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Artículo

Floristic diversity of steppe vegetation in the region of Djelfa, North-West Algeria

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Abstract

This study is a floristic investigation of the steppe region of Djelfa located in northern Algeria, with the aim of characterizing and analysing the wild flora of this region. Four stations were chosen according to a stratified sampling method and phyto-ecological surveys were carried out in 32 plots of 100m^2 each. This allowed us to identify 127 taxa of plants belonging to 33 families dominated by *Asteraceae* (29%) and *Poaceae* (12%). The analysis of biological types has shown the dominance of annual Therophytes (56%) in this flora, which indicates the presence of the phenomenon of Therophytization in these regions. This phenomenon was also measured by calculating the perturbation index. The analysis of chorological types has shown the dominance of the Mediterranean element (48%), with an interesting number of endemic taxa. However, all the endemic taxa cited in the literature for this region have not been found, which reinforces our fears about the state of conservation of these taxa of biological and heritage value.

Key words: Chorology, Djelfa, Endemic Flora, Steppe, Stratified method

Résumé

Analyse floristique de la végétation steppique dans la région de Djelfa, Nord-Ouest algérien

Cette étude est une investigation floristique de la région steppique de Djelfa située au nord de l'Algérie, et cela dans le but de caractériser et d'analyser la flore sauvage de cette région. 4 stations ont été choisies selon une méthode d'échantillonnage stratifié et des relevés phytoécologiques ont été réalisés sur 32 parcelles de 100m^2. Cela nous a permis d'identifier 127 taxons de plantes appartenant à 33 familles dominées par les *Asteraceae* (29%) et les *Poaceae* (12%). L'analyse des types biologiques a montré la dominance des Thérophytes annuels (56%) dans cette flore, ce qui indique la présence du phénomène de Thérophytisation dans ces régions. Ce phénomène a également été mesuré en calculant l'indice de perturbation. L'analyse des types chorologiques a montré la dominance de l'élément méditerranéen (48%), avec un nombre intéressant de taxons endémiques. Cependant, tous les taxons endémiques cités dans la littérature pour cette région n'ont pas été retrouvés, ce qui renforce nos inquiétudes quant au statut de conservation de ces taxons de valeur biologique et patrimoniale.

Mots clés : Chorologie, Djelfa, Flore endémique, Steppe, Méthode stratifiée

Introduction

The Mediterranean region is characterized by an exceptional biological diversity as well as considerable biological richness estimated at 25,000 species of vascular plants, which corresponds to 9.2% of the total diversity of species in a territory representing only 1.5% of the terrestrial surface (Médail & Quézel, 1997; Myers, 1988, 1990; Mittermeier *et al*., 2004). Algeria, due to its geographical position, presents a great diversity of habitats occupied by an important floristic richness (Médail & Quézel, 1997; Véla & Benhouhou, 2007 in Miara *et al*., 2018a).

According to Quézel & Santa (1962-63 in Véla & Benhouhou, 2007), the Algerian flora comprises

3,139 species consisting of 3,744 taxa including 464 endemic and 1,818 more or less rare species. This inventory is now evaluated at 4,449 taxa including 3,951 native taxa and 498 introduced to Algeria (Dobignard & Chatelain, 2010-13). The flora of this country is mainly dominated by 3 botanical families with more than 150 species each: *Asteraceae, Poaceae* and *Brassicaceae* (433, 289 and 171 species, respectively), while 7 genera present between 30 and 58 species: *Helianthemum, Linaria, Centaurea, Ononis, Trifolium, Astragalus, Silene* (Abdelguerfi & Ramdane, 2003).

The Algerian steppes constitute a geographical unit whose limits are defined by a bioclimatic criterion. With an estimated area of about 20 million hectares, the Algerian steppes are located between the 400-mm rainfall isohyet to the North and 100 mm-rainfall isohyet to the South, forming a 1000-km-long ribbon over a width of 300 km in the west and in the center, reduced to less than 150 km in the East (Halem, 1997 in Miara *et al*., 2018b). According to Nedjraoui & Bedrani (2008), the steppe regions constitute a buffer between coastal Algeria and Saharian Algeria, of which they limit the negative climatic influences on the former.

Several studies (Le Houerou, 1969; Djebaili, 1978; Aiduod, 1983) confirm that in the Algerian steppe, the reduction in floristic diversity is not only occurring as a result of climatic factors (dryness and heightened aridity), but it is also strongly impacted by anthropic factors (primarily fires and grazing), which are prompted by irrational land exploitation such as overgrazing and land clearing.

To this, the effect of the phenomenon of therophytization is also to be considered. According to Quézel & Médail (2003). Therophytization can be defined as the generalized invasion by annual and often ruderal species, which are mainly disseminated by herds. According to Daget (1980), this is a characteristic of arid zones, expressed as a strategy of adaptation to unfavorable conditions and a form of resistance to harsh climatic conditions.

The region of Djelfa is located in the south of the Algerian Tell Atlas in contact with the Saharian Atlas.

This region is a typical example of the North African steppe which is highly threatened and weakened by ecological and anthropic factors including desertification (Nedjraoui & Bedrani, 2008).

So, in order to contribute to better conservation of these very sensitive natural spaces, a deeper knowledge of the biodiversity of these areas is essential. Unfortunately, and despite several floristic studies published recently for the region of Djelfa (Korichi, 2016; Maamri, 2016; Rahmoune, 2018; Benalia *et al.*, 2018; Bekai *et al*., 2019), the floristic knowledge on this area is still insufficient, while several endemic and rare taxa cited in this region since the colonial period there has not been observed, namely: *Erodium hymenodes* L'Her., *Echium suffruticosum* Baratte., *Celsia battandieri* Murb. *Bellium rotundifolium* (Desf.) DC., *Atractylis polycephala* Coss. and *A. phaeolepis* Pomel.

This research aims to highlight the floristic diversity of the wild steppe areas of the Djelfa region in the Northwest Algeria, by seeking the aforementioned taxa. Specifically, we will assess the floristic biodiversity of this region to analyze some aspects related to the local flora such as life traits (biological types) and chorology (chorological types).

Materials and methods

Study area

The province of Djelfa is located in the central part of Algeria beyond the southern boundary of the Tellian Atlas; our study area is located between 2°and 5° of longitude East and 33°and 35° of North latitude (Figure 1). Three quarters of the territory of the province of Djelfa is made up of steppe ecosystems. In addition, a significant forest heritage exists in this region and consists mainly of Aleppo pine (215,182 ha), representing only 6.67% of the total area of the province (Cherfaoui, 2017).

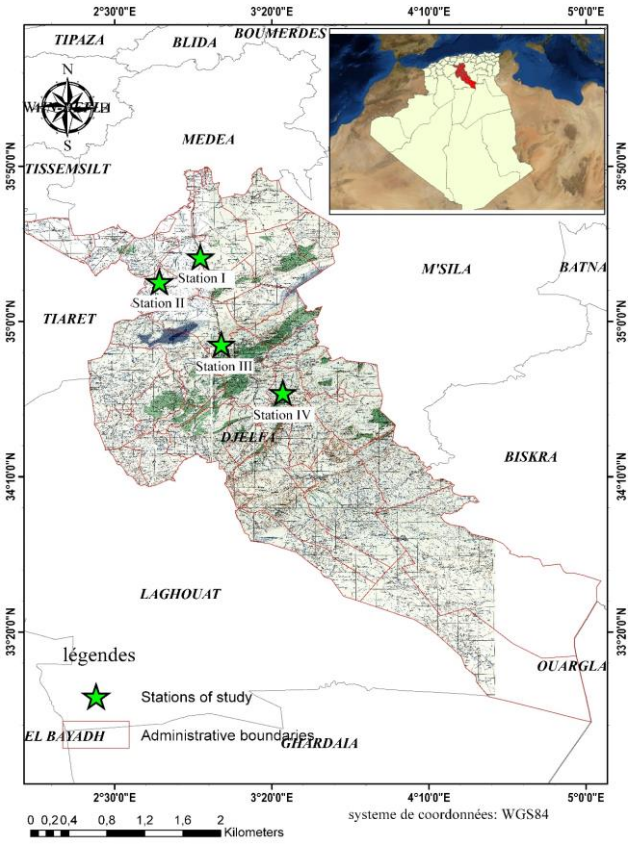

Figure 1. Geographical location of the study area.

Figure 1. *Localisation géographique de la zone d'étude.*

Field sampling

We carried out a total of 32 phytoecological surveys at 4 stations (Table 1) which were chosen according to a stratified sampling method (Gounot, 1969).

The station I is located in Ain Oussera at approximately 90 km northwest of the province of Djelfa. It is characterized by some diversified steppe formations with *Stipa tenacissima* L*. and Artemisia herba-alba* Asso*.*

The station II is located in Guernini at approximately 80 km northwest of the province of Djelfa. It contains some degraded rangelands with vegetation dominated by *Stipa tenacissima* L*.* and *Lygeum spartum* L.

The station III is located in Zaafrane, 60 km northwest of the province of Djelfa. It is characterized by sand dunes with vegetation dominated by*Tamarix gallica* L. In this area, there are also some artificial plantations of *Atriplex canescens* Sieb is located in the region of Ain Maabed at 30 km from the province of Djelfa.

The station IV is located in the city of Moudjbara at approximately 18 km southeast of the province of Djelfa. It is characterized by pre-forest formations dominated by *Pinus halepensis* Mill., *Stipa tenacissima* L*.* and *Artemisia herba-alba* Asso*.*

Data collection and plant identification

The location of the 32 phytosociological surveys was chosen in a random way in zones that were clearly homogeneous and representative. Surveys were carried out according to the method of Braun-Blanquet (1951). For each surveys, we noted the floristic, geographical and environmental data.

Table 1: GPS coordinates and altitudes of the 4 stations of Djelfa province.

Tableau 1: *Coordonnées GPS et altitudes des 4 stations de la province de Djelfa.*

Stations	Longitude	Latitude	Altitude
Station I (Ain Ouessara)	2,95	35,34	728
Station II (Guernini)	2,73	35,21	814
Station III (Ain Maabed)	3,06	34,89	881
Station IV (Moudjbara)	3,40	34,57	1320

In each station, we took eight floristic samples from an area measuring 100 m^2. According to Djebaili (1984), this surface is the minimum area required to be a representative sample of the characteristic flora of the Algerian steppe regions. These floristic surveys were carried out during the optimal periods (spring) of 2016 and 2017. The botanical identification of the collected taxa was made using the flora of Quézel & Santa (1962-63) and that of Ozenda (1977). The species chorology was defined according to Dobignard & Chatelain (2010-13). Chorological types have been grouped according to Benabadji *et al.* (2007) which comprises the following groupings: 1) Mediterranean species (West-Mediterranean, East-Mediterranean, Ibero-Mauritanian, Center-Mediterranean, Sub-Mediterranean), 2) Nordic species (European, Eurasians, Paleo-temperate, Boreals-circum and Paleo sub-tropical), 3) widely distributed species (Euro-Mediterranean, Atlantic-Mediterranean, Eurasian-Mediterranean, Irano-Touranian, Cosmopolitan), 4) Saharan species and 5) endemic species. The nomenclature of the identified taxa was updated using the synonymic index of North Africa (Dobignard & Chatelain, 2010-13). The specimens of plants harvested in the field were coded and deposited in the herbarium of the Botanical laboratory of the University of Tiaret, Algeria.

The perturbation index (PI) is used to quantify the therophytisation. It is calculated according to Loisel & Gamila (1993) as the ratio of the sum of chamaephytes and therophytes on the full number of the species.

Results and discussion

Floristic analyses

In total, we recorded 127 taxa at the four sites (Table 2). This number seems very interesting compared to that obtained by some authors who worked in the same region including Zehraoui (2016) with 107 species, Korichi (2016) with 66 species, Maamri (2016) with 129 species, Rahmoune (2018) with 126 species, Benalia *et al.* (2018) with 84 species and Bekai *et al.* (2019) with 106 species.

Our taxa belong to 33 botanical families. The most represented families are: *Asteraceae* (37 taxa, 29%), *Poaceae* (15 taxa, 12%), *Brassicaceae* and *Fabaceae* with a total of 11 taxa (9%) per family (fig.2). Other families like *Amaranthaceae*, *Lamiaceae* and *Caryophyllaceae* are moderately represented with 6, 5 and 4 taxa respectively. The rest of the families are poorly represented and accounted less than 4 taxa. According to Ozenda (1977), *Asteraceae, Poaceae* and *Brassicaceae* characterize the arid and semi-arid areas in the Mediterranean regions.

In Algeria, some studies (Benabadji *et al.*, 2007; Kazi-Tani *et al.*, 2010) highlighted the dominance of *Asteraceae*, *Poaceae* and *Fabaceae* in the steppe regions. This was also reported in Morocco by Fennane et al. (2012).

In the region of Djelfa, the study of Djaballah & Chehma (2008) about the floristic and nutritional characteristics of the steppe rangelands mention the dominance of the same families in the most stations. It is also the case in the studies published by Korichi (2016), Maamri (2016), Rahmoune (2018), Benalia *et al.* (2018) and Bekai *et al.* (2019) in the same region.

The biological types

The abundance of the various species related to their biological type according to Raunkiaer (1934) is as follows: therophytes > hemicryptophytes > chamaephytes > geophytes > phanerophytes, with a clear predominance of therophytes (71 taxa, 56%) and hemicryptophytes (fig. 3).

Table 2. List of the inventoried taxa.

Tableau 2. *List des taxons inventoriés.*

Taxa (Dobignard &Chatelain, 2010-13)	Biological types	Chorological types	Locality
Aizoaceae			
Aizoanthemopsis hispanicum (L.) Klak	Th	Med	SI
Amaranthaceae			
Atriplex canescens (Pursh) Nutt.	Ch	Wd	SIII
Blitum exsuccum C. Loscos	Th	Wd	SI,SII
Caroxylon vermiculatum (L.) Akhani & Roalson	Ch	Wd	SI,SII
Hammada schmittiana (Pomel) Botsch.	Ch	Sah	SI,SII
Hammada scoparia (Pomel) Iljin	Ch	Sah	SI
Noaea mucronata (Forssk.) Asch. & Schweinf.	Ch	Wd	SI,SII,SIII
Anacardiaceae			
Pistacia atlantica Desf.	Ph	End (North Africa)	SI
Apiaceae			
Eryngium ilicifolium Lam.	Th	Med	SII
Stoibrax pomelianum (Maire) B. L. Burtt	Th	End (Algeria-Morocco)	SIV
Thapsia garganica L.	Hc	Med	SI,SII
Apocinaceae			
Nerium oleander L.	Ph	Med	SIII
Asparagaceae			
Muscari comosum (L.) Mill.	Ge	Med	SI,SII
Asteraceae			
Anacyclus clavatus (Desf.).	Th	Wd	SI,SII,SIII,SIV
Anacyclus monanthos subsp. cyrtolepidioides (Pomel) Humphries	Th	End (North Africa)	SI,SIII
Andryala integrifolia L.	Th	Med	SIV
Artemisia campestris L.	Ch	Nor	SI,SII,SIII,SIV
Artemisia herba-alba Asso	Ch	Med	SI,SII,SIII
Atractylis caespitosa Desf.	Hc	Med	SI,SII
Atractylis cancellata L.	Th	Med	SI
Atractylis serratuloides Sieber ex Cass.	Ch	Sah	SI,SII,SIII
Bombycilaena discolor (Pers.) M. Laínz	Th	Wd	SI,SII
Calendula arvensis (Vaill.) L.	Th	Med	SI,SII,SIII,SIV
Carduus spachianus Durieu	Th	Med	SI,SII
Carthamus eriocephalus (Boiss.) Greuter	Th	Sah	SI
Carthamus lanatus L.	Th	Wd	SI,SII,SIII,SIV
Carthamus rhaponticoides (Pomel) Greuter	Th	End (Algeria-Morocco)	SIV
Centaurea furfuracea Coss. & Durieu	Th	Med	SI
Centaurea maroccana BaIl	Th	Med	SI,SII,SIII
Centaurea oranensis Greuter & M. V. Agab.	Hc	End (Algeria-Morocco)	SI,SII,SIII,SIV
Centaurea sicula L.	Th	Med	SI,SII, SIV
Echinops spinosissimus Turra	Hc	Sah	SI,SII
Erigeron trilobus (Decne.) Boiss.	Th	Med	SIII
Filago crocidion (Pomel) Chrtek & Holub	Th	End (Algeria-Morocco)	SI,SII,SIII
Koelpinia linearis Pallas.	Th	Wd	SI,SII,SIII,SIV
Launaea fragilis (Asso) Pau	Th	Wd	SI,SII
Launaea mucronata (Forssk.) Muschl. subsp. mucronata	Th	Sah	SI,SII
Launaea nudicaulis (L.) Hook. f.	Th	Wd	SII
Onopordum acaulon L.	Hc	Med	SI,SII,SIII

Onopordum espinae Coss. ex Bonnet	Hc	Med	SI
Pallenis hierichuntica (Michon) Greuter	Th	Sah	SI,SII,SIII
Pallenis spinosa (L.) Cass.	Ch	Wd	SI
Picris asplenioides subsp. saharae (Coss. & Kralik) Dobignard	Th	End (North Africa)	SI,SII,SIII
Reichardia tingitana (L.) Roth	Th	Med	SI,SII,SIII
Scolymus hispanicus L.	Hc	Med	SI,SII,SIII
Scorzonera undulata Vahl	Ge	Med	SI,SII,SIII
Senecio gallicus Vill.	Th	Med	SIII
Xeranthemum inapertum (L.) Mill	Th	Wd	SI,SII,SIII
Boraginaceae			
Echium humile subsp. pycnanthum (Pomel) Greuter & Burdet	Th	Sah	SI,SII,SIII
Lappula patula (Lehm.) Gürke	Hc	Wd	SI,SII
Brassicaceae			
Brassica fruticulosa Cirillo	Hc	Med	SIV
Clypeola cyclodontea Delile	Th	Med	SIV
Clypeola jonthlaspi subsp. microcarpa (Moris) Arcang.	Th	Wd	SII
Diplotaxis harra (Forssk.) Boiss.	Th	Wd	SI,SII
Enarthrocarpus clavatus Delile ex Godr.	Th	End (North Africa)	SI,SII
Eruca vesicaria (L.) Cav.	Th	Med	SI,SII,SIII,SIV
Maresia nana (DC.) Batt.	Th	Wd	SI,SII,SIII
Matthiola fruticulosa (Loefl. ex L.) Maire	Ch	Med	SIV
Matthiola longipetala (Vent.) DC.	Th	Wd	SI,SII
Muricaria prostrata (Desf.) Desv.	Th	End (North Africa)	SI,SII,SIII
Pseuderucaria clavata (Boiss. & Reut.) O. E. Schulz	Th	Sah	SIII
Caprifoliaceae			
Lomelosia crenata (Cirillo) Greuter & Burdet	Th	Sah	SI,SII,SIII,SIV
Caryophyllaceae			
Herniaria cinerea DC.	Th	Nor	SI,SII,SIII,SIV
Paronychia argentea Lam.	Hc	Med	SI,SII,SIII,SIV
Silene secundiflora Otth	Th	Med	SIII
Telephium imperati L. subsp. imperati	Hc	Med	SI,SII,SIII
Cistaceae			
Helianthemum cinereum (Cav.) Pers.	Ch	Wd	SIV
Helianthemum helianthemoides (Desf.) Grosser	Ch	End (North Africa)	SI,SII
Helianthemum ruficomum (Viv.) Spreng.	Ch	Med	SIV
Cucurbitaceae			
Citrullus colocynthis (L.) Schrad.	Hc	Wd	SIII
Euphorbiaceae			
Euphorbia falcata L.	Th	Wd	SI,SIII
Fabaceae			
Argyrolobium uniflorum (Decne.) Jaub. & Spach	Hc	Sah	SII
Astragalus crenatus Schult.	Th	Sah	SI,SII
Astragalus gombo Bunge	Hc	Sah	SIII
Astragalus reinii BaIl.	Hc	End (Algeria-Morocco)	SI,SII,SIII,SIV
Coronilla scorpioides (L.) W.D.J. Koch	Th	Med	SI,SII,SIII
Hippocrepis multisiliquosa L.	Th	Med	SI
Lathyrus clymenum L.	Th	Med	SI
Lotus ornithopodioides L.	Th	Med	SI,SII
Medicago littoralis Loisel.	Th	Med	SI,SII
Medicago minima (L.) L.	Th	Wd	SI,SII,SIII

Onobrychis alba (Waldst. & Kit.) Desv.	Hc	Nor	SIV
Ononis serrata Forssk.	Hc	Med	SIII
Retama raetam (Forssk.) Webb	Ph	Wd	SIII
Geraniaceae			
Erodium crassifolium (Forssk.) L'Hér.	Th	Med	SI,SII
Hyacynthaceae			
Dipcadi serotinum (L.) Medik.	Ge	Wd	SII,SIV
Iridaceae			
Moraea sisyrinchium (L.) Ker Gawl.	Ge	Nor	SI,SII,SIII
Ajuga iva (L.) Schreb.	Th	Med	SI,SII,SIII,SIV
Maropsis deserti (de Noé) Pomel	Hc	Sah	SIII
Salvia verbenaca L.	Hc	Wd	SI,SII
Teucrium polium L.	Hc	Wd	SI,SII,SIII
Thymus algeriensis Boiss. & Reut.	Ch	End (North Africa)	SIV
Malvaceae			
Malva aegyptia L.	Th	Wd	SI,SII,SIII
Malva parviflora L.	Th	Wd	SI,SII,SIII
Nitrariaceae			
Peganum harmala L.	Ch	Wd	SI,SII,SIII,SIV
Orobanchaceae			
Cistanche lutea (Desf.) Hoffmanns. & Link	Ge	End (North Africa)	SIII
Papaveraceae			
Glaucium corniculatum (L.) Rudolph	Th	Med	SI,SIV
Papaver hybridum L.	Th	Med	SIV
Pinaceae			
Pinus halepensis Mill.	Ph	Med	SIV
Plantaginaceae			
Kickxia aegyptiaca (L.) Nábelek	Th	Sah	SI
Plantago albicans L.	Hc	Med	SI,SII,SIII,SIV
Plantago ciliata Desf.	Th	Wd	SI,SII,SIII
Plantago ovata Forssk.	Th	Med	SI,SII,SIII
Poaceae			
Aegilops peregrina (Hack.) Eig	Th	Med	SII
Anisantha rubens (L.) Nevski	Th	Nor	SII,SIII,SIV
Centropodia forsskalii (Vahl) Cope	Th	Sah	SI
Cynodon dactylon (L.) Pers.	Ge	Wd	SI,SII,SIII,SIV
Echinaria capitata (L.) Desf.	Th	Wd	SI,SII,SIII
Hordeum murinum L.	Th	Nor	SI,SII,SIII,SIV
Lygeum spartum L.	Ge	Med	SI,SII,SIII
Macrochloa tenacissima (L.) Kunth	Hc	Med	SI,SIII
Poa bulbosa L. subsp. bulbosa	Th	Nor	SIV
Rostraria cristata (L.) Tzvelev	Th	Wd	SI,SII
Schismus barbatus (Loefl. ex L.) Thell.	Th	Wd	SI,SII
Stipa parviflora Desf.	Hc	Med	SI,SII,SIII
Stipagrostis obtusa (Delile) Nees	Hc	Wd	SIII
Stipagrostis plumosa (L.) Munro ex T. Anderson	Hc	Wd	SI
Stipagrostis pungens (Desf.) De Winter subsp. pungens	Hc	Wd	SIII
Ranunculaceae			
Adonis aestivalis L.	Th	Nor	SI,SII,SIII,SIV
Resedaceae			

Reseda alba L. subsp. alba	Th	Nor	SI,SIV
Reseda decursiva Forssk.	Hc	Med	SI,SII,SIII
Reseda lutea L. subsp. lutea	Th	Nor	SI,SII
Rhamnaceae			
Ziziphus lotus (L.) Lam.	Ph	Med	SI,SII,SIII
Scrophulariaceae			
Scrophularia canina L.	Th	Med	SIII
Tamaricaceae			
Tamarix gallica L.	Ph	Wd	SIII
Thymelaceae			
Thymelaea microphylla Coss. & Durieu ex Meisn.	Ch	End (North Africa)	SI
Zygophyllaceae			
Tribulus terrestris L.	Th	Wd	SI

Wd: wide distributed; End: endemic; Sah: Saharian; Nor: Nordic; Med: Mediterranean; Th: therophytes; Ch: chamaephytes; Ph: phanerophytes; Ge: geophytes; Hc: hemicryptophytes.
Wd: large distribution; End: endémique; Sah: saharienne; Nor: nordique; Med: Méditerranéen; Th: thérophytes; Ch: chaméhytes; Ph: phanérophytes; Ge: géophytes; Hc: hemicryptophytes.

Indeed, the dominance of therophytes characterizes the arid and semi-arid regions (Aidoud, 1984; Miara *et al.*, 2016). Several authors (Daget, 1980; Barbero et al., 1990; Aidoud, 1984) underline the relationship between the high rate of therophytes and the increasing gradient of aridity in the Algerian steppe areas. The phenomenon of therophytisation observed in the present study is probably related to

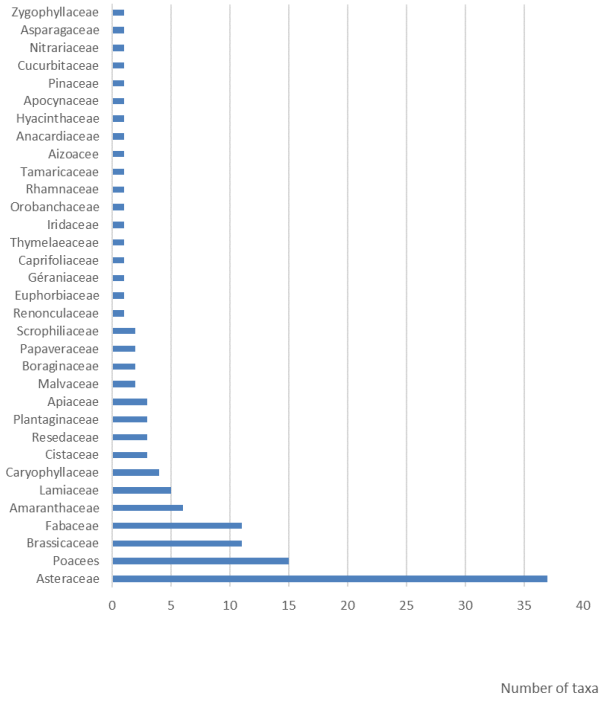

Figure 2. The most represented families (number of taxa).

Figure 2. *Les familles les plus représentées (nombre de taxons).*

the arduous climatic conditions but also to the anthropogenic actions (Benabadji & Bouazza, 2002; Benaradji *et al*., 2009; Hachemi *et al*., 2012). The high number of therophytes taxa represented in our list indicate some undergoing degradation of the local vegetation like in the Mediterranean region (Miara *et al.*, 2016).

Hemicryptophytes are classified in second position of contribution with 27 taxa (21%). The prevalence of hemicryptophytes can be explained by the degradation of the ecological conditions generally related to the climate and the anthropic action (Ozenda, 1977).

The other chorological types (chamaephytes, geophytes, phanerophytes) are moderately or weakly represented with 16, 7 and 6 species respectively. Indeed, Kadi-Hanifi (2003) reported that the number of the phanerophytes, hémicryptophytes and geophytes declined with the aridity and openness of the environment.

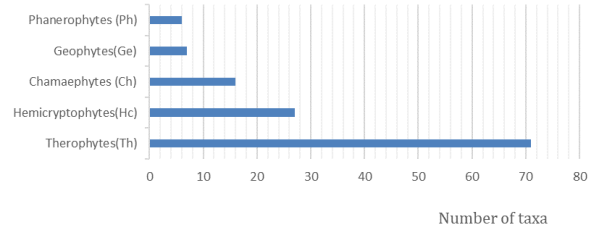

Figure 3. Biological types (number of taxa).

Figure 3*. Types biologiques (nombre de taxons).*

The rates of the perturbation index (PI) in the four stations of study vary between 59% and 81%. This confirms the presence of the phenomenon of Therophytization in these regions by the dominance of Therophytes annual species more or less needing water resources, trophic and the opening areas (Regagba, 2012).This also indicate the adaptation of these species to the effect of the anthropic actions (Grime,1977; Barbero *et al.*,1989a,1989b). The Therophytisation is the ultimate stage of degradation of the ecosystems with the dominance of the sub-

nitrophiles species related to the overgrazing (Hachemi *et al.*, 2002).

Chorological types

The chorological spectrum of our studied areas is generally marked by the prevalence of the Mediterranean element (48 taxa, 35%). This reflects the global and logical affinity of our flora to the Mediterranean region that is generally appropriate to the climate which characterizes this area (Le Houerou, 1995; Quézel, 1983).

The wide distribution taxa come in second position with 38 taxa (28%). The abundance of these species is generally related to the phenomenon of Therophytization of the Mediterranean flora induced by the action of several ecological and anthropogenic factors (Miara *et al*., 2016). The Nordic taxa occupies the third position with a total number of 19 taxa (14%). This number can also be explained by the remote geographical location of northern Europe.

The Saharian element comes in fourth position with 17 taxa (13%). The presence of a significant number of these taxa in these environments is explained by the geographic situation of the steppe areas bordering the desert (Aidoud, 1983).

Finally, the endemic type is represented with 14 taxa (10%). These taxa belongs to Algerian-Moroccan (5 taxa) and North African elements (9 taxa). The number of endemic species reported in this study is quite low compared to the endemic taxon richness of these regions (Bekai et al., 2019). Indeed, an important reduction of the rates of endemic taxa in the steppe area was observed by the previous studies (Kadi-Hanifi, 2003; Abdelmoumen & Zoheir, 2015; Nacère et al., 2016). In the Mediterranean region, these endemic taxa, even when they occur as Therophytes, are very fragile and vulnerable to anthropogenic disturbances (Quézel and Médail, 2003).

Thus, all the endemic species cited for the region in the flora of Quézel and Santa (1962-63) were not found in particular: *Erodium hymenodes*, *Echium suffruticosum*, *Celsia battandieri*, *Bellium rotundifolium*, *Atractylis polycephala*, *A. phaeolepis*. This may indicate local extinctions which are the result of a trivialization of the local flora by annual therophyte sub- nitrophiles taxa with greater ecological valence.

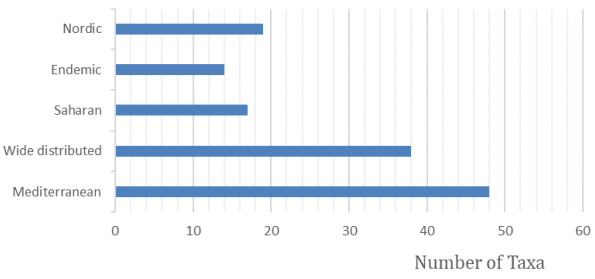

Figure 4. Chorological types (number of taxa).

Figure 4. *Types chorologiques (nombre de taxons).*

Conclusion

The results obtained show an interesting richness of the local flora (127 taxa, which is mainly dominated by therophyte taxa of low ecological and heritage value. It also turns out that the phenomenon of therophytization observed in this region has contributed to a certain "trivialization" of the regional flora which normally is quite specific and rich with strict endemic taxa. This is confirmed by the chorological analysis showing the absence of all endemic plants (including strict endemics) reported in this region in the past. In addition, the presence of a good number of other endemics of North Africa relatively preserves the floristic originality of this region. Finally, we insist on the necessity and the urgency to protect these natural spaces containing a rich and original biodiversity.

Conflicts of interest

The authors declare no conflict of interest throughout this research and writing process.

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