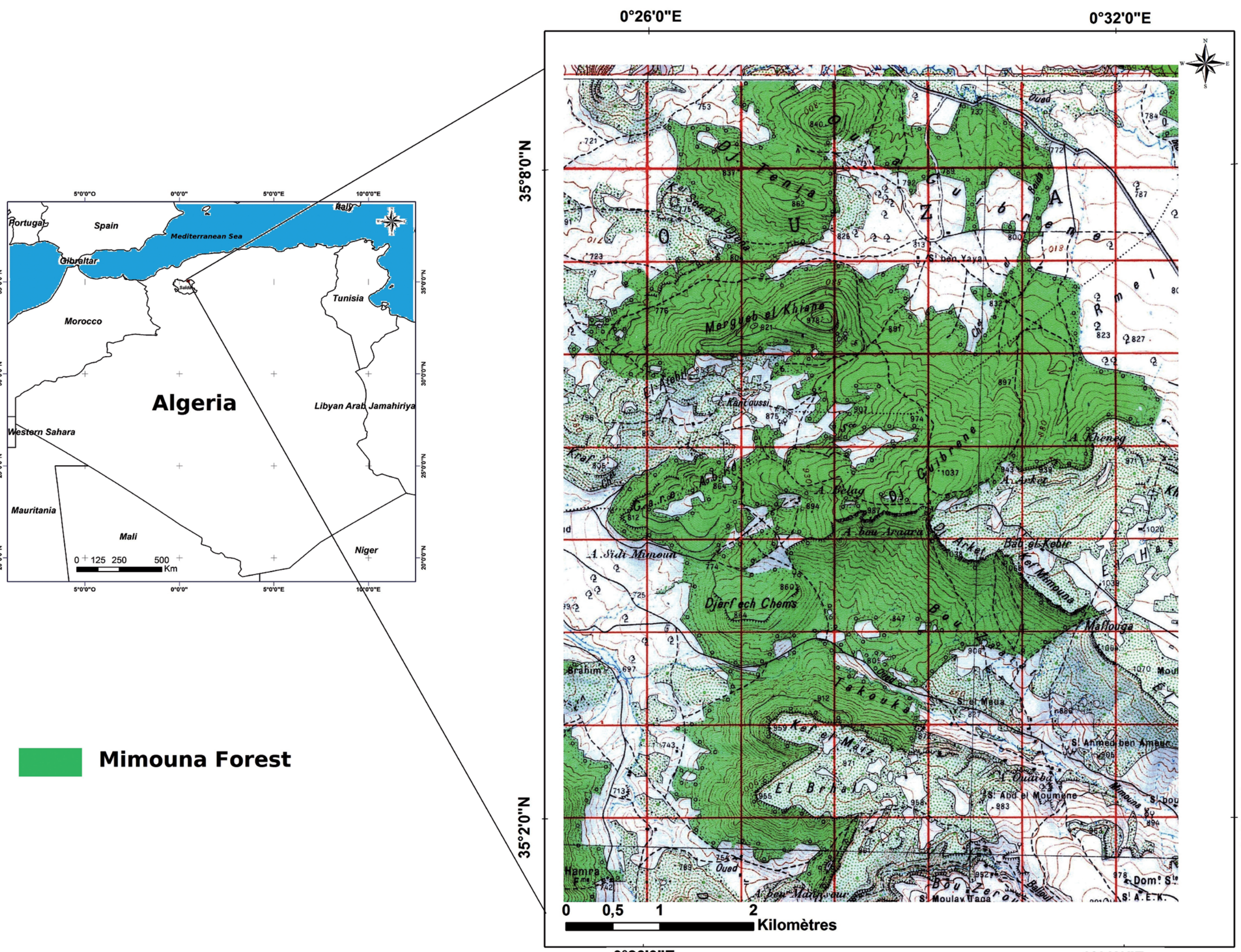

Fig. 1. Location map of the study area: the Mimouna Forest in Algeria

(Fig. 1). It belongs to the district of Ouled Brahim. This forest in the southern foothills of the Tell Atlas is part of the Saida Mountains, at altitudes of 870-980 m (Kefifa & Benabdeli 2013).

This region is characterized by a Mediterranean climate with a dry summer and a cold and wet autumn and winter. According to climate data for 1996-2016, the maximum monthly temperature is 27.1°C and the minimum is 8.3°C (O.N.M. 2016). With annual rainfall of 345 mm, the dominant season of rainfall is winter.

On the floristic level, the study area is located in the Maghreb-Mediterranean domain, in its Oran sector and O3 sub-sector: the Tell Atlas (Quézel & Santa 1962, 1963).

2.2. Methods

For the floristic study, we adopted subjective sampling, as it is suitable for the constraints encountered in the field, such as the rugged relief of the study area. The choice of survey sites in the field was made according to the ecological homogeneity in terms of exposure, light, and topography, as well as the floristic and physiognomic homogeneity of vegetation (Delassus 2015).

Using the phytosociological method (Braun-Blanquet 1951), we carried out 28 surveys with a minimum area of 200 m^2 each, which is considered sufficiently representative in Mediterranean formations (Daget & Godron 1982; Aimé *et al*. 1986; Fennane 2003). The inventory was conducted in the spring of 2020 – a period during which most of perennial species are flowering and the greatest number of annual plants appear.

For each survey, the presence of the species was recorded as 1, while its absence as 0. For species not identified in the field, samples were taken and determined in the laboratory. The nomenclature used is mainly based on the flora of Quézel and Santa (1962, 1963) and the index of North African plant name synonyms of Dobignard and Chatelain (2010-2013). The species surveyed were also classified according to their biogeographic type (Quézel & Santa 1962, 1963; Blanca *et al*. 2011; Julve 2021) and their plant life-forms, as defined by Raunkiaer (1934).

To assess the floristic diversity of the flora, we used the Shannon index (*H'*) and the Pielou evenness (*E*). Additionally, the species surveyed were classified according to the rarity criteria established by Quézel & Santa (1962, 1963).

3. Results

3.1. Systematic composition and species diversity

The inventory carried out in the study area allowed us to record 93 species of vascular plants (Appendix 1). They belong to 80 genera and 33 botanical families, so these species account for 23% of the Tell Atlas flora, estimated at about 400 species (Quézel & Santa 1962, 1963). Among the recorded taxa, dicotyledonous angiosperms are the largest systematic group, with 69 species belonging to 20 families and 57 genera, followed by monocotyledons, represented by 21 species of 7 families and 20 genera. We recorded only 2 families, 3 genera, and 3 species of gymnosperms in the study area.

As many as 15 species belong to the Asteraceae family, accounting for 16% of all taxa, while the Poaceae rank second with 13 species, i.e 14%. The other families are much less represented (Table 1).

Table. 1. Systematic composition of the flora of the Mimouna Forest in Algeria

Familly	Number of species	% of flora
Asteraceae	15	16.1
Poaceae	13	14.0
Brassicaceae	7	7.5
Lamiaceae	7	7.5
Fabaceae	6	6.5
Apiaceae	5	5.4
Plantaginaceae	4	4.3
Cistaceae	3	3.2
Boraginaceae	3	3.2
Cupressaceae	2	2.2
Anacardiaceae	2	2.2
Asparagaceae	2	2.2
Caryophyllaceae	2	2.2
Fagaceae	2	2.2
Rhamnaceae	2	2.2
Pinaceae	1	1.1
Apocynaceae	1	1.1
Arecaceae	1	1.1
Caprifoliaceae	1	1.1
Convolvulaceae	1	1.1
Euphorbiaceae	1	1.1
Iridaceae	1	1.1
Juncaceae	1	1.1
Liliaceae	1	1.1
Malvaceae	1	1.1
Myrsinaceae	1	1.1
Orchidaceae	1	1.1
Papaveraceae	1	1.1
Ranunculaceae	1	1.1
Resedaceae	1	1.1
Rutaceae	1	1.1
Salicaceae	1	1.1
Xanthorrhoeaceae	1	1.1
	93	100.0

3.2. Raunkiaer's plant life-forms

Raunkiaer's (1934) classification is a valuable tool for describing the physiognomy and structure of vegetation. Plant life-forms are considered to express the adaptation strategies of the vegetation to environmental conditions (Dahmani-Megrouche 1997; Messaoudene *et al*. 2007). This most commonly used classification is of a morphological nature, which takes into account the position of the plant's resting buds in relation to the ground during the unfavourable season. First of all, it takes into account the physiology and the forms of plant resistance, hence their effective major role in the response of communities to different disturbances (McIntyre *et al*. 1995).

The analysis of the distribution of plant life-forms shows the dominance of therophytes (34 species; 36.6%) over other forms. Hemicryptophytes (26 species; 28.0%) are also well represented, followed by geophytes (10 species; 10.8%), chamaephytes (9 species; 9.7%), megaphanerophytes (8 species; 8.6%), and nanophanerophytes (6 species; 6.5%).

3.3. Biogeographic analysis

Among the considered criteria for assessing plant diversity, the phytogeographic classification is an essential basis for any attempt to conserve biodiversity (Quèzel 1995). It also constitutes a real model for interpreting regression phenomena (Olivier *et al*. 1995). Our results indicate that the flora of the study area is a heterogeneous set of elements of very diverse origins (Table 2).

The composition of the general spectrum shows a predominance of elements of Mediterranean affinity (in total 64% of the flora). This group includes primarily the autochthonous Mediterranean element (22 species), followed by Ibero-Mauritanian (12), western Mediterranean (9), Mediterranean-Macaronisian (9), Circummediterranean (5), Ibero-Mauritanian-Malte (1), Circummediterranean-Macaronisian (1) and Canarian-Mediterranean (1). The groups of widely distributed elements ranks second (14 % of the flora) and includes chiefly the Subcosmopolitan element (4 species), Eurasian-North African (2). The Cosmopolitan, Eurasian, Palaeo-subtropical-Mediterranean, Circummediterranean-Irano-Turanian, Mediterranean-Saharan, Mediterranean-Irano-Turanian and Southmediterranean-Saharo-Arabic elements are represented by only single

Table 2. Phytogeographic types elements in the flora of the Mimouna Forest in Algeria

Chorological elements	Number of species	% of flora
Mediterranean	22	23.7
Ibero-Mauritanian	12	12.9
Western Mediterranean	9	9.7
Mediterranean-Macaronisian	9	9.7
Circummediterranean	5	5.4
Circummediterranean-Macaronisian	1	1.1
Ibero-Mauritanian-Malte	1	1.1
Canarian-Mediterranean	1	1.1
Subcosmopolitan	4	4.3
Eurasian-North African	2	2.2
Circummediterranean-Irano-Turanian	1	1.1
Cosmopolitan	1	1.1
Eurasian	1	1.1
Mediterranean-Irano-Turanian	1	1.1
Mediterranean-Saharan	1	1.1
Palaeo-subtropical-Mediterranean	1	1.1
Southmediterranean-Saharo-Arabic	1	1.1
Palaeo-temperate	5	5.4
Euro-Mediterranean	2	2.2
Eurosiberian-Mediterranean-Macaronisian	2	2.2
Circummediterranean-Atlantic	1	1.1
Euro-Circummediterranean	1	1.1
Holarctic	1	1.1
North African endemics	5	5.4
Algerian endemics	2	2.2
Algerian-Moroccan endemic	1	1.1
	93	100.0

species each. The group of northern elements occupy the third position (13% of the flora), formed chiefly by the Palaeo-temperate and (5 species), Euro-Mediterranean and Eurosiberian-Mediterranean-Macaronisian (2 species each), Circummediterranean-Atlantic (1), Euro-Circummediterranean (1) and Holarctic (1). The endemic group (9% in total) includes mostly North African endemics (5 species), but also Algerian (2) and Algerian-Moroccan (1).

3.4. Diversity indices and frequency classes

Species diversity in the study area was relatively high, as the Shannon index reached 3.62. Also the Pielou evenness value of 0.76 was high. The rarity of species is related to various factors of the environment (climate, topography, soil type) and anthropozoogenic action. The listed species were classified according to the rarity criteria established by Quézel & Santa (1962-1963) as follows: very common species (CC) accounted for 43.0% of the flora, common species (C) for 24.7%, fairly common species (AC) for 15.1%, particularly widespread species (CCC) for 5.4%, rare species (R) for 7.5%, fairly rare species (AR) for 2.2%, and very rare species (RR) for 2.2% (Table 3).

4. Discussion

The systematic classification of the species inventoried in the study area shows the dominance of 2 families: the Asteraceae (16%) and Poaceae (14%). According to Ozenda (1977), these families are well adapted to arid and semi-arid zones as well as to severe environmental degradation. They are among the richest in genera and species in the taxonomic composition of the Ibero-Maghreb flora and are well represented in Mediterranean regions (Le Houérou 1995). The globally dominant families are the same families that predominate in the Oranian sector flora (Saidi & Mehdadi 2015; Miara 2017; Saidi 2017).

Considering plant life-forms, therophytes in the study area are the most diverse, accounting for 36% of the flora. The richness of therophytes is characteristic of the arid and semi-arid Mediterranean zones, where a strong water stress dominates (Daget 1980; Madon & Medail 1996). Thus the species richness of

Table 3. Frequency classes of plant species found in the Mimouna Forest in Algeria

Frequency class		Number of species	% of flora
CCC	particularly widespread species	5	5.4
CC	very common species	40	43.0
C	common species	23	24.7
AC	fairly common species	14	15.1
AR	fairly rare species	2	2.2
R	rare species	7	7.5
RR	very rare species	2	2.2
	In total	93	100.0

therophytes represents a sign of environmental aridity (Négre 1966) and the phenomenon known as therophytia is considered by Daget (1980) as a strategy for avoiding unfavourable periods. A high proportion of therophytes appears also in other studies in arid and semi-arid Mediterranean areas (e.g. Floret *et al*. 1990; Aidoud-Lounis 1997; Saidi & Mehdadi 2015; Saidi *et al*. 2017). Hemicryptophytes occupy the second position after therophytes, and make up 28% of the flora. An abundance of hemicryptophytes is often explained by high soil moisture and organic matter contents in forest environments (Barbéro *et al*. 1989). According to Dahmani-Megerouche (1996), the proportion of hemicryptophytes increases in forest environments at higher altitudes. Geophytes rank third (11%), so they are well represented in this region. According to Kadi-Hanifi (2003), the number of geophyte species decreases as the aridity and openness of the environment increase. The contribution of chamaephytes is similar (10%). This life-form is usually less common in forests and matorrals because chamaephytes are generally adapted to arid environments (Raunkiaer 1934; Floret *et al*. 1990). Phanerophytes rank fifth (9%) and are mainly represented in the study area by *Juniperus oxycedrus*, *Pinus halepensis*, *Tetraclinis articulata*, *Pistacia atlantica*, *Pistacia lentiscus*, *Quercus canariensis*, and *Populus alba*. In most cases, phanerophytes dominate in respect of coverage and therefore play a decisive role in the establishment of a specific floristic sequence (Le Compte Barbet 1975). It is noteworthy that *Quercus canariensis* thrives mainly in humid bioclimatic conditions, so the existence of this species in a semi-arid environment is an indicator of a local humid forest environment in the foothills of this mountain range. With a low contribution (6%), nanophanerophytes occupy the last position.

The establishment of the flora is due to 3 combined processes: climate change, long-range transport by wind and birds, and changes in the geographic model. Quézel (1983) explained the importance of the biogeographic diversity of Mediterranean Africa due to the harsh climatic changes that have been experienced in this region since the Miocene, which has led to migrations of tropical species.

In our study, our results of the biogeographic classification seem to be consistent with those of several authors (Gharzouli & Djellouli 2005; Bourorga 2016; Mebarek *et al.* 2017). The flora in the Mimouna Forest is a heterogeneous set of elements of very diverse origins (Fig. 4), marked by the predominance of those of Mediterranean affinity (in total 60 taxa, 64%). This reflects the overall connection of the studied flora to the Mediterranean region, generally adapted to the climate that characterizes this region (Quézel 1983; Le Houerou 1995). Among the Mediterranean elements, the indigenous Mediterranean element is the most important (22 species, 24%). This supports the observations of several authors in the Mediterranean region (Quézel 1983, 1995; Dahmani-Megrouche 1997, El Bouhissi *et al.* 2014; Larbi *et al.* 2021).

The widely distributed species come at the second position (13 taxa, 14%). Their high contribution is generally related to the phenomenon of therophytization of the Mediterranean flora, induced by the action of several natural and anthropogenic factors (Miara *et al*. 2016). According to Gharzouli & Djellouli (2005), these species correspond to transitional elements between the Mediterranean group and neighbouring chorological groups. The relatively high number of these taxa also reflects the openness of this flora to external influences and reflects environmental disturbance.

The northern taxa rank third (in total 12 taxa, 13%), which can be partly explained by the remote geographic location of Northern Europe. The presence of species of northern origin is also explained according to Doyle & Le Thomas (1993) by the altitude factor, the influence of the temperate climate of Europe, and by historical and palaeobiological traits.

Endemic taxa represent 9% of the studied flora. This order of magnitude of the contribution of endemic flora is comparable to results of several works on the forests and matorrals of the biogeographic unit of the Western Tell Atlas (Le Houérou 1995; Kadi-Hanifi 2003; Latreche 2004; Yahi *et al*. 2008). The main concern of this flora lies in the vulnerability of these taxa to extinction because they are naturally concentrated in small habitats with limited surface area. In the Mediterranean region, these endemic taxa, even when in the form of therophytes, are very fragile and vulnerable to anthropogenic disturbance (Quézel & Médail 2003).

The analysis of the degree of rarity of the recorded species, according to the classification adopted by Quézel and Santa (1962), shows a relatively high contribution of 13% (12 taxa) to the total flora of the study area, including 2 very rare (RR), 8 rare (R), and 2 fairly rare species (AR). This value is comparable to those obtained in other regional studies on the Tell Atlas (e.g. Véla & Benhouhou 2007). A species can become rare for several reasons: (1) it is characteristic of another environment and is therefore there by accident; (2) it is naturally rare, its frequency is very low in all ecological conditions; (3) it has a very narrow ecological spectrum; (4) it is common in a very small range of settings and absent elsewhere (Gegout 1995). Rare plants, therefore, have a great value in terms of conservation, either for heritage reasons or for their risk of extinction (Pimm *et al*. 1988; Gaston *et al*. 1991).

Among the taxa identified in the study area, 5 benefit from the status of protected species included in the Algerian list of uncultivated plant species protected by Executive Decree 12-03 of 4 January 2012. These species are: *Juniperus oxycedrus*, *Pistacia atlantica*, *Scabiosa stellata*, *Tetraclinis articulata*, and *Otocarpus virgatus.*

The Shannon index and the Pielou evenness, calculated for the whole list of inventoried species, reflect the ecosystem's biological diversity level. The value of the Shannon index shows moderately high diversity (3.62), comparable to those reported by Saidi (2017) and Aouadj *et al*. (2020). In fact, forests and matorrals generally have higher values of this index than those of open formations. The value of the Pielou evenness (0.76) fits within the range of values considered optimal (Gillet 2000).

5. Conclusions

This study highlights the floristic diversity of this ecosystem. In particular, its rare and endemic fractions are very interesting, so this study has provided indispensable ecological information to guide the action programmes for the conservation of biodiversity and the environment as well as the development of this forest ecosystem. Concrete actions can reduce the devastating human impact and protect our biological heritage.

Author Contributions:
Research concept and design: A. Saidi
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Writing the article: A. Saidi, A. Kefifa
Critical revision of the article: A. Saidi
Final approval of article: A. Saidi

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Appendix 1. List of the identified species in the Mimouna Forest in Algeria

Family	Species	Life-forms	Frequency classes	Chorological elements
Anacardiaceae	*Pistacia atlantica* Desf.	PH	AC	Endemic to North Africa
	Pistacia lentiscus L.	PH	CC	Mediterranean-Macaronesian
Apiaceae	*Bunium mauritanicum* (Boiss. & Reut.) Batt.	GE	R	Endemic to North Africa
	Eryngium dichotomum var. *attenuatum* Maire	HEM	CC	West Mediterranean
	Ferula communis L. subsp. *communis*	HEM	CC	Mediterranean
	Ferula cossoniana Batt. & Trab.	HEM	RR	Endemic to North Africa
	Thapsia garganica L. subsp. *garganica*	HEM	CC	Ibero-Mauritanian
Arecaceae	*Chamaerops humilis* L.	NPH	CC	West Mediterranean
Asparagaceae	*Muscari comosum* (L.) Mill.	GE	C	Mediterranean
	Urginea maritima (L.) Baker	GE	CC	Mediterranean-Macaronesian
Asteraceae	*Anthemis arvensis* L. subsp. *arvensis*	TH	R	Euro-Mediterranean
	Atractylis aristata Batt.	TH	R	Endemic to Algieria
	Atractylis humilis subsp. *caespitosa* (Desf.) Maire	GE	CC	Ibero-Mauritanian
	Bellis sylvestris Cirillo	HEM	R	Mediterranean
	Carthamus pinnatus Desf.	HEM	R	Algerian-Moroccan
	Centaurea acaulis L.	HEM	CC	Mediterranean
	Centaurea pullata L. subsp. *pullata*	HEM	CCC	Ibero-Mauritanian
	Filago spathulata auct.	TH	CC	Mediterranean
	Hedypnois cretica (L.) Dum. Cours.	TH	C	Mediterranean
	Launaea nudicaulis (L.) Hook. f.	TH	CC	Ibero-Mauritanian
	Matricaria chamomilla L.	TH	CC	Euro-Circummediterranean
	Micropus bombycinus Lag.	TH	CCC	Mediterranean
	Onopordum arenarium (Desf.) Pomel	HEM	AC	Mediterranean-Saharan
	Pallenis cuspidata Pomel subsp. *cuspidata*	HEM	AC	Euro-Mediterranean
	Silybum marianum (L.) Gaertn.	HEM	CCC	Ibero-Mauritanian
Apocynaceae	*Nerium oleander* L.	NPH	CC	Mediterranean
Boraginaceae	*Anchusa italica* Retz.	HEM	R	Eurasian
	Echium humile Desf. subsp. *humile*	TH	AC	Ibero-Mauritanian
	Lithospermum apulum (L.) Vahl	TH	CC	Mediterranean-Macaronesian
Brassicaceae	*Biscutella auriculata* L.	TH	AC	West Mediterranean
	Eruca vesicaria (L.) Cav. subsp. *sativa* (Mill.) Thell.	TH	C	Circummediterranean
	Lobularia maritima (L.) Desv.	CH	CC	Circummediterranean-Macaronesian
	Matthiola lunata DC.	CH	AC	Ibero-Mauritanian
	Otocarpus virgatus Durieu.	TH	RR	Endemic to Algeria
	Psychine stylosa Desf.	CH	AC	Endemic to North Africa
	Sinapis arvensis L.	TH	AC	Holarctic
Caprifoliaceae	*Scabiosa stellata* L.	TH	CC	West Mediterranean
Caryophyllaceae	*Herniaria hirsuta* L. subsp. *hirsuta*	TH	AC	Eurasian-Northafrican
	Paronychia argentea Lam.	HEM	C	Mediterranean-Macaronesian
Cistaceae	*Cistus albidus* L.	CH	AC	West Mediterranean
	Helianthemum syriacum (Jacq.) Dum. Cours.	CH	AC	Circunmediterránea
	Helianthemum virgatum (Desf.) Pers.	HEM	CC	Ibero-Mauritanian
Convolvulaceae	*Convolvulus arvensis* L.	HEM	CC	Subcosmopolitan
Cupressaceae	*Juniperus oxycedrus* L. subsp. *oxycedrus*	PH	C	Circum-Mediterranean
	Tetraclinis articulata (Vahl) Mast.	PH	CC	Ibero-Mauritanian-Malte
Euphorbiaceae	*Euphorbia helioscopia* L.	TH	CC	Subcosmopolitan
Fabaceae	*Astragalus incanus* L. subsp. *incanus*	TH	C	Ibero-Mauritanian
	Astragalus lusitanicus Lam.	TH	C	Ibero-Mauritanian
	Astragalus scorpioides Willd.	TH	AR	West Mediterranean
	Genista tricuspidata Desf.	PH	CC	Endemic to North Africa
	Trifolium campestre Schreb.	TH	CC	Eurosiberian-Mediterranean-Macaronesian
	Trifolium stellatum L.	TH	CC	Mediterranean-Macaronesian
Fagaceae	*Quercus canariensis* Willd.	PH	R	Ibero-Mauritanian
	Quercus coccifera f. *angustifolia* Laguna	NPH	C	West Mediterranean
Juncaceae	*Juncus acutus* L.	GE	CC	Mediterranean

Iridaceae	*Iris sisyrinchium* L.	GE	CC	Mediterranean-Irano-Turanian
Lamiaceae	*Ajuga iva* (L.) Schreb.	HEM	CC	Mediterranean-Macaronesian
	Ballota hirsuta Benth.	HEM	AC	Ibero-Mauritanian
	Lavandula stoechas L.	CH	CC	Mediterranean-Macaronesian
	Rosmarinus officinalis L.	CH	C	Mediterranean
	Salvia argentea L.	HEM	C	Mediterranean
	Salvia verbenaca L.	HEM	C	Circummediterranean-Atlantic
	Teucrium polium auct.	CH	C	Mediterranean
Liliaceae	*Asparagus acutifolius* L.	NPH	CC	Mediterranean
Malvaceae	*Malva sylvestris* L. subsp. *sylvestris*	TH	CC	Palaeo-Temperate
Myrsinaceae	*Anagallis monelli* L.	HEM	C	West Mediterranean
Orchidaceae	*Ophrys lutea* Cav.	GE	C	Mediterranean
Papaveraceae	*Papaver rhoeas* L.	TH	C	Palaeo-Temperate
Pinaceae	*Pinus halepensis* Mill.	PH	CC	Mediterranean
Plantaginaceae	*Globularia alypum* L.	CH	CC	Mediterranean
	Plantago albicans L. subsp. *albicans*	TH	CC	Mediterranean
	Plantago lanceolata L	HEM	C	Palaeo-Temperate
	Plantago ovata Forssk.	TH	CC	Mediterranean-Macaronesian
Poaceae	*Aegilops triuncialis* L.	TH	CC	Circummediterranean-Irano-Turanian
	Ampelodesmos mauritanicus (Poir.) T. Durand & Schinz	GE	CC	West Mediterranean
	Avena sterilis L.	TH	CC	Subcosmopolitan
	Brachypodium distachyum (L.) P. Beauv.	TH	CC	Mediterranean-Macaronesian
	Bromus hordeaceus L.	TH	C	Eurosiberian- Mediterranean-Macaronesian
	Cynodon dactylon (L.) Pers.	GE	CC	Cosmopolitan
	Hordeum bulbosum L.	TH	AC	Paleo-Subtropical-Circunmediterranean
	Hordeum murinum L.	TH	C	Palaeo-Temperate
	Lygeum spartum L.	HEM	CCC	Mediterranean
	Lolium perenne L. subsp. *perenne*	HEM	C	Eurasian
	Phalaris minor Retz.	TH	C	Mediterranean
	Rostraria cristata (L.) Tzvelev	TH	C	Subcosmopolitan
	Stipa tenacissima L.	HEM	CCC	Mediterranean
Resedaceae	*Reseda alba* L.	HEM	AC	Circunmediterranean
Ranunculaceae	*Adonis dentata* Delile	TH	C	Mediterranean
Rhamnaceae	*Rhamnus alaternus* L.	NPH	AR	Mediterranean
	Ziziphus lotus (L.) Lam.	NPH	CC	Southernmediterranean-Saharo-Arabic
Rutaceae	*Ruta montana* (L.) L.	TH	C	Circunmediterranean
Salicaceae	*Populus alba* L.	PH	CC	Palaeo-Temperate
Xanthorrhoeaceae	*Asphodelus microcarpus* Viv.	GE	CC	Canarian-Mediterranean

Explanations: Life-forms – PH – megaphanerophytes, NPH – nanophanerophytes, CH – chamaephytes, HEM – hemicryptophytes, GE – geophytes, TH – therophytes; Frequency classes – CCC – particularly widespread species, CC – very common species, C – common species, AC – fairly common species, AR – fairly rare species, R – rare species, RR – very rare species