

# ENDEMIC TAXA AND THEIR VULNERABILITY STATUS IN NORTH - EASTERN ALGERIA: CONSERVATION AND PROTECTION

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**Abstract:** Our study aims to develop the first list of taxa endemic to the Sétif region. In this research, we mainly relied on floristic work carried out on a North-South transect covering two types of bioclimate and including forest and steppe massifs. Thus, we have counted 148 endemic taxa including 25 subspecies. Belonging to 33 botanical families and dominated by Asteraceae with 15.54%. The endemics of North Africa are the most representative with 62 taxa. The region of Sétif is very impacted; its plant cover is subject to climatic and anthropogenic constraints, which would certainly contribute to more scarcity or even to the gradual disappearance of endemic and rare species very soon.

**Keywords:** Endemic taxa, Degradation, Rarefaction, Preservation, Sétif

## 1. Introduction

The flora of a geographic area is the most important biotic component. It is clear that for flora, endemic taxa arise from a botanical curiosity, biogeographical importance, and rather specific ecological places. They reflect quite remarkable conditions of the type of environment in which they meet. Endemism is most often due to very old isolation of a given region, the rate of which increases with this age. Endemic species are not distributed at random, but are found in regions whose flora has been relatively isolated for geographic reasons, current or past [1].

The Mediterranean region is one of the world's major centers of plant diversity where 10% of higher plants can be found in an area which represents only 1.6% of the earth's surface [2,3]. This flora is currently undergoing a regressive evolution resulting in the destruction of the plant cover for which man is indisputably responsible for the unprecedented erosion that biological diversity is currently experiencing [4,5].

The mechanisms by which human activities cause the disappearance of animal or plant species are very diverse: modification, fragmentation or direct destruction of their

habitats, the introduction of invasive species, pollution, or even overexploitation.

in Algeria the phenomenon of degradation is already perceived particularly in the Setifen high plains where the plant formations were currently entering a phase of intense and continuous degradation, leading to a great disturbance of the plant cover with the regression and disappearance of endemic and vulnerable species [6].

Endemic species occupying small habitats, and limited areas remain the most vulnerable to extinction [7]. The conservation and enhancement of the diversity of the genetic resources of plants in a country first require precise knowledge of this heritage. Starting from the complexity of constantly evolving flora, the definition of an optimal strategy giving all the means to the operators constitutes the guarantee to achieve this objective.

Most of the work carried out on flora and vegetation in the Sétif region has focused on two lines of research involving phytosociological and phytodynamic studies. According to a North-South transect, we quote the stations explored in the Setif region : the Babors mountains, djebel Megress, djebel Yousse ,djebel, Zdim et djebel Boutaleb [8,9,10,11,12].

Currently, one of the priorities in terms of floristic and ecological diversity, but also

preservation and conservation is to diagnose the composition of the endemic flora of the Sétif region by determining the threats exerted on it by developing a most exhaustive inventory as possible to develop a monitoring strategy for their monitoring and conservation as well as their integration into and into the list of protected non-cultivated plant species.

## 2. Materials and Methods

### 2.1. Study area

The wilaya of Sétif is located in eastern Algeria (fig. 1), in the region of the highlands of Constantine, it occupies an area of 6504 km<sup>2</sup> between a longitude of 5 ° 24 '34' East and a latitude of 36 ° 11 '29' North. It is bounded to the north by the wilayas of Bejaia and Jijel, to the south by the wilayas of Batna and M'Sila, to the east by the wilaya of Mila and to the west, we find the wilaya of Bordj Bou Arreridj. The relief of the Sétif region is distinguished by two main areas:

-The mountainous area extends over a hundred kilometers practically covering the north of the

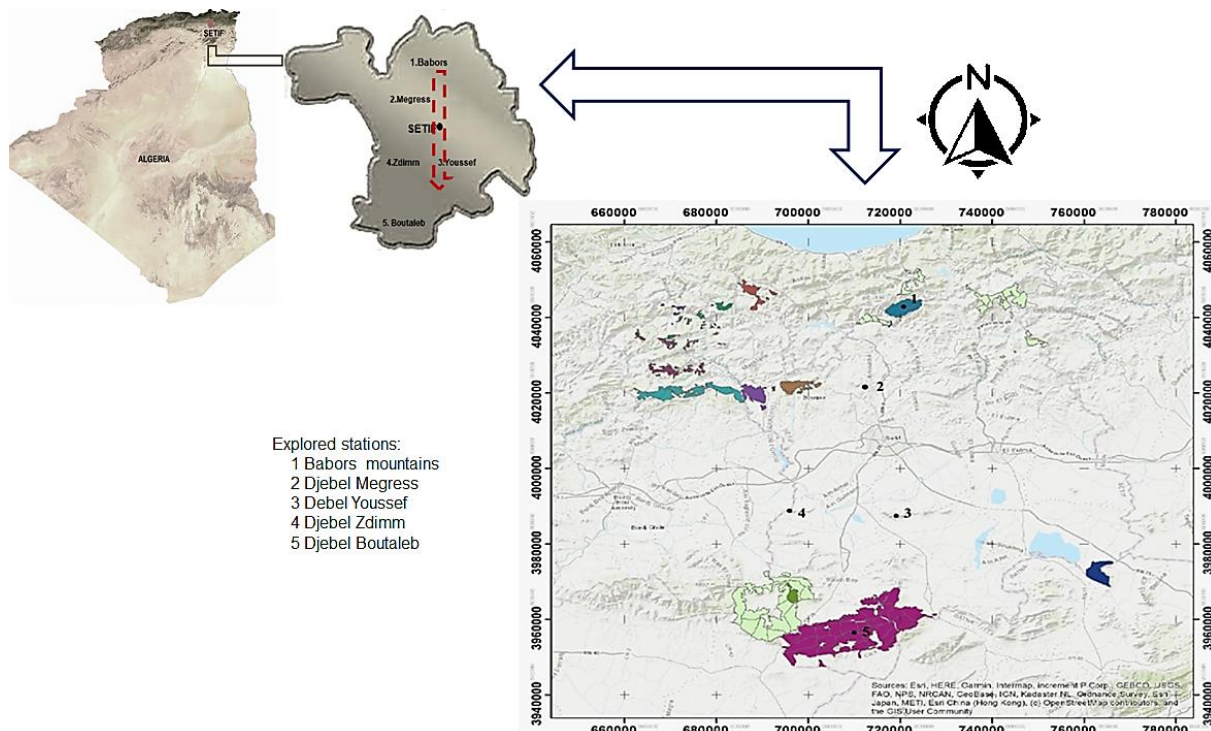
wilaya where the Babors mountains located in the eastern part of the Tellien Atlas meet and follows, to the east, the Djurdjura chain with the highest point of 2004 m altitude.

-The area of the high Setifian plains corresponding to the central and southern part of the wilaya, is characterized by isolated mountain ranges with the presence of chotts and Sebchas: Djebel Megriss is located in the northern part of the high Sétifian plains with the highest point of 1737 m altitude.

Djebel Youssef stretches from East to West for about 10 km. It rises to 1442 m with foothills around 910 m altitudes.

Djebel Zdimm is located about twenty km west of djebel Youssef. It rises to an altitude of 1,258 m and foothills of 900 m.

Djebel Boutaleb is an important and well-individualized link in the southern part of the Sétif region with an area of 28427h. It has relatively high altitudes, varying between 980 m and 1886 m of which the Afghan djebel constitutes the highest point.



**Fig 1.** The location of the study area-Setif (Algeria)

In the Sétif region, the rainfall regime is characterized by annual and inter-annual variability. Generally, the rains are insufficient and irregular both in time and in space, the lengthening of the mountainous masses

perpendicular to the direction of the humid winds favors the condensation of the clouds on the northern slopes of Babors and on djebel Megriss where they receive most of the precipitation on average 500 mm / year, unlike on the southern

platform where djebel Youssef, Jebel Zdimm and djebel Boutaleb receive only 200 to 300mm / year. Thus there are two bioclimatic fringes, humid in the north and semi-arid lower in the south. From the point of view of plant formation, the Sétifienne region is characterized by a mosaic ranging from forest formation (djebel Babor and Boutaleb); lawns (djebel Megress), low matorrals, and chamaephytic steppes (djebel Youssef and Zdimm).

## 2.2. Methodology

Establishing such a study involves taking into account the data selected on the basis of purely phytosociological and phytoecological criteria in the Sétif region. Our choice fell on a North-South transect, going from the humid bioclimatic stage to the lower semi-arid stage, thus passing through various regions with specific ecological characteristics. The stations exploited concern the work carried out in the Babors [8,12], in djebel Megress [9], in djebels Zdimm and djebel Youssef [11,6] and in djebel Boutaleb [10].

The methodology adopted here is based on the exploitation and phytoecological surveys carried out in the various sites by the examination of endemic taxa appearing in the floristic lists taking into account their ecological coordinates, taxonomy, chorology, biological type, and vulnerability status. The initial data set was supplemented by follow-up surveys using other phytoecological surveys, carried out over two campaigns (2017, 2018). In total, we carried out a

batch of 88 readings on the various stations including 10 at Babors, 18 at Megress, 12 at djebel Youssef, 25 at Zdimm, and 23 at Boutaleb. For the determination and the nomenclature of the taxa we used the flora of Algeria and the southern desert regions [13] and flora practice in Morocco [14]. The biological types were determined with reference to the work of Raunkiaer [15] and the phytogeographic elements grouping together taxa with the same geographical distribution are described according to Ozenda and Bonnier [16,17].

The updating of nomenclature and chorology data was carried out following the use of the synonymic index of the flora of North Africa [18].

Subsequently, we carried out statistical analyzes to establish a list of endemic species typical of the Sétif region. The specimens were carefully stored in a herbarium in the city and territory urban project laboratory (LPUVT) at Ferhat Abbas University in Sétif 1.

## 3. Results

The research carried out through this study allowed us to count 148 taxa including endemic species and subspecies for the Sétif region. The highest rate of endemism is recorded at the Babors level with 80 taxa followed by djebel Megress with 42 taxa and djebel Youssef with 40 taxa. Djebel Zdimm and djebel Boutaleb are less represented by this element, they successively record 34 and 31 taxa (Table 1).

**Table 1. Endemic taxa identified in the Sétif region**  
(1) Babors, (2) Megriss, (3) Youssef, (4) Zdimm, (5) Boutaleb

Botanical family	Taxon	Chorology	Bio-T	Station
Abietaceae	<i>Abies numidica</i> De Lanno	End	Ph	1
	<i>Cedrus atlantica</i> Manetti	End N. A	Ph	1 - 5
Anacardiaceae	<i>Pistacia atlantica</i> Desf.	End N. A	Ph	3 - 4 - 5
	<i>Ammoides atlantica</i> (Coss. et Dur.) Wolf.	End	He	1 - 2 - 5
	<i>Balansaea glaberrima</i> (Desf.) Lange	End N. A	Geo	1 - 5
	<i>Bunium elatum</i> Batt.	End	Geo	3 - 4
	<i>Bunium Fontanesii</i> (Pers.) Maire	End N. A	Geo	3 - 4
	<i>Bunium mauritanicum</i> Batt.	End N. A	Geo	5
	<i>Bupleurum Chouletti</i> Pomel.	End N. A	He	3 - 4
	<i>Bupleurum montanum</i> Coss.	End N. A	He	1 - 2
	<i>Carum foetidum</i> (Coss. et Dur) Benth. et Hook.	End Alg - Tun	He	2
	<i>Carum montanum</i> (Coss. et Dur.) Benth. Et Hook	End	Geo	1 - 2 - 3 - 5
	<i>Daucus biseriatus</i> .Murb	End	He	3 - 4
	<i>Daucus crinitus</i> Desf.	End Alg - Tun	He	2
	<i>Eryngium triquetrum</i>	End N. A	He	3
	<i>Ferula cossoniana</i> Batt. et Trab.	End N. A	He	4
<i>Oenanthe virgata</i> Poiret	End .N. A	He	2	
Apiaceae	<i>Pimpinella battandieri</i> Chabert	End	He	1 - 2

	<i>Pituranthos chloranthus</i> (Coss. et Dur.) Benth. et Hook. subsp. Cossonianus Maire	End N. A	Ch	4
	<i>Pituranthos scoparius</i> (Coss. et Dur.) B. Hook.	End N. A	Ch	3 - 4 - 5
	<i>Anacyclus cyrtolepidioides</i> Pomel.	End N. A	He	3 - 4
	<i>Anthemis monilicostata</i> Pomel	End Alg - Tun	He	2
	<i>Atractylis polycephala</i> Coss.	End N. A	Ch	3 - 4
	<i>Carduncellus ilicifolius</i> Pomel	End	He	3 - 4
	<i>Carthamus multifidus</i> Desf.	End N. A	Ch.	1
	<i>Catananche arenaria</i> Coss. et Dur.	End	The	4
	<i>Catananche montana</i> Coss	End Alg - Mar	He	1
	<i>Centaurea amara</i> L. subsp. <i>rapalon</i> (Pomel) A.	End Alg - Tun	He	2
	<i>Centaurea parviflora</i> Desf.	End Alg - Tun	Ch.	1 - 5
	<i>Chrysanthemum fontanesii</i> (B. et R.) Q. et S.	End N. A	Ch	1
	<i>Doronicum atlanticum</i> (Chabert) Rouy	End N. A.	Ch	1
	<i>Filago exigua</i> Sibth	End	He	3
	<i>Galactites mutabilis</i> spach.	End Alg - Tun	Ch	1-5
Asteraceae	<i>Helichrysum lacteum</i> Coss. et Dur.	End N. A	He	1
	<i>Hertia cheirifolia</i> (L.) O.K.	End Alg - Tun	Ch	2 - 4 - 3
	<i>Leontodon balansae</i> Boiss.	End Alg - Mar	He	5
	<i>Ormenis africana</i> (Jord. et F.) Lit. et M.	End N. A	Ch.	1 - 3 - 4 - 5
	<i>Picris duriaei</i> Sch. Bip.	End	He	2
	<i>Rhanterium suaveolens</i> Desf.	End. N.A	N.Ph	4
	<i>Senecio gallerandianus</i> Coss. et Dur	End	He	1 - 5
	<i>Senecio giganteus</i> Desf.	End N. A	He	1
	<i>Senecio perralderianus</i> Coss. et Dur.	End Alg - Mar	He	1
	<i>Taraxacum megalorrhizon</i> (Forsk.) Hand. Mazz.	End N. A	He	1
Berberidaceae	<i>Epimedium perralderianum</i> Coss.	End	He	1
Boraginaceae	<i>Echium suffruticosum</i> Baratte	End Alg - Tun	He	2
	<i>Onosma fastigiata</i> (Br. Bl.) Lacaita subsp. <i>mauretanica</i> Maire	End Alg - Mar	He	1 - 3
	<i>Arabis doumetii</i> Coss	End	He	1
	<i>Arabis pubescens</i> (Desf.) Poir.	End N. A	The	1 - 2 - 3 - 4 - 5
	<i>Biscutella raphanifolia</i> Poiret	End N. A	He	5
Brassicaceae	<i>Brassica dimorpha</i> Coss. et Dur.	End	Ch	3 - 4
	<i>Iberis atlantica</i> (Litard. et Maire) G.B.	End Alg - Mar	He	1
	<i>Isatis djurdjurae</i> Coss. Durieu.	End Alg - Mar	He	1
	<i>Lonchophora capiomontana</i> Dur.	End. N.A	The	3 - 4
	<i>Rhaponticum acaule</i> (L.) D.C	End N. A	He	1
	<i>Rhaponticum acaule</i> (L.) D.C.	End N. A	He	1 - 2
Campanulaceae	<i>Campanula alata</i> Desf.	End Alg - Tun	Ch	1
	<i>Campanula trachelium</i> L. subsp. <i>mauritanica</i> PQ.	End N. A	He	1
Caprifoliaceae	<i>Knautia mauritanica</i> Pomel	End Alg - Mar	He	1
	<i>Lonicera kabylica</i> (Batt.) Rehder	End	Nph	1
	<i>Cerastium atlanticum</i> Dur	End N. A	He	2
	<i>Moehringia stellarioides</i> Coss.	End	He	1
	<i>Paronychia arabica</i> (L.) DC subsp. <i>aurasiaca</i> W.	End. A. N	He	1 - 3 - 4
Caryophyllaceae	<i>Silene andryalifolia</i> Pomel	End N. A	He	1
	<i>Silene atlantica</i> Coss.	End Alg - Tun	He	1 - 2 - 5
	<i>Silene choulettii</i> Coss.	End	He	1 - 5 - 3
	<i>Silene cirstensis</i> Pomel	End	He	2
	<i>Silene oropediorum</i> Coss.	End	He	3
	<i>Silene patula</i> Desf.	End N. A	He	1
Cistaceae	<i>Helianthemum apertum</i> Pomel.	End N. A	Ch	3 - 4
	<i>Helianthemum helianthemoides</i> (Desf.) Grosser	End N. A	Ch	1 - 2
	<i>Helianthemum salicifolium</i> (L.) Mill. subsp. <i>brevipes</i> Coss.	End N. A	Ch	3
Convolvulaceae	<i>Convolvulus dryadum</i> Maire	End. Rif. Babors	He	1
Crassulaceae	<i>Sedum multiceps</i> Coss. et Dur	End	He	1
	<i>Sedum pubescens</i> Vahl	End Alg - Tun	The	1 - 2 - 3 - 4

Dipsaceae	<i>Cephalaria mauritanica</i> Pomel	End N. A	Geo.	1
	<i>Argyrolobium saharae</i> Pomel	End. N. Sah	Ch	4
	<i>Astragalus falciformis</i> Desf.	End N. A	Ch	3 - 4
	<i>Astragalus armatus</i> Willd. subsp <i>tragacanthoides</i> (Desf.)Maire.	End N. A	Ch	3 - 4 - 5
Fabaceae	<i>Astragalus armatus</i> Willd. subsp. <i>numidicus</i> (Murb.) Emberger et Maire	End N. A	Ch	1 - 2
	<i>Coronilla valentina</i> L. subsp. <i>speciosa</i> (Uhrova) Greuter et Burdet	End	Ch	1
	<i>Ebenus pinnata</i> L.	End N. A.	The	3 - 4 - 5
	<i>Genista microcephala</i> subsp. <i>genuina</i> M.	End N. A	Nph	5
	<i>Genista tricuspidata</i> Desf. subsp. <i>tricuspidata</i> M.	End N. A	Nph	1 - 5
	<i>Hedysarum carnosum</i> Desf.	End Alg - Tun	Ch	3 - 4
	<i>Hedysarum naudinianum</i> Coss.	End	He	3
	<i>Hedysarum perraldrianum</i> Coss.	End	He	5
	<i>Hippocrepis atlantica</i> Ball.	End Alg - Mar	He	1 - 3 - 5
	<i>Ononis incisa</i> Coss. et Dur.	End	He	3 - 4
	<i>Trifolium juliani</i> Batt.	End N. A	The	2
	<i>Vicia ochroleuca</i> Ten. subsp. <i>baborensis</i> (Batt et Trabut) Greuter et Burdet	End	He	1
	Geraniaceae	<i>Erodium battandieranum</i> Rouy	End	He
<i>Geranium atlanticum</i> B. et R.		End N. A	He	1- 2
Iridaceae	<i>Iris unguicularis</i> Poiret	End Alg-Tun	Geo	2
	<i>Lamium mauritanicum</i> Gandoger	End N. A	The	5
	<i>Origanum glandulosum</i> Desf.	End Alg - Tun	He	2
	<i>Origanum vulgare</i> L. subsp. <i>glandulosum</i> (Desf.) Letswaart	End Alg -Tun	He	1
	<i>Phlomis bovei</i> De Noe	End. A. N	He	1 - 2
	<i>Rosmarinus tournefortii</i> de Noé	End	N.Ph	5
Lamiaceae	<i>Satureja grandiflora</i> subsp. <i>baborensis</i> (Batt.) M.	End. Rif. Babors	He	1
	<i>Stachys guyoniana</i> De Noé	End N. A	He	2
	<i>Stachys officinalis</i> (L.) Trevisan subsp <i>algeriensis</i> (De Noé) Franco.	End	He	1
	<i>Teucrium atratum</i> Pomel	End Alg - Tun	He	1
	<i>Teucrium kabylicum</i> Batt.	End	He	1
	<i>Teucrium pseudo-scorodonia</i> Desf.	End N. A	He	1
	<i>Thymus algeriensis</i> Boiss et Reut.	End. N.A	Ch	3 - 4
	<i>Thymus munbyanus</i> Bois et Reut. subsp. <i>coloratus</i> (Boiss. et Reuter) Greuter et Burdet	End Alg- Mar	Ch	1
	<i>Thymus numidicus</i> Poiret	End	Ch	2
	<i>Thymus ciliatus</i> Desf. subsp. <i>eu-ciliatus</i> Maire	End. N.A	Ch	2- 3 - 4 - 5
Liliaceae	<i>Allium trichocnemis</i> J. Gay	End	He	2
	<i>Asparagus altissimus</i> Munby	End.Alg.Mar	He	5
	<i>Gagea granatellii</i> Parl. subsp. <i>eu- granatellii</i> M.	End N. A	Geo	3 - 4 - 5
	<i>Gagea granatelli</i> Parl. subsp <i>chaberti</i> terrace	End Alg	Geo	2
Linaceae	<i>Scilla lingulata</i> Poiret.	End N. A	Geo	3 - 4
	<i>Linum aristidis</i> Batt.	End N. A	He	5
	<i>Linum numidicum</i> Murbeck	End N. A	He	1
Onograceae	<i>Linum tenue</i> Desf. subsp. <i>tenue</i> Martinez	End N. A	He	1 - 2
	<i>Epilobium numidicum</i> Batt.	End	He	2
Orchidaceae	<i>Dactylorhiza maculata</i> L. subsp. <i>baborica</i> M.W.	End	Geo	2
Paeoniaceae	<i>Paeonia mascula</i> (L.) Miller subsp. <i>atlantica</i> (Cosson) Greuter et Burdet	End	Geo	1
Plantaginaceae	<i>Plantago mauritanica</i> Boiss. et Reut.	End N. A	He	1
Poaceae	<i>Cynosorus cristatus</i> Poiret.	End Alg -Tun	He	2
	<i>Cynosurus balansae</i> Coss. et Dur.	End Alg -Mar	He	1
	<i>Festuca algeriensis</i> Trab.	End	He	1
	<i>Festuca atlantica</i> Duv. Jouve	End Alg - Mar	He	1-2 - 3- 5
	<i>Festuca deserti</i> (Coss. et Dur) Trab.	End Alg - Mar	He	1
	<i>Festuca triflora</i> Desf.	End Alg - Mar	He	1

	<i>Vulpia obtusa</i> Trab.	End	The	2
Polygonaceae	<i>Rumex algeriensis</i> Barr. et Murb.	End	He	2
Primulaceae	<i>Cyclamen africanum</i> Boiss. et Reut.	End N. A	Geo	1 - 2
	<i>Primula acaulis</i> (L.) L. subsp. <i>atlantica</i> (Maire & Wilczek) Greuter et Burdet	End Alg - Mar	He	1
	<i>Aquilegia vulgaris</i> L. subsp. <i>cossoniana</i> (Maire et Sennen) Dobignard	End Alg -Mar	Geo	1
Ranunculaceae	<i>Delphinium balansae</i> Boiss. et Reut.	End N. A	He	1 - 5
	<i>Delphinium sylvaticum</i> Pomel	End Alg - Tun	He	1- 2
	<i>Ranunculus spicatus</i> Desf. subsp. <i>maroccanus</i> (Cosson) Greuter et Burdet	End. A. N	Geo	1
Rubiaceae	<i>Crucianella patula</i> L.	End. N.A	The	3 - 4
	<i>Galim tunetanum</i> Lam.	End N. A	He	3
	<i>Galium petraeum</i> Coss	End Alg - Tun	He	3
	<i>Galium brunnaeum</i> Munby	End N. A	He	1
	<i>Galium tunetanum</i> Poiret	End N. A	He	1 - 2 - 5
Saxifragaceae	<i>Saxifraga numidica</i> Maire	End	He	1 - 2
	<i>Anarrhinum pedatum</i> Desf.	End N. A	The	1
	<i>Linaria pinnifolia</i> (Poiret) Maire	End N. A	He	1
Scrofulariaceae	<i>Scrofularia tenuipes</i> Coss. et Dur.	End	He	2
	<i>Scrophularia laevigata</i> Vahl	End N. A	He	1
	<i>Linaria virgata</i> Desf.	End N. A	The	1
Thymelaeaeceae	<i>Thymelaea microphylla</i> Coss. et Dur.	End. N.A	N.Ph	3 - 4
	<i>Thymelaea virescens</i> Coss. et Dur	End. N.A	N.Ph	4
Valerianaceae	<i>Fedia sulcata</i> Pomel	End	The	1

Abbreviations : End : Endemic, A : Africa, Alg : Algeria, Tunisia, M : Morocco, N : North, Bio-T : Biological type, Ch : Chamephyte, Geo : Geophyte, He : Hemicryptophyte, Ph : Pherophyte, The :Therophyte

From a biodiversity point of view, the families represented by these endemics are among the most representative of the flora of Algeria, the largest number of endemic taxa is found in the Asteraceae family with 19 genus and 23 taxa, i.e. a rate of 15, 54% followed by the Apiaceae 11 genera with 17 taxa. The Fabaceae 10 genera and the Lamiaceae 8 genera are

manifested by a similar number of 15 taxa. Caryophyllaceae and Brassicaceae with 9 taxa each followed by Poaceae with 7 taxa, Scrofulariaceae, Liliaceae, and Rubiaceae with the same number of 5 taxa. The rest of the families include between 2 and 4 taxa. It should be noted that 12 families are monospecific (fig.2).

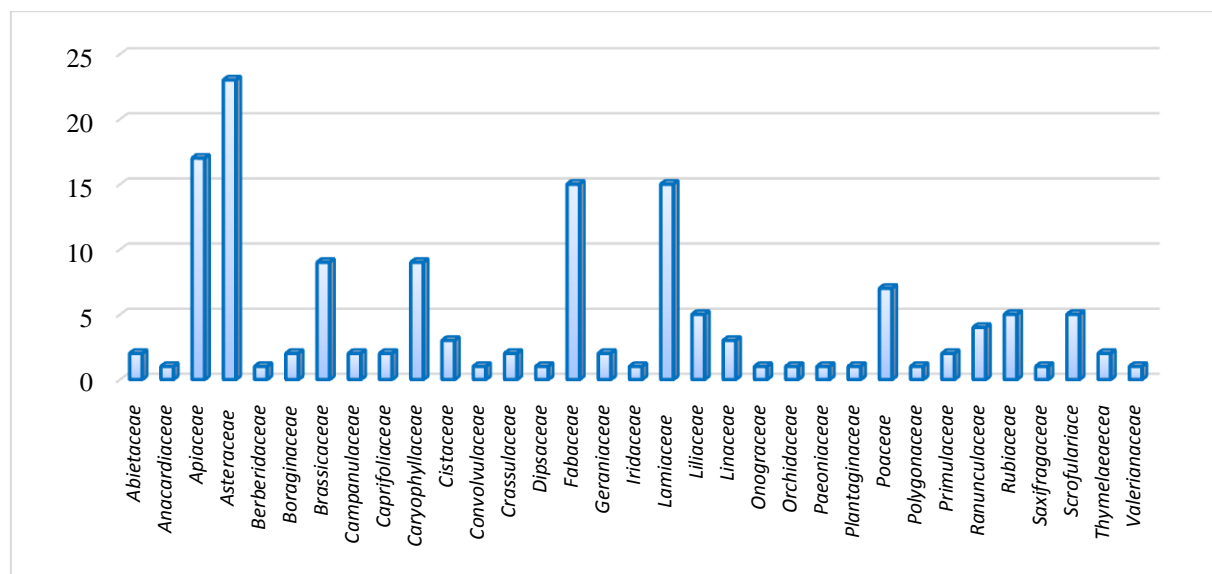


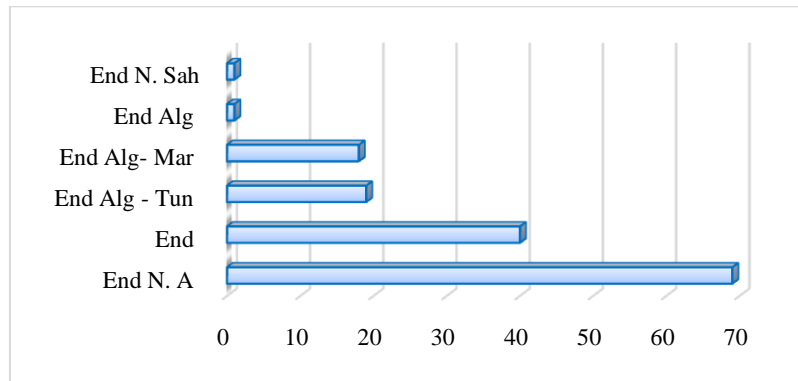
Fig.2. Distribution of endemic taxa by botanical family

According to phytochoric elements, the endemic flora of the Sétif region is distributed as

follows (fig. 3): the strict endemics of Algeria represent 42 taxa (6.75%). The other taxa

consider as regional endemics including 69 North Africans, 19 Algerian-Tunisians and 18 Algerian-Moroccan with a single species endemic to the North of the Sahara distinguished in the semi-arid steppe in djebel Zdimm. However, among the 148 taxa inventoried, 25 subspecies are reported

at the five stations. The Babors mountains individualize with 16 subspecies, djebel Megress with 7 subspecies, djebel Zdimm and Youssef with a similar number of 5 subspecies, and djebel Boutaleb with 3 subspecies.

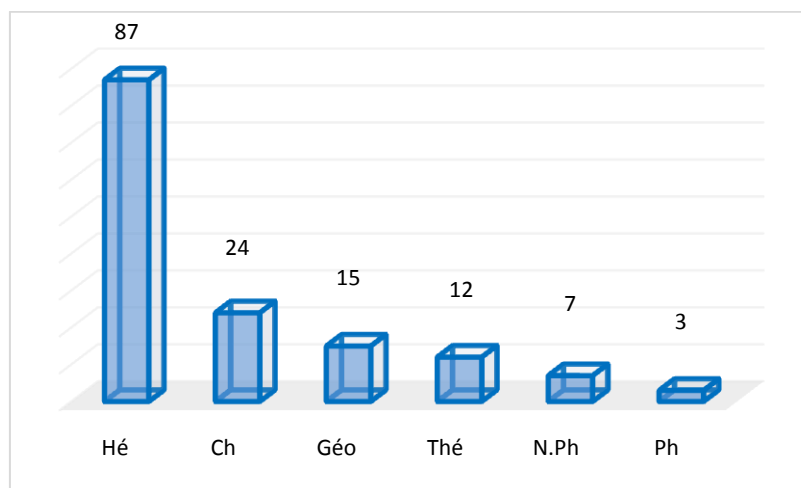


**Fig. 3.** Phytochoric distribution of endemic taxa in the Setif region

Morphologically, we found that the majority of species inventoried are perennials with predominant hemicryptophytes with 58.78% (87 taxa), followed by chamaephytes with 24 taxa (16.22%) and geophytes with 15 taxa (10.13%). The therophytes are manifested by 12 taxa (8%). The phanerophytes are represented by 10 taxa. So

we can adopt this classification of biological types : He > Ch > Geo > Th > N.ph > Ph (fig. 4).

Analysis of this structure revealed the existence of two lasting components representative of the resilience of endemic taxa in the Sétif region, the hemicryptophytes in the North and the chamaephytes in the South.

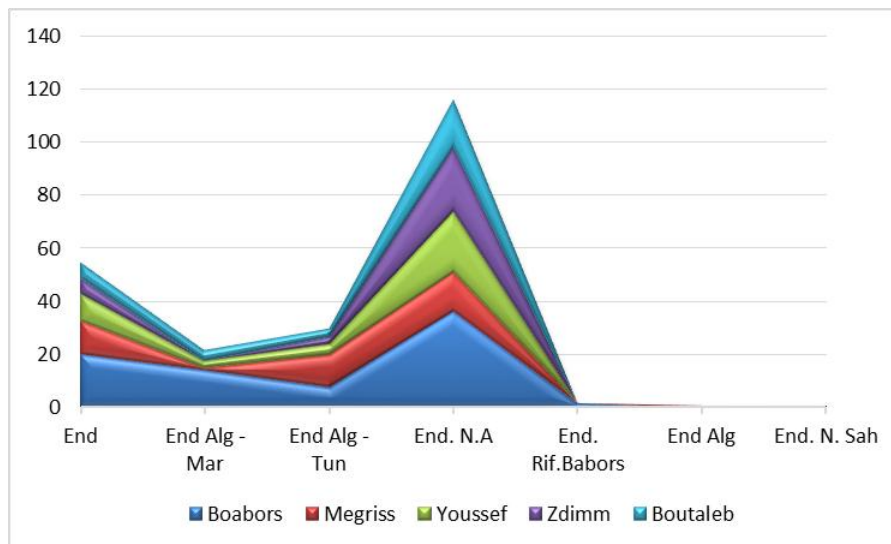


**Fig.4.** Different biological forms characterizing the endemic flora of Setif

#### 4. Discussion

Knowledge of Algerian flora remains rather fragmentary and incomplete. Quézel (1964) [19] gives, for Algeria, 247 endemic species of Algeria, 126 endemic North African species, 117 West North Africa and 59 East North Africa. Enriquez-Barroso and Gomez-Campo (1991) [20] put forward a figure of 176 species and 80

endemic subspecies, with 256 taxa specific to Algeria and 521 taxa (including species and subspecies) common with Tunisia and Morocco (endemic to North Africa in the broad sense). By updating this list, we note a higher figure of 320 endemic species for Algeria, without referring to the subspecies, and 1038 endemic species for all 3 countries of the Maghreb [21] (fig. 5).



**Fig.5.** Frequency of endemic elements according to the ecosystems selected

The endemic taxa clearly mark the study region with 148 taxa including 25 subspecies with individualization of Babors by two endemic species of the Rif-Babors (*Satureja grandiflora* Maire, *Convolvulus dryadum* Maire), djebel Megriss by a species endemic to Algeria (*Gagea granatelli* Parl.) and djebel Zdimm by a strict endemic species of the North of the Sahara (*Argyrobium saharae* Pomel). The relative importance of these species denotes the richness in endemic taxa of this region and thus makes it possible to reconstitute the history and the causes of endemism and the speciation of certain stations and to clarify the relationships and the evolution between the phenomena regional geological, pedological and climatic conditions in eastern Algeria.

It is in this sense that several authors have insisted on the importance of endemic species of well-defined regions in reconstructing the history of biogeographical zones [22, 23].

The distribution of the biological types of the species listed is highly variable within the ecosystems selected. Knowing that in forest and pre-forest ecosystems (Babors, Boutaleb and Megriss) the dominant biological type is represented by the hemicryptophyte where there are a total of 74 taxa unlike the steppe ecosystems (Zdimm and Youssef) which are distinguished by the predominance of Chamaephyte with 14 taxa.

According to the results obtained several endemic species are common between the different stations despite their difference in their climatic nuances (humid, semi-arid cool and semi-arid lower (fig. 4). The greatest correspondences in endemic taxa are

distinguished in steppe ecosystems in djebel Youssef and Zdimm where we find 28 taxa are common for the two massifs including 23 species and 5 subspecies: *Paronychia arabica* (L.) DC subsp. *aurasiaca* (Webb.) Maire and Weiller, *Astragalus armatus* Willd. subsp. *tragacanthoides* (Desf.) Maire. *Thymus ciliatus* Desf. subsp. *eu-ciliatus* Mayor *Gagea granatelli* Parl. subsp. *eu-granatelli* M. *Genista microcephala* subsp. *genuina* M.

The common endemics between Babors and djebel Megriss are 18 taxa including 16 species and 2 subspecies: *Linum outfit* Desf. subsp. *outfit* Martinez, *Astragalus armatus* Willd. subsp. *numidicus* (Murb.) Emberger and Maire. Concerning common endemics for all the stations there are 5 species with only one subspecies; *Thymus ciliatus* Desf. subsp. *eu-ciliatus* Mayor. Also, it is important to note the specific uniqueness noted for each ecosystem knowing that the Babors are individualized with 50 taxa including 2 strict species from the Rif des Babors, the djebel Megriss with 18 taxa, and in djebel Youssef, Zdimm, and Boutaleb we have found 6 uni-specific taxa for each one.

Endemism and species richness represent the complexity and uniqueness of natural ecosystems and allow the identification of hotspots of biodiversity [24,25]. For the historical reconstruction of the different biomes and biogeographical zones, it is necessary to take into account the notion of the overlapping areas of distribution of endemic species belonging to different taxonomic groups [22].

A fact of field observation deserves to be reported concerning rare and protected endemic species, it is the presence of 15 rare and protected



endemic species (According to decree n ° 93-285 corresponding to November 23, 1993) are declared in the list setting out the non-cultivated

plant species protected throughout the Algerian territory (Table 2).

**Table 2.** *Endemic and protected species of the Sétif region*

Species	Station	Species	Station
<i>Allium trichocnemis</i> J. Gay	2	<i>Rumex algeriensis</i> Barr. et Murb.	2
<i>Arabis doumetii</i> Coss	1	<i>Saxifraga numidica</i> Maire	1 - 2
<i>Argyrolobium saharae</i> Pomel	4	<i>Scrofularia tenuipes</i> Coss. et Dur.	2
<i>Brassica dimorpha</i> Coss. et Dur.	3 - 4	<i>Senecio gallerandianus</i> Coss. et Dur	1 - 5
<i>Convolvulus dryadum</i> Maire	1	<i>Silene cirstensis</i> Pomel	2
<i>Convolvulus dryadum</i> Maire	1	<i>Stachys guyoniana</i> De Noé	2
<i>Epilobium numidicum</i> Batt.	2	<i>Teucrium atratum</i> Pomel	1
<i>Epimedium perralderianum</i> Coss.	1	<i>Teucrium kabylicum</i> Batt.	1
<i>Helianthemum helianthemoides</i> (Desf.) Gr.	1 - 2	<i>Vulpia obtusa</i> Trab.	2
<i>Pistacia atlantica</i> Desf.	3 - 4 - 5		

The steppe ecosystems of Sétif have already suffered severe degradation due to climate change and strong anthropization. This situation is detrimental to plant resources and to the loss of endemic taxa and especially those representing specific and situational uniqueness [26].

This alarming level of vulnerability prompts us to recommend the establishment of an emergency intervention plan, the main conservation strategies of which are aimed at delimiting the protected areas of endemic species.

## Conclusions

Data on endemism in Algeria are scarce and fragmentary. The region of Setif by its geographical position combines pedological factors and great climatic variations allowing the development of a rich and varied endemic flora with many subspecies reported for the first time. The results obtained inform us of a worrying state of degradation and rarefaction of the Setifian endemic flora because several taxa are declared rare and protected and others encountered only once in this region.

Knowing that there is no legislation protecting regional and endemic taxa in Algeria, it is, therefore, time to think seriously about the protection of these species and to establish urgently a management strategy to conserve these habitats and their plant heritage.

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