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Research Article

Floristic and Ecological Study of *Erica arborea* L. in the Western of Algeria

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Abstract

This work focuses on clusters in *Erica arborea* L in western Algeria. To understand the floristic diversity of groups in *Erica arborea*. A floristic analysis was carried out based on floristic surveys on three regions in western Algeria according to an aridity gradient. This allowed us initially to count 100 species belonging to 75 genera and 40 families, which are predominated by asteraceae and lamiaceae with 08% of each family, Mediterranean elements dominate the biogeographical type with a percentage of 43% followed by the western Mediterranean elements. Therophytes predominate the biological spectrum of this flora with 39% followed by chamephytes with 28%. The abundance analysis shows the predominance of common elements with more than 83% of the flora, 12% of rare elements and 4% quite rare. Three morphological forms predominated by perennial woody. The Shannon (H) biodiversity index was between 2.99 and 3.37, while the Simpson index was between 0.91 and 0.95, and the Piélou equitability situated from 0.86 to 0.89. Whereas the disturbance index (DI) varied between 53 and 71%. These results show the anthropogenic pressure exerted on this ecosystem due to human activities and climate change, which requires the development of emergency restoration and conservation plans.

Keywords: Analysis, *Erica arborea* L, floristic diversity, restoration, Western Algeria.

Introduction

The genus *Erica* (heather) is the largest genus in the family *Ericaceae*, with 22 species in the mountains of East Africa and 50 species in Madagascar, but the great diversity (about 700 species) is found in the southwestern Cape region of South Africa [1]. *Erica arborea* is the only specie found in Europe and Africa which gave

them a disjunct range. It is a native species of the Mediterranean basin [2,3].

This specie grows on barrens, slopes, and forest edges amidst siliceous and low-acid soils, but also calcareous [4]. Known for its excellent charcoal and pipes made from its roots, *Erica arborea* is also commonly used in the traditional medicine since the Middle Ages for its therapeutic virtues, as: antiseptic, sedative, anti-inflammatory and antiputrid [5-7].

Algeria occupies an important place on the part of its Mediterranean floristic diversity. The phytogeographic sector of Oran alone contains about 1,780 plant varieties of the total Algerian flora, representing about 57 percent of the

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national flora [8]. In the last decades, several factors have been threatening significant populations of habitats and their associated plants. The extinction rate of higher Mediterranean plants has been estimated at 0.15% in total, which corresponds to 37 presumably extinct species, totaling more than 4,250 taxa [9]. It is thus essential to establish an effective method to improve the management of vegetation and to assure their conservation.

In Algeria, studies about the composition of forest and pre-forest stands are still insufficient [10] and the identification and description of plant stands is a crucial step for the understanding of arid environments[11] firstly, and secondly, for an effective plan of vegetal conservation, which also requires identification and a description of the plant communities [12].

In Algeria, *E.arborea* is present across the Tell, constituting a significant part of the scrub in the cork oak forests of the center and the East, and more abounding in the scrub areas deprived of

any trees, which do not exclude its constant presence in combination with cedar and holm oak in the high plateaus [2,3].

The analysis of the floristic diversity of the various species, as well as their biological and chronological character, would emphasize their floristic originality, their state of conservation and their heredity value [13].

In this context, the aim of this study was to characterize the floristic diversity of *Erica arborea*. L communities at the systematic, biological, morphological, and biogeographical levels.

Material and methods

Presentation of the study area

Station of Saida. The choice of the study sites was practically obligatory, but it has been determined according to the presence of the species *E.A* in the west of Algeria. This has allowed us to characterize three sites that are representative for the study area (Figure 1).

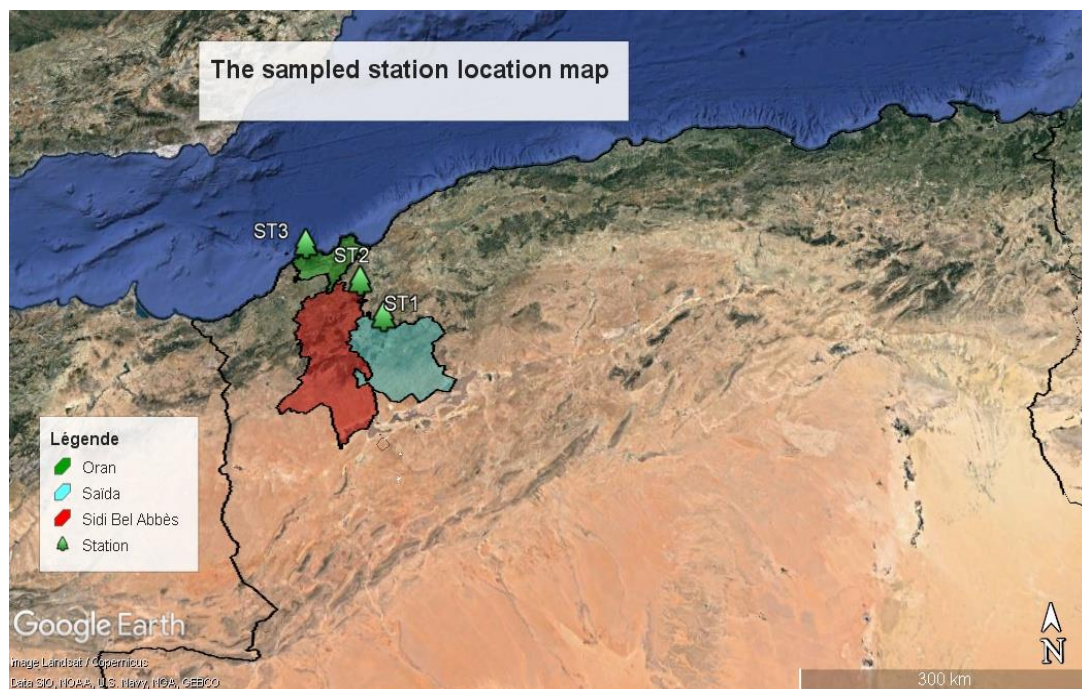


Figure 1. The location map of the stations sampled (source: google earth pro 2023)

Tefrent forest. The forest of Tafrent is in the daïra of Sidi Boubekeur and is divided into the following three municipalities: Sidi Boubekeur, Sidi Amar, and Ouled Khaled. It is located north of the wilaya of Saida, with 15 km from the main town of the Wilaya with an area of 12228 ha. It is at the junction of three municipalities, including Sidi Boubekeur, Sidi Amar and Ouled Khaled (Figure 1). The administrative and forest management is ensured by the Circumscription of Sidi Boubekeur

(Forest conservation Direction of Saida). The type of the climate of the area is Mediterranean belonging to the bioclimatic semi-arid fresh stage, with irregular and weak pluviometry (between 300 and 370 mm / year). The altitudes are high (1,000 m on the average) [14]. The types of soils are poorly evolved, calcareous brown soil, rendzine, fersiallitic, calcomagnesium, and isohumic brown soils [15] (Table 1).

Table 1. Geographical and phytoecological characterization of Station 01

Station	The forest of Tafrent - district of Sidi Amar- wilaya of Saida					
Number statement	01	02	03	04	05	
longitude	0.071007°	0.104442°	0.105882°	0.106897°	0.105542°	
latitude	34.952276°	34.929496°	34.930113°	34.929449°	34.928869°	
altitude (m)	864	1053	1027	1004	1045	
slope (°)	6	10	12	30	16	
Bioclimatic floor	Semi-arid to cold winter [14]					
Pluviometry	Between 300 and 350 mm/year [27]					
Vegetation floor	meso-mediterranean	Supra- mediterranean [14]				
Nature of soil	brown calcareous, rendzines, fersiallitic, calcomagnesian, and brown isohumic soil [15]					
formation	degraded aleppo pine forest					
exposure	NE	N	NE	NE	NE	
grazing	Medium	Intense	Medium	weak	Medium	
fire	Yes	Yes	Yes	Yes	Yes	
regeneration	Yes	Yes	Yes	Yes	Yes	
Total recovery	40	50	60	50	70	
Number of taxa	43	38	32	39	39	

Table 2. Geographical and phytoecological characterization of Station 02

Station	Forest of Guetarnia district of Ain aden wilaya of Sidi bel abbes				
Number statement	06	07	08	09	10
Longitude	-0.207653°	-0.206228°	-0.203637°	-0.210378°	-0.208325°
Latitude	35.286069°	35.283842°	35.283316°	35.282258°	35.283128°
altitude (m)	707	693	704	734	706
slope (°)	14	6	27	25	14
Bioclimatic floor	Semi-arid to temperate [18]				
Pluviometry	350 mm/year [18]				
Vegetation floor	Meso- mediterranean [18]				
Nature of soil	clay-sandy to sandy [17]				
formation	degraded aleppo pine forest				
exposure	SE	N	N	N	N
grazing	Medium	Medium	Intense	weak	Medium
fire	Yes	Yes	Yes	Yes	Yes
regeneration	Yes	Yes	Yes	Yes	Yes
Total recovery	50	40	45	30	30
Number of taxa	60	52	54	53	57

Table 3. Geographical and phytocological characterization of Station 03

Station	The forest of M'sila district of Boutlilil wilaya of Oran				
Number statement	11	12	13	14	15
Longitude	0.890318°	-0.886353°	-0.884326°	-0.887532°	-0.891432°
Latitude	35.642532°	35.641264°	35.644014°	35.645999°	35.645950°
altitude (m)	364	358	371	378	382
slope (°)	1	1	1	3	3
Bioclimatic floor	Semi-arid to mild winter[19]				
Pluviometry	450 mm/year [38]				
Vegetation floor	Thermo-Mediterranean [19]				
Nature of soil	clayey-siliceous of the intermediate soil type [38]				
formation	cork oak forest				
exposure	SE	S	S	NW	S
grazing	weak	NO	NO	weak	NO
fire	NO	NO	NO	NO	NO
regeneration	Yes	Yes	Yes	Yes	Yes
Total recovery	70	85	80	75	80
Number of taxa	34	32	35	27	33

Station of Sidi Bel Abbes (forest of Guetarnia).

The forest of Guetarnia is in the northwestern region of Algeria and is part of the mountains of Beni-Chou Grane. Guetarnia is situated between longitude 0°00 and 0°30'E and latitude 35°00' N and 35°30' N with an area of 10,140.12 ha and concentrated between two wilayas: the Wilaya of Mascara with an area of 2,818.82 ha and the Wilaya of Sidi-Belabbes with 7,321.30 ha (Figure 1). The forest of Guetarnia has a rugged topography of mountains and foothills with an altitude ranging between 411.8 and 813 m inducing a slope class ranging from 15 to 30% to more than 55% [16] Soils are clayey-sandy to

sandy [17] The forest is in the semi-arid to temperate bioclimatic stage variant with an average annual rainfall of 350 mm [18] (Table 2).

Oran station (the forest of M'sila). The forest of M'Sila is located 30 km, west of the city of Oran and 7 km north of Boutlélis. It covers an area of 6163 Ha and includes six cantons. Administratively, it under the territorial jurisdiction of the Wilaya of Oran (Figure 1) and depends on the conservation of the forests of the same wilaya, and the forest circumscription of Boutlélis. It is subject to the semi-arid climate with mild winter [19] (Table 3).

Working method

We have focused our work on the establishment of an inventory of the groupings in EA. The inventory was carried out at the level of different ranges of EA in western Algeria.

The results obtained in this present study are from field observations that took place between March and May of 2021-2022 at the three stations chosen. During this period, most perennials are in flower and the greatest number of therophytes appear [20, 21]. Floristic inventories were conducted based on expert assessment, using a subjective sampling plan for site selection [22]. and systematically to the availability of the species EA and the ecological gradient (altitude ranging

from 360 to 700 to 1055m) (Table 1). These inventories were based principally on the list of taxa in the 15 floristic surveys that were done at the three stations over two consecutive years using Braun-Blanquet method (1951).

The distribution of areas, in the Mediterranean region, between forest areas and matorral formations are estimated between 100 to 400 m² 50 to 100 m² respectively [23]. For the present study, we have chosen a minimum area of 100 m², to obtain satisfactory and analyzable results.

Two steps guided our work methodology, the analysis of the vegetation through the elaboration of floristic lists with the quantitative estimations of the different aspects of the vegetation and the statistical treatment of the floristic data. The floras

used for the determination of the collected taxa, their families, the chorological types, and the rarity of these species are: The new flora of Algeria and the southern desert regions by Quezel and Santa (1962-1963) [24], the Angiosperm Phylogeny Group 2016 by byng and al [25] and the North African synonym index by Dobignard and Chatelain (2010-2013) [26] for updating the flora. Using the modified TWINSpan method, integrated into the JUICE 7.0 program [27]. We calculated for each survey the following diversity indices: Shannon Wiener Index, Simpson's Index, Pielou J' Equitability Index and Disturbance Index.

Results and discussion

The results of the numerical and floristic analysis of the study area are shown in (Table 4).

1. Taxonomic diversity:

The floristic richness of the study areas is 100 taxa; belongs to 75 genera and 40 families of subphylum angiosperms and gymnosperms species. The distribution of taxa is very unequal within these different botanical families, which

they are divided into families in the following order:

1. Asteraceae and Lamiaceae with 08 species of each family, or 08%
2. Cistaceae; Fabaceae and Poaceae with 07 species of each family, or 07%.
3. Caryophyllaceae with 06 species or 06%
4. Fagaceae, Oleaceae and Papaveraceae with 04 species of each family, or 04%.
5. Asparagaceae, Cupressaceae, Apiaceae, Brassicaceae, Linaceae and Primulaceae with 03 species of each family, or 03%.
6. Ericaceae and Euphorbiaceae; with 02 species of each family, or 02%.

And finally, the families of: Anacardiaceae, Apocynaceae, Araleaceae, Pinaceae, Arecaceae, Boraginaceae, Caprifoliaceae, Convolvulaceae, Cytinaceae, Iridaceae, Malvaceae, Myrtaceae, Plantaginaceae, Rubiaceae, Smilacaceae, Thymelaeaceae, Residaceae, Crassulaceae, Dioscoreaceae, Ephedraceae, Gentianaceae, Polygonaceae and Xanthorrhoeaceae with 01 species of each family, or 01% (Figure 2).

Table 4. Floristic and numerical analysis of study area

Station (drill)		St1: Tafrent	St2:Guetarnia	St3:M'sila	Total
Systematics of Composition (%)	Families	24	31	23	40
	Genres	46	54	34	75
	species	55	66	39	100
Biological type	Ph	16	15	31	18
	Ch	33	27	28	28
	He	11	8	8	8
	Th	33	44	26	39
	Ge	7	56	6	7
Biogeographic type	With	42	50	44	43
	W.med	11	6	10	8
	Euro. med	4	3	3	5
	other	43	41	43	44
degree of abundance and rarity	C, CC, CCC, AC	87	87	87	84
	R, AR	13	13	13	16
morphological type	WP	47	41	56	45
	HP	22	15	18	18
	AH	31	44	26	37
Biodiversity indices	DI	66%	71%	53%	63%
	Shannon	3.37	3.54	2.99	3.30
	Simpson	0.94	0.95	0.91	0.94
	PIELOU	0.92	0.88	0.86	0.89

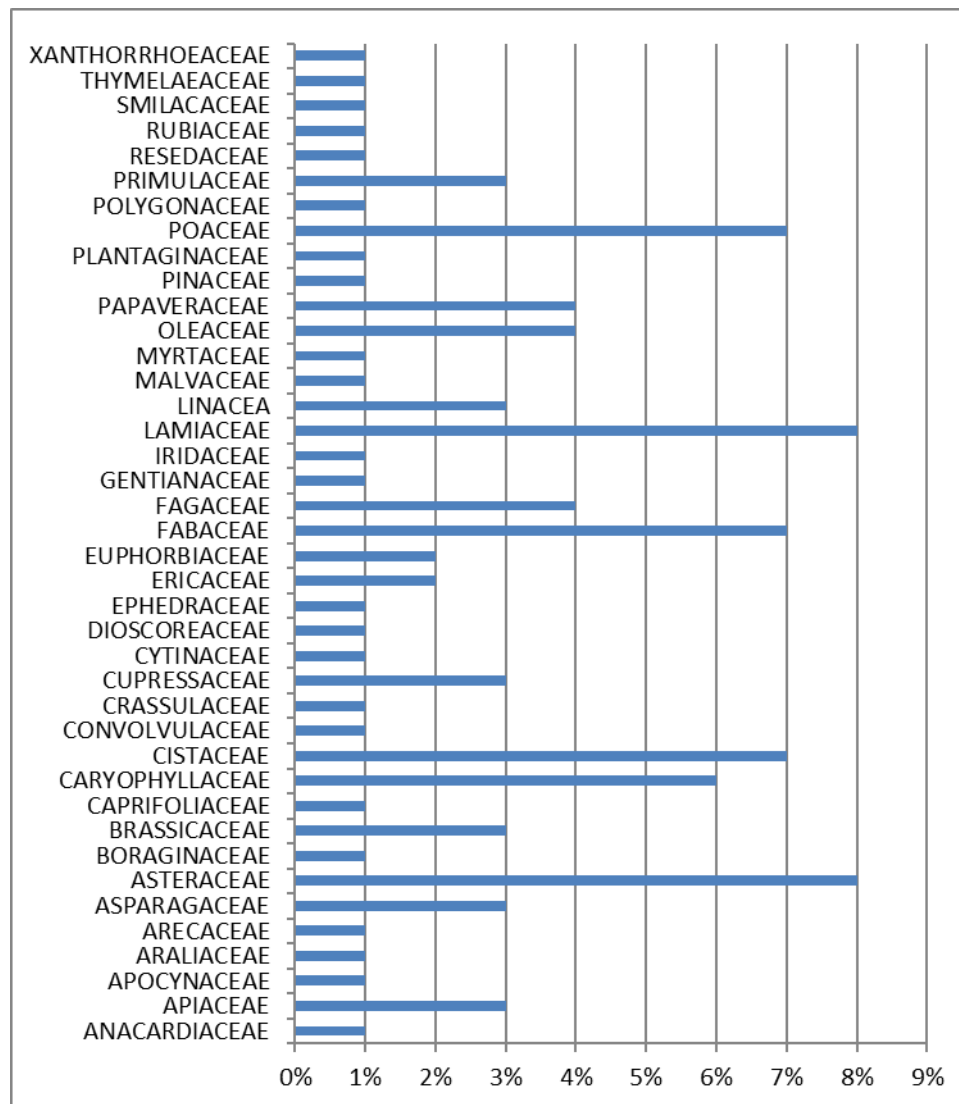


Figure 2. Contributions of botanical families in percentage

The most represented genres were:

1. Cistus with 06 species, or 06%.
2. Silene with 05 species, or 05%.
3. Quercus with 04 species, or 04%.
4. The genera Phillyrea, Thymus and Linum with 03 species of each genus, or 03%.
5. The genera of: Calicotome, Anagallis, Euphorbia, Genista, Papaver, Juniperus and Teucrium with 02 species, or 02%.

The common species associated with EA in all three studied stations were: *Arbutus unedo* L., *Pinus halepensis* Mill., *Quercus coccifera* L., *Rosmarinus eriocalyx*, *Bellis sylvestris* Cirillo, *Chamaerops humilis*, *Lavatera tremestris*, *Cistus halimifolius* L. *Cistus salviifolius* L., *Dactylis glomerata* L., *Genista quadriflora* Munby, *Genista tricuspidata* Desf., *Horedeum murinum*, *Anthemis valentinus*, *Mauranthemum decipiens*, *Papaver hybridum*, *Ampelodesma mauritanicum*, and

Phillyria media. This floristic plant diversity of the studied areas was distributed according to the stations as follows:

1.1 Station 1 - The forest of Tafrent:

It contains 55 species with 46 genera and 24 families in the following order: - Asteraceae and Lamiaceae with 11%. Cistaceae, Fabaceae and Poaceae with 09% for each one, followed by Apiaceae, Brassicaceae and Oleaceae with 05% of each family. Ericaceae, Euphorbiaceae, Fagaceae and Papaveraceae are represented by 4% only, while the remaining families were poorly represented.

1.2. Station 2 - Guetarnia forest:

It contains 66 species with 54 genera and 31 families in the following order:

-The most frequented families were the Cistaceae and Poaceae with 11%, followed by the Asteraceae and the Lamiaceae with 09% and

08% respectively. The families of the Fabaceae and Papaveraceae were represented by 6% each, and the Brassicaceae and Primulaceae with 05% of each family. The remaining families were poorly represented with 1% only of the floral diversity.

1.3. Station 3 - M'sila forest:

This station contains 39 species divided into 34 genera and 23 families in the following order:

- The most frequented families are the Asteraceae with 13% and Fabaceae with 10% followed by 8% of the Fagaceae and Poaceae ones each. Whereas Asparagaceae, Cistaceae, Ericaceae, Lamiaceae and Oleaceae were represented by 05%, while the remaining families were negligible.

These data show that in all the forest massifs of the Algerian Tell, the same plant families dominate in almost the same order [28-30]. In addition, these studied areas were characterized

by significant wooded, shrubby, and herbaceous forest vegetation, with a domination of Asteraceae, which is the largest family of flowering plants in Algeria with more than 408 species and 109 genera [24]. This family as well as Fabaceae, Lamiaceae, Brassicaceae, Apiaceae, Poaceae and Cistaceae families were characterized by their adaptations to extreme drought conditions [20, 30]. These seven families alone account for 43% of the total wealth of the 3 areas studied.

2. Biogeographical types:

The chorological analysis of the species identified in this current study clearly showed the very clear dominance of Mediterranean groupings with 43% of Mediterranean Biogeographical Type (MBT) species. The western Mediterranean groupings with 08%, 9% of Euro-Mediterranean and Ibero-Mauritanian one with 04%. The rest were no significant as showed in (Figure 3).

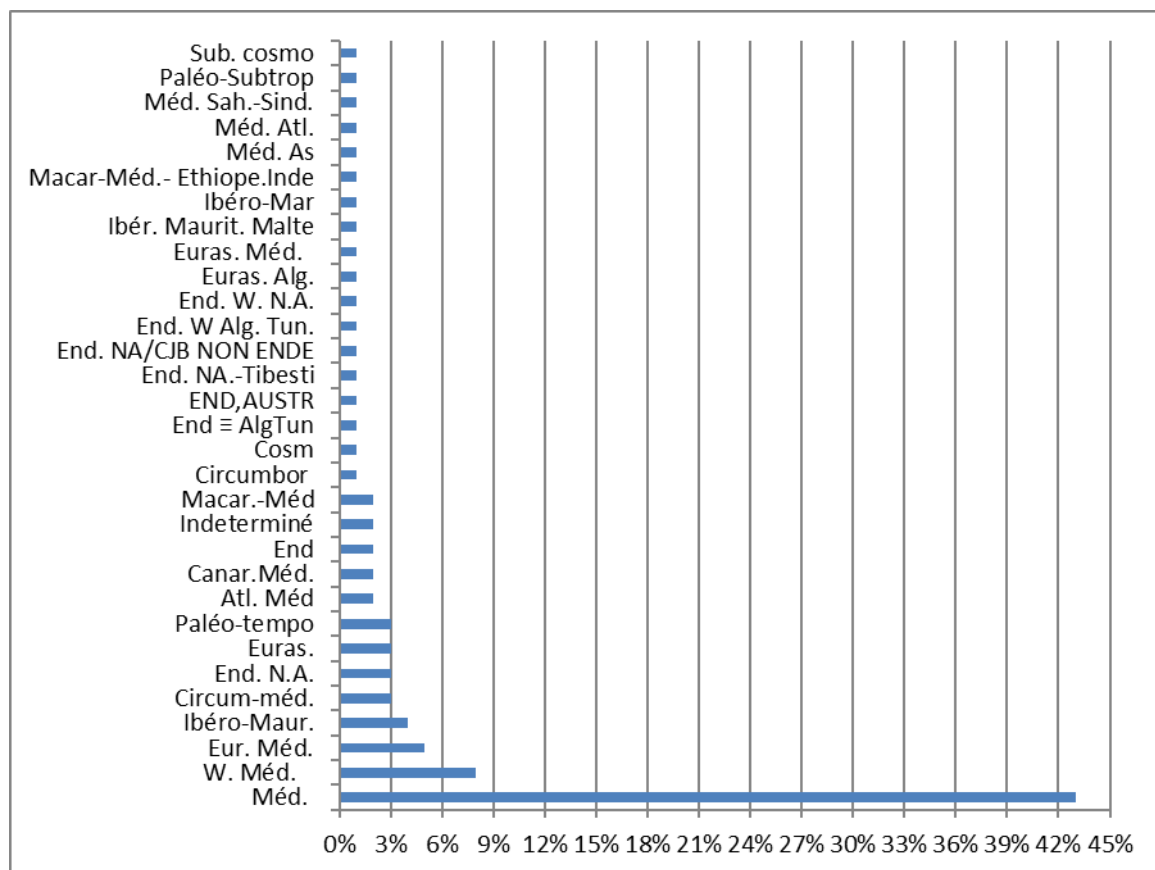


Figure 3. Distribution of biogeographic types of the flora inventoried in percentage

The distribution of the species inventoried biographically was very heterogenous in the three stations, where we noted the dominance of the Mediterranean biogeographical type, followed by the West Mediterranean one, with 42 and 11%

respectively for station of Tefrent. 50 and 6% for station of Guetarnia, then 44 and 10% in m'sila station. The endemic species of the area under consideration were few. We have noted the presence of four North African endemic species:

Genista tricuspidata. Desf., *Genista quadriflora* Munby, *Thymus ciliatus* and *Thymus munbyanus*. These results are in concordance with those of many authors at different regions of western Algerian: (Miara and al 2018) [28] in the mountains of Tiaret, (Belhacini and al 2017) [31] in the forest of bissa, (Medjahdi and al 2018) [32] in the oak woods of Tlemcen Mountains, (Djebbouri and Terras) [20] in the forests of Saïda, (Hedidi and al 2019) [33] in the mountains of Saïda wilaya of Chlef, and (Aouedj and al 2020) [30] in the mountains of Saïda.

3. Biological spectrum: Analysis of biogeographic types can provide information on the effects of environmental factors on local vegetation [34].

According to the global list of species identified in the current work, the composition of the biological spectrum showed a predominance of Therophytes (39%) over other life forms. Chamaephytes are moderately represented by 28%, followed by Phanerophytes with 18%. Hemicryptophytes and Geophytes are poorly represented with 08% and 07% respectively. The biological spectrum of our study follows the following order: TH>CH>PH>HE>GE (Figure 4).

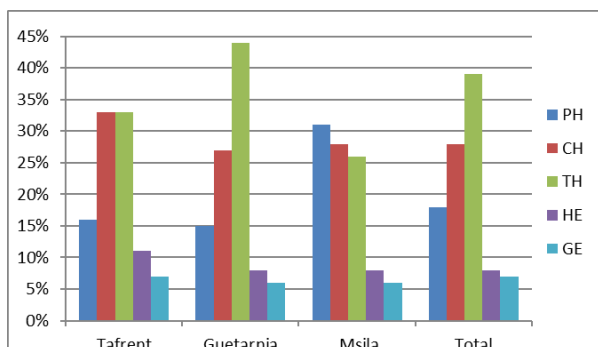


Figure 4. Biological spectrum of flora in percentage

The successions of the raw biological spectrum of the stations in the studied areas, confirm the heterogeneity that characterizes them. This therophytisation is linked on the one hand to anthropogenic actions, and the harshness of the climate on the other hand, this Therophytisation indicates globally the floristic richness of the herbaceous stratum of the stations, in addition to the aridity of the environment [35-37]. The Chamaephytes which represented only 28%, are widely known for their ability to develop various forms of adaptation to drought, including the reduction of the foliar area and the development of the rooting system [37]. This was the case of station of Tefrent (33% of Chamaephytes on a par with Thyrophytes). For station 03, as illustrated in (Figure 4), was characterized by the

predominance of Phanerophytes and Chamaephytes. This indicates that the arboreal stratum is floristically diversified and explains its closeness to the Mediterranean and its Mediterranean bioclimatic condition between the lower semi-arid and upper sub-humid, with an annual rainfall of 350 to 400 mm [38].

4. Degree of abundance in Algeria: The analysis of the degree of the flora abundance at the three stations allowed us to note, that most of the species listed are common to the Tell. However, some of rare species have been highlighted (Figure 5). According to Quezel and Santa (1962-1963) [24], there are 16% rare species, of which 12 taxa are considered too rare and 4 taxa quite rare (Figure 5). The rarity of these species in certain sectors of the Algerian territory is linked to their chorological affiliation, which denotes their specificities in terms of their adaptation to the stationary conditions of the environment [39]. These rare species are represented by the following taxa: *Bupleurum rigidum*; *Centaurea phaeolepis* Coss.; *Cirsium vulgare*; *Eryngium campestre* L.; *Euphorbia Squamigera* Loisel.; *Genista quadriflora* Munby; *Linum corymbiferum* Desf. Subsp. *Corymbiferum*; *Linum tenue*; *Papaver argemone*; *Phillyrea angustifolia* L.; *Platycapnos spicata* (L.) Bernh.; *Rosmarinus eriocalyx*, *Rosmarinus tournefortii*; *Rubia tinctorum*; *Silene cerastoides* L.; *Silene coelirosa* (L.) Godr; *Thymus numidicus*.

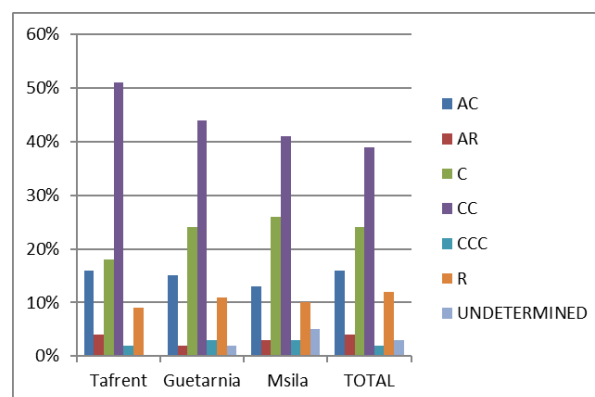


Figure 5. Distribution of the flora according to their degree of abundance in Algeria

5-Morphological types:

Despite the morphological point of view, the vegetation cover of our study stations was marked by heterogeneity between woody and herbaceous plants and between perennials and annuals. Perennial woody was predominated with 45%, followed by annual herbaceous with 37%, and perennial herbaceous plants in third rank with

18% (Figure 6). This indicates the floristic richness of our zones of studying with their three strata: An arborescent stratum, A bushy stratum and A herbaceous stratum.

The dominance of perennial woody plants is due to the predominance of the bushy stratum (*Pistacia lentiscus*, *Erica arborea*, *Arbutus unedo*). Except for station of M'sila (Figure 6), in which, we find the dominance of the tree stratum, such as *Quercus suber* and *Pinus halepensis*. Within Guetarnia station, we noticed the predominance of annual herbaceous species due to anthropozoic pressures such as repeated fires, overgrazing and land clearing. Wilson (1988) [40] states that severe degradations affect species regeneration and non-regeneration of perennial plants leads to changes in potential production and botanical composition. Additionally, Barbero and al. (1990) [41] report that disturbances caused by humans and their herds are numerous and correspond to two increasingly many situations ranging from matorralization to desertification through steppisation.

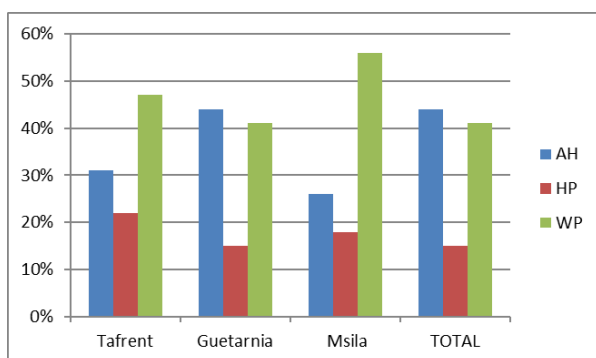


Figure 6. Morphological type of flora in percentage

6-Diversity indices:

6.1. Disturbance index: The disturbance index is used to quantify the therophytization of an environment [42].

$$DI = \frac{(\text{Number of Chamaephytes} + \text{Number of Therophytes})}{\text{Total species number}}$$

6.2. Shannon Wiener Index: This index considers the number of species and the regularity of the species. The index is increased either by having more unique species or by having greater uniformity [27], its value is between 0 bits and 5 bits per specie.

6.3. Simpson's index: This equitable index is used to express the dominance of species when it tends towards 0, or the codominance of several species when it tends towards 1 [43].

6.3. The J'de Pielou equitability index:

Corresponds to the ratio between the diversity obtained and the maximum diversity. It expresses the regularity or equitable distribution of individuals within species. Equitability is low when $Eq < 0.6$; mean when Eq is between 0.6 and 0.8 and high if $Eq \geq 0.8$ [43].

Depending on the station, we noted the increase in the value of the disturbance index (DI) in each of stations of Tafrent and Guetarnia (66 and 71% respectively) due to the zoo-anthropogenic pressure factor exerted in these areas (fire, clearing, overgrazing). The portion of the area burned at the Guetarnia forest was 31 ha/year from 1903 to 1922, to be more important (8 x more); 250 ha/year were damaged between 1981 to 2014 [18]. According to the forest administration of the wilaya of Saida, a total of 73 fires have been recorded in the forest of Tafrent during the last decade, destroying approximately 869 ha of the vegetation zone. The overgrazing observed at both stations Tafrent and Guetarnia, mainly due to goat and sheep, since they are released by the shepherds without control, which can limit the regeneration of forest species. However, this DI was lower at the M'sila station (53%), because this forest is protected and fenced by the authority (Order No. 699 of March 11, 2015) [44]. These DIs (rates) reflects an opening of environments and give an idea about the important changes in floristic composition [45]. The value of the Shannon index varied between 2.99 and 3.54 bit, which leads to the conclusion that the studied areas have moderately homogeneous and diversified environment [46]. For the Simpson index which varied between 0.91 and 0.95, reflecting a low diversity of stands [45], and this may be due to the codominance of several species in each station (ex. Station of Tafrent: *Pinus halepensis*, *Quercus ilex* and *Quercus coccifera*; Station of Guetarnia: *Pinus halepensis*, *Quercus coccifera* and *Tetraclinis articulata*. and *Pinus halepensis* and *Quercus suber* in Station of M'sila). Finally, the value of the Pielou equitability index was between 0.88 and 0.92 showing an equitable distribution among species [47-58].

Conclusions

The study of floristic compositions of *Erica arborea* L. in western Algeria showed a significant floristic diversity. This diversity represented by 100 species, 75 genera, 40 botanical families, 31 biogeographical types, 5 biological types, 3 morphological forms and 6 elements of degrees of abundance classed between rare and quite rare. The floristic groups of EA. were characterized by the predominance of

elements resistant to the climatic hardness and to the anthropogenic pressure. In addition to an equitable distribution among species and a richness of taxonomic biodiversity at the high-altitude mountain areas (Guétarnia forest and Tafrent forest) in comparison to the M'sila forest, which known by its low altitude.

This present work confirms the results of the previous study conducted in Algeria. on *EA* clusters in the Bissa forest, (north-west of Algeria), with a slight deference between these two studies regarding the species predominancy. In fact, their study, they observed a predominance of rosacea and annual herbaceous plants, while we reported a predominance of Cistaceae and perennial woody. In general, there is an important similarity in the floristic composition between the Bissa forest and the Guétarnia station as we observed. This probably due to the proximity of altitude between these two forests (between 500 to 750 m), in addition to the similarities in the topography (a very rugged relief) and in the climatic conditions (variable annual rainfall between 400 and 600 mm) between them. For a perspective proposal and to better understand the main factors involved in the evolution and what is the potential of floristic groups in *EA*. in western Algeria, as well as the principal habitat characterization of this species, we suggest conducting further studies by expanding the study area and including more phytoecological surveys with the introduction of environmental and climatic variables of the habitat.

Abbreviations:

Biological types:

PH: Phanérophytes. CH: Chamæphytes. HE: Hemicryptophytes. GE: Geophytes. TH: Therophytes.

Diversity Indices: DI: Disturbance Index. SH: Shannon Wiener index. SIMP: Simpson's index. SM-WIL: Fairness (regularity) Smith_wilson1996_Evar. PIELOU: The J'de Pielou Equity Index 1975

Types biogeographic (Quezel & Santa, 1962-1963):

Cent. -Med. = Mediterranean Centre. Circum-med. = Circummediterranean. E.- Med. = Eastern Mediterranean. Ibero. -Maur. = Iberomauretan. Med. = Mediterranean. Oro. Med = Oromediterranean. W. Med. = Western Mediterranean. End. = Endemic. End. A. N. = North African endemic. End. Alg. -Mar. = Algerian Moroccan endemic. End. Alg. -Tun. = Algerian-Tunisian endemic. Mad. = Madeira Archipelago (Portugal), including Ilhéus Salvages. Can. = Canary Islands Archipelago (Spain). Eur. = European. Euras. = Eurasian. Paleotemp. =

Paleotemperate. Atl. = Atlantic. Circumbor. = Circumborealis

Appreciation of Abundance (Quezel & Santa, 1962-1963): AC: quite common. C: common. CC: Very common. CCC: particularly widespread. AR: quite rare. R: rare. RR: Very rare. RRR: extremely rare.

Morphological type: WP: Woody perennial. HP: Perennial herbaceous. AH: Annual herbaceous.

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