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Floristic diversity of the Cap de Garde (North-East Algeria)

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Abstract

The Cap de Garde (North-East Algeria) has a rich floristic, estimated at 349 species representing 254 genera and 87 families. These species are either strictly subservient to the insular climate or transgressive to terrestrial environments. This work therefore focuses on the systematic study of the flora, the phytogeographical and biological significance of the floristic of this region. The preservation of this short-term exceptional biodiversity requires the urgent establishment of scientific studies and appropriate safeguards.

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Introduction

If the rich floristic and biogeographical interest of the Mediterranean basin are now highlighted worldwide (Myers *et al.,* 2000; Médail and Myers, 2004). This area is considered a hot spot, known as the "biodiversity hotspots" (Myers *et al.,* 2000). This hotspot is characterized by species richness and endemism (Myers, 1988-1990) and by the increasing anthropogenic threats (Myers *et al.,* 2000).

Algeria, and especially Numidia K3 (as proposed in the biogeographic divisions by Quézel and Santa 1962), is rich in endemic (76 endemic species) (Quézel and Santa, 1962-1963). All mountains of the Algerian-Tunisian coast called "Kabylias-Numidia-Kroumirie" have high plant diversity and a high rate of endemism (Véla and Benhouhou, 2007). Within the sector of coastal Numidia separate Jebel Edough truly as a geologically metamorphic barrier in two ecologically similar wetlands: one located in western Edough that is to say that of Guerbès- Senhadja and the other positioned at the eastern Edough, it is the Annaba-Bouteldja-El Kala region (Marre, 1992).

The Edough peninsula (including the Cap de Garde site) is an Important Algerian Plant Area (ZIP). It has indeed a great floristic diversity and richness in endemic and sub-endimic taxa with a fragmented area, rare in Algeria, often very localized (stenoendemics) (Yahi *et al.,* 2012; Hamel *et al.,* 2013).

On the plan of vegetation, there are few articles (Toubal-Boumaza, 1986; Toubal and Toubal, 1998; De Bélair *et al.,* 2005; Hamel *et al.,* 2013; Hamel and Meddad-Hamza, 2016; Hamel *et al.,* 2017).

This study essentially presents the biological and biogeographic order of the vascular flora of the Cap de Garde.

The purpose of this study is to determine the floristic composition of the study area due to lack of floristic data on this part of the Edough peninsula.

Material and methods

Study area

The Cap de Garde is located in the northeastern part of the Edough peninsula, it extends into the Mediterranean Sea with a length of 1785 m and a width of 785 m. It is limited to the northwest and southeast by the Mediterranean and south-west by the extension of the Edough massif itself (Hadj Zobir *et al.,* 2013).

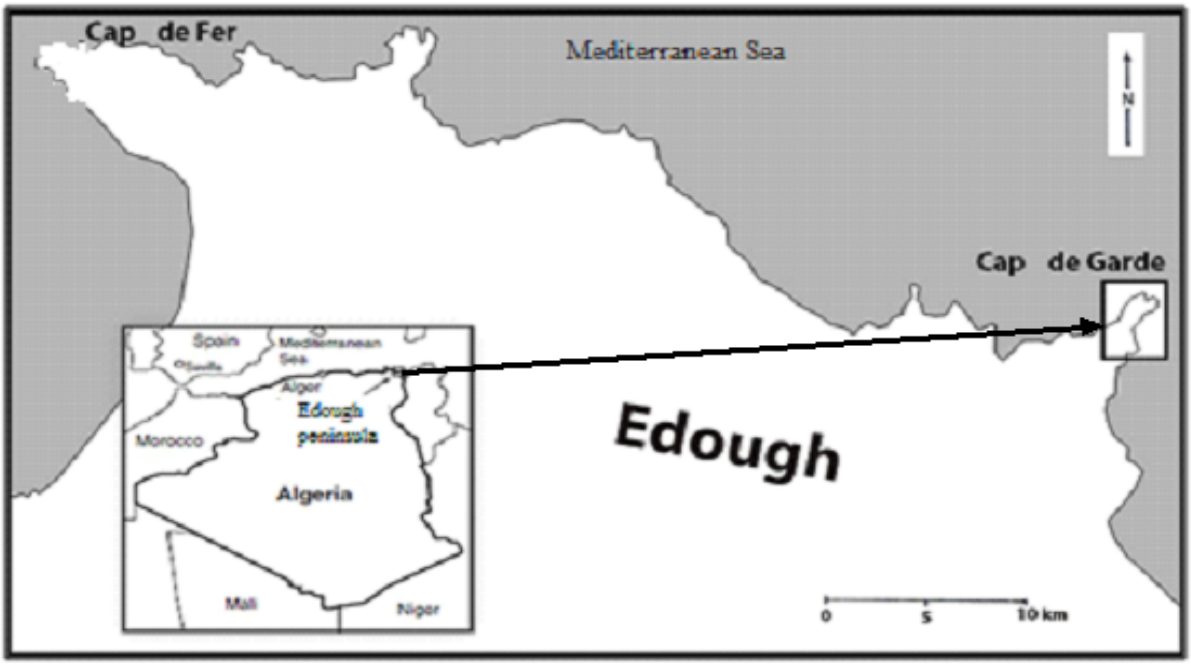

Fig. 1. Location of the study area

The Cap de Garde is characterized by a highly rugged, steep topography (P = 30-40%) (Oularbi and Zeguiche, 2009) (Fig.1). It is dominated by an exhibition of the North and Northeast, calcimagnesic rocks (Toubal and Toubal, 1998), marbles; very skeletal soil, unsaturated, dominated by the rock; burned, planted with *Pinus pinaster* Aiton, very trampled, washed away by the waters (Hamel, 2013). Among the characteristic species of the study area we have: *Pistacia lentiscus, Genista numidica, Genista ferox, Phillyrea latifolia, Olea europaea, Galactites mutabilis, Lithospermum rosmarinifolium, Teucrium fruticans, Chamaerops humilis, Helichrysum stoechas, Asteriscus maritimus* (De Bélair *et al.,* 2005).

Floristic study

Three stations are studied (The Cap de Garde cave, Sidi Aissa, Sidi Abderrahmen), we conducted 10 surveys in each station on a plot of 10m x 10m. The identification of species was made during 4 campaigns (2013-2014-2015, 2016). Taxa were identified according to the flora of Quezel & Santa (1962-1963). The new nomenclature was updated for the species surveyed in the light of recent work compiled in the synonymous and bibliographic index of the North African flora (Dobignard and Chatelain, 2010-2013). The recorded species were indicated by their biogeographical type recomposed by Pignatti (1982), Blanca *et al.,* (2009), Dobignard and Chatelain, (2010-2013), and their biological type according Raunkiar (1934), Pignatti (1982), Blanca *et al.,* (2009).

Statistical analysis

Species riachness corresponds to concepts of Alpha diversity (αaverage) and diversity Gamma (γ) (Whittaker, 1972). The Shannon index can express the diversity taking into account the number of species and abundance of individuals within each species (Gray *et al.,* 1992). Simpson's Diversity Index allows to express the dominance of a species when it tends to 0, or when several species codominance approaches 1 (Pielou, 1969; Pearson and Rosenberg, 1978).

Results and discussion

The vegetation sampling, carried out from 30 floristic, allowed us to inventory 349 taxa or 48.20% of the Edough peninsula flora estimated at 724 species (Hamel, Vela and De Belair, unpublished); predominantly broadleaf angiosperms who form the largest group systematically with 253 taxa belonging to 54 families and 183 genera; monocots gather 79 taxa in 20 families and 58 genera. Gymnosperms have 6 taxa distributed in 5 families. Depending on the distribution of pteridophytes as phytogeographical subdivisions of Algeria (Maire, 1952; Dubuis and Faurel, 1957; Quézel and Santa, 1962; Louhi-Haou, 2014) (Tab. 1), the sector of Numidia K3 contains 28 fern species, in this work we have identified half of the ferns seen in K3, namely 11 pteridophytes belonging to 8 families and 8 genera.

On the generic level, the best represented families are Asteraceae with 34 genera, Poaceae with 22, with 15 the Fabaceae and the Apiaceae with 12.

Table 1. Summary of the floristic diversity of the Cap de Garde.

	Pteridophyte		Monocotyledones		Dicotyledones				Total
					Gymnospermes		Angiospermes		
	Nb	%	Nb	%	Nb	%	Nb	%	
Families	8	9.2	20	22.98	5	5.74	54	62.06	87
Genera	8	3.15	58	22.83	5	1.97	183	72.04	254
Species	11	3.15	79	22.63	6	1.72	253	72.49	349

Nb. Number.

Let us add a very large number of orchids were observed in the study area (11 taxa). According to Hamel and Meddad-Hamza (2016), the Sidi Abderrahmen station is one of the richest resorts on the Edough peninsula with 12 taxa.

Many families are bigeneric and sometimes monogeneric (Tab. 2).

Table 2. List of species in Cap de Garde.

Taxa (Dobignard and Chatelain, 2010-2013)	Family	Bio. Type	BiogeograpType
Acacia melanoxylon R. Br.	Fabaceae	Ph	Intr
Adiantum capillus-veneris L.	Adianthaceae	Hem	Subcosm
Aegilops triuncialis L.	Poaceae	Th	Circummed
Aguga iva L.subsp. *iva*	Lamiaceae	Ch	Med
Aizoanthemum hispanicum (L.) Hartmann	Aizoaceae	Th	Med
Allium chamaemoly L. subsp chamaemoly	Alliaceae	Geo	Med
Allium roseum L.	Alliaceae	Geo	Med
Allium triquestum L.	Alliaceae	Geo	Med Atl
Ambrosinia bassii L.	Araceae	Geo	Subend
Ampelodesmos mauritanicus (Poiret) Durand	Poaceae	Hem	Med
Anacamptis longicornu (Poiret) Bateman, Pridgeon & Chase	Orchidaceae	Geo	Stenomed
Anacamptis papilionacea (L.) Bateman, Pridgeon & Chase	Orchidaceae	Geo	Circummed
Anacyclus clavatus (Desf.) Pers.	Asteraceae	Th	Med
Anagallis arvensis subsp. *arvensis* L.	Primulaceae	Th	Subcosm
Anagallis monelli subsp. *linifolia* (L.) Maire	Primulaceae	Th	Med
Andryala integrifolia L.	Asteraceae	Th	Circummed
Anemone palmata L.	Ranunculaceae	Geo	Med
Anogramma leptophylla (L.) Link	Hemionitidaceae	Th	Subcosm
Anthemis maritima L subsp. *Maritima*	Asteraceae	Hem	Med
Anthyllis barba-jovis L.	Fabaceae	Ph	Med
Arbutus unedo L.	Ericaceae	Ph	Med Atl
Arisarum vulgare Targ-Toz.subsp. *vulgare*	Araceae	Geo	Med
Aristolochiapaucinervis Pomel	Aristolochiaceae	Geo	Subend
Artemisia arborescens L.	Lamiaceae	Ph	Intr
Arum italicum subsp. *italicum* Miller	Araceae	Geo	Circummed
Arundo donax L.	Poaceae	Geo	Subcosm
Asparagus acutifolius L.	Asparagaceae	Geo	Med
Asperula aristata subsp. *longiflora* (Waldst. & Kit.) Hayek	Rubiaceae	Th	Med
Asphodelus ramosus subsp. *ramosus* L.	Asphodelaceae	Geo	Med Atl
Asplenium obovatum subsp. *obovatum* Viv.	Aspleniaceae	Hem	Med Atl

Asplenium onopteris L.	Aspleniaceae	Hem	Eur Med
Asplenium trichomanes subsp. *quadrivalens* D. E. Meyer	Aspleniaceae	Hem	Subcosm
Asteriscus maritimus (L.)	Asteraceae	Ch	Med
Avena sterilis L.	Poaceae	Th	Eur Med
Bellis annua subsp. *annua* L.	Asteraceae	Th	Med
Bellis sylvestris Cirillo	Asteraceae	Hem	Med
Beta vulgaris subsp. *maritima* (L.) Arcang.	Chenopodiaceae	Hem	Circummed
Biscutella maritima Ten.	Brassicaceae	Th	Med
Blakstonia grandiflora (Viv.) Pau	Gentianaceae	Th	Med
Bombycilaena discolor (Pers.) Laínz	Asteraceae	Th	Euras Med
Borago officinalis L.	Boraginaceae	Th	Med
Brachypodium sylvaticum (Hudson) Beauv	Poaceae	Th	Med
Brassica fruticulosa subsp. *mauritanica* (Coss.) Maire	Brassicaceae	Ch	End Alg-Tun
Brassica procumbens (Poiret) O. E. Schulz	Brassicaceae	Th	Med
Brassica rapa subsp. *campestris*L.	Brassicaceae	Th	Med
Briza maxima L.	Poaceae	Th	Med
Briza minor L.	Poaceae	Th	Med Atl
Bromus hordeaceus L. subsp. *hordeaceus*	Poaceae	Th	Circummed
Bromus rubens subsp. *rubens* L.	Poaceae	Th	Eur Seb
Bunium crassifolium Batt.	Apiaceae	Geo	End Alg-Tun
Cakile maritima subsp. *maritima* Scop.	Brassicaceae	Th	Med
Calamintha nepeta (L.) Savi	Lamiaceae	Ch	Med
Calendula arvensis subsp. *arvensis* L.	Asteraceae	Th	Med
Calendula suffruticosa Vahl subsp. *boissieri* (Lanza) Ohle	Asteraceae	Hem	End Alg- Tun
Calicotome villosa subsp. *villosa* Poiret Link	Fabaceae	Ph	Med Atl
Campanula kremeri Boiss. & Reuter	Campanulaceae	Th	Med Occ
Capsella bursa-pastoris (L.) Medik.	Brassicaceae	Th	Cosm
Cardamine hirsuta L.	Brassicaceae	Th	Subcosm
Carex flacca L.	Cyperaceae	Hem	Circumbor
Carex remota L.	Cyperaceae	Hem	Paleotem
Carlina involucrata Poiret	Asteraceae	Th	Euras

Carlina racemosa L.	Asteraceae	Th	Ibero N Af
Catapodium rigidum (L.) C.E. Hubbard	Poaceae	Th	Med Atl
Centaurea calcitrapa L.	Asteraceae	Th	Eur Med
Centaurea cinerea subsp. *papposa* (Coss.) Q. S	Asteraceae	Ch	End Alg Tun
Centaurea napifolia L.	Asteraceae	Th	Med
Centaurium erythraea Raf.	Gentianaceae	Th	Med
Centaurium maritimum (L.) Fritsch	Gentianaceae	Th	Paleotem
Centaurium pulchellum subsp. *pulchellum*	Gentianaceae	Th	Med
Centaurium spicatum (L.) Fritsch	Gentianaceae	Th	Med
Cerastium glomeratum L.	Caryophyllaceae	Th	Holar
Ceratonia siliqua L.	Fabaceae	Ph	Med
Cerinthe major subsp. *major* L.	Boraginaceae	Th	Med
Chamaemelum fuscatum (Brot.) Vasc.	Euphorbiaceae	Th	Med
Chamaerops humilis L.	Palmae	Ph	Med Occ
Chamaesyce peplis (L.) Prokh.	Euphorbiaceae	Th	Med Atl
Chenopodium album L.	Chenopodiaceae	Th	Subcosm
Chondrilla juncea L.	Asteraceae	Hem	Circummed
Cichorium intybus subsp. *glabratum* Arcang.	Asteraceae	Hem	Eur Med
Cirsium scabrum L.	Asteraceae	Hem	Med Occ
Cistus monspeliensis L.	Cistaceae	Ph	Med
Cistus salvifolius L.	Cistaceae	Ph	Med
Cladanthus mixtus (L.) Oberprieler & Vogt	Asteraceae	Th	Circummed
Clematis cirrhosa L.	Ranunculaceae	Ph	Med
Clematis flammula L.	Ranunculaceae	Ph	Circummed
Clinopodium vulgare subsp. *arundanum* Bois.	Lamiaceae	Ch	Med
Convolvulus arvensis subsp. *arvensis* L.	Convolvulaceae	Geo	Med
Conyza bonariensis (L.) Cronq	Asteraceae	Th	Intr
Conyza canadensis (L.) Cronq.	Asteraceae	Th	Intr
Coronilla juncea subsp. *juncea* L.	Fabaceae	Ch	Med
Corrigiola littoralis subsp. *littoralis* L.	Caryophyllaceae	Th	Med
Crassula alata (Viv.) A. Berger	Crassulaceae	Th	Med

Crataegus monogyna Jacq.	Rosaceae	Ph	Euras
Crithmum maritimum L.	Apiaceae	Ch	Eur Med
Cupressus sempervirens L.	Cupressaceae	Ph	Intr
Cuscuta epilinum Weihe	Convolvulaceae	Th	Cosm
Cutandia maritima (L.) W. Barbey	Poaceae	Th	Med
Cyclamen africanum Boiss. & Reuter	Primulaceae	Geo	End Mag
Cynara cardunculus L. subsp. *cardunculus*	Asteraceae	Hem	Med
Cynodon dactylon (L.) Pers.	Poaceae	Geo	Cosm
Cynoglossum cheirifolium subsp. *heterocarpum*	Boraginaceae	Hem	Med
Cynosurus echinatus L.	Poaceae	Th	Eur
Cynosurus polybracteatus Poiret	Poaceae	Th	Med Atl
Cyperus longus subsp. *badius* (Desf.) Asch.	Cyperaceae	Hyd	Paleotem
Cystopteris fragilis subsp. *fragilis* (L.) Bernh.	Athyriaceae	Hem	Cosm
Cytinus hypocistis subsp. *hipocistis* (L.) L.	Rafflesiaceae	Th	Med
Cytisus villosus Pourret	Fabaceae	Ph	Med
Dactylis glomerata L subsp. *glomerata*	Poaceae	Hem	Med
Daphne gnidium L.	Thymelaeaceae	Ph	Med
Datura stramonium subsp. *stramonium* L.	Solanaceae	Th	Cosm
Datylis glomerata L. subsp. *hispanica* (Roth) Nyman	Poaceae	Hem	Euras
Daucus carota subsp. *hispanicus* (Gouan).	Apiaceae	Hem	Med
Daucus gracilis Steinh.	Apiaceae	Th	End NE-Alg
Daucus virgatus (Poiret) Maire	Apiaceae	Hem	End Alg-Tun
Dianthus sylvestris subsp. *aristidis* Batt.Greut.	Caryophyllaceae	Hem	End Alg
Dioscorea communis (L.) Caddick & Wilki	Dioscoriaceae	Geo	Med
Dittrichia graveolens (L.) Greuter	Asteraceae	Th	Irano Tor
Dittrichia viscosa (L.) Greuter	Asteraceae	Ch	Med
Drimia fugax (Moris) Stearn	Hyacinthaceae	Geo	Med
Drimia numidica (Jord. & Fourr.) J.C.	Hyacinthaceae	Geo	Med
Echinops bovei Boiss.	Asteraceae	Th	Ibero-Mag
Echium creticum subsp. *criticum* L.	Boraginaceae	Th	Med
Echium sabulicolum subsp. *decipiens* Klotz	Boraginaceae	Th	Med

Ephedra fragilis Desf.	Ephedraceae	Ch	Med Occ
Erica arborea L.	Ericaceae	Ph	Med
Erica multifora L.	Ericaceae	Ph	Med
Erica scoparia subsp. *scoparia* L.	Ericaceae	Ph	Med Atl
Erodium cicutarium subsp. *cicutarium* L.	Geraniaceae	Th	Euras
Erodium malacoides (L.) L'Hér.	Geraniaceae	Th	Circummed
Erodium moschatum (L.) L'Hér.	Geraniaceae	Th	Circummed
Erophila verna (L.) Chevall.	Brassicaceae	Th	Paleotem
Eryngium dichotomum Desf.	Apiaceae	Hem	Ibero Mag
Eryngium maritimum L.	Apiaceae	Hem	Euras
Eryngium tricuspidatum subsp. *tricuspidatum*	Apiaceae	Hem	Med
Eucalyptus globulus	Myrtaceae	Ph	Intr
Euphorbia dendroides L.	Euphorbiaceae	Ph	Med
Euphorbia exigua subsp. *exigua* L.	Euphorbiaceae	Th	Euras
Euphorbia helioscopia subsp. *helioscopia* L.	Euphorbiaceae	Th	Subcosm
Euphorbia peplus L.	Euphorbiaceae	Th	Eur
Euphorbia segetalis subsp. *pinea* (L.) Rouy	Euphorbiaceae	Th	Med Atl
Euphorbia terracina L.	Euphorbiaceae	Th	Circummed
Fedia graciliflora Fisch. & Meyer	Valerianaceae	Th	Ibero Mag
Ferula communis subsp. *communis* L.	Apiaceae	Hem	Med
Festuca coerulescens Desf.	Poaceae	Hem	Med
Ficus carica L.	Moraceae	Ph	Med
Filago asterisciflora (Lam.) Chrtek	Asteraceae	Th	Med Atl
Filago gallica L.	Asteraceae	Th	Subcosm
Filago pygmaea L.	Asteraceae	Th	Med Atl
Fraxinus angustifolia subsp. *oxycarpa* Willd.	Oleaceae	Ph	Euras Med
Fumana laevipes (L.) Spach	Cistaceae	Ch	Circummed
Fumana thymifolia subsp. *thymifolia* (L.)	Cistaceae	Ch	Circummed
Fumaria capreolata L.	Papaveraceae	Th	Eur Med
Gagea granatelli (Parl.) Parl. subsp. *granatelli*	Hyacinthaceae	Geo	Circummed
Galactites elegans (All.) Soldano	Asteraceae	Th	Med

Galactites mutabilis Durieu	Asteraceae	Hem	End Alg-Tun
Galium aparine L.subsp. *aparine*	Rubiaceae	Th	Subcosm
Galium lucidum All.	Rubiaceae	Hem	Euras
Galium parisiense subsp. *parisiense* L.	Rubiaceae	Th	Med Atl
Galium rotundifolium subsp. *rotundifolium* L.	Rubiaceae	Th	Med
Galium verrucosum Hudson	Rubiaceae	Th	Eur
Galium viscosum subsp. *viscosum* Vahl	Rubiaceae	Th	Ibero Mag
Genista ferox subsp. *ferox* (Poiret) Dum. Cour.	Fabaceae	Ph	End Alg-Tun
Genista numidica Spach subsp. *numidica*	Fabaceae	Ph	End Alg
Genista ulicina Spach	Fabaceae	Ph	End Alg-Tun
Geranium molle subsp. *molle* L.	Geraniaceae	Th	Paleotem
Geranium robertianum subsp. *purpureum* Vi.	Geraniaceae	Th	Euras
Gladiolus dubius Guss.	Iridaceae	Geo	Med Occ
Glebiobis segetum (L.) Fourr.	Asteraceae	Th	Eur Med
Hedera algeriensis Hibberd	Araliaceae	Ph	End Alg- Tun
Hedysarum coronarium L.	Fabaceae	Th	Med
Helichrysum rupestre subsp. *rupestre* (Raf.)	Asteraceae	Ch	Subcosm
Heliotropium europaeum L.	Boraginaceae	Th	Med Atl
Helminthotheca echioides (L.) J. Holub	Asteraceae	Hem	Med
Helosciadium nodiflorum (L.) W. D. J. Koch	Apiaceae	Hem	Paleotem
Herniaria hirsuta L.	Caryophyllaceae	Th	Euras
Hyoseris radiata L.	Asteraceae	Hem	Med
Hyparrhenia hirta (L.) Stapf	Poaceae	Hem	Paleotem
Hypericum humifosum L.	Hypericaceae	Th	Ibero Mag
Hypochaeris achyrophorus L.	Asteraceae	Th	Med
Hypochaeris radicata subsp. *radicata* L.	Asteraceae	Hem	Eur Med
Iris unguicularis Poiret	Iridaceae	Geo	Med
Juncus effusus L.	Juncaceae	Hem	Subcosm
Juncus maritimus Lam.	Juncaceae	Hem	Med
Juncus tenageia subsp. *tenageia* L. fil.	Juncaceae	Th	Subcosm
Juniperus oxycedrus L.	Cupressaceae	Ph	Med

Juniperus phoenicea subsp. *turbinata* (Guss.) Nyman	Cupressaceae	Ph	Intr
Kickxia commutata (Reichenb.) Fritsch	Scrophulariaceae	Th	Eur Med
Lagurus ovatus L.	Poaceae	Th	Med Atl
Lamarckia aurea (L.) Moench	Poaceae	Th	Med
Lathyrus clymenum L.	Fabaceae	Th	Med Atl
Lavandula stoechas L.	Lauraceae	Ph	Med Atl
Lavatera olbia L.	Lamiaceae	Ch	Med Atl
Legousia falcata (Ten.) Janchen	Campanulaceae	Th	Med
Lemna minor L.	Lemnaceae	Hyd	Subcosm
Leontodon tuberosus L.	Asteraceae	Hem	Med
Limonium gougetianum (Girard) O.Kuntze subsp. *gougetianum*	Plumbaginaceae	Hem	End Alg-Tun
Linaria reflexa (L.) Chaz.	Plantaginaceae	Th	Med
Linumbienne Miller	Linaceae	Th	Med Atl
Linum tenue Desf.subsp. *tenue*	Linaceae	Th	End Alg-Tun
Linum trigynum L.	Linaceae	Hém	Med Atl
Lithodora rosmarinifolia (Ten.) I.M. Johnston	Boraginaceae	Ch	Med
Lobularia maritima (L.) Desv.	Brassicaceae	Hem	Med
Lolium perenne L.	Poaceae	Hem	Euras
Lonicera implexa Aiton	Caprifoliaceae	Ph	Med
Lotus corniculatus subsp. *corniculatus* L.	Fabaceae	Hem	Euras
Lotus drepanocarpus Durieu	Fabaceae	Th	End Alg-Tun
Lotus edulis L.	Fabaceae	Th	Med
Lotus hispidus subsp. *hispidus* DC.	Fabaceae	Th	Med Atl
Lotus ornithopodioides L.	Fabaceae	Th	Med
Lythrum junceum Banks & Solander	Lythraceae	Th	Med Atl
Magydaris panacifolia (Vahl) Lange	Apiaceae	Hem	Med Atl
Malva sylvestris subsp. *sylvestris* L.	Malvaceae	Hem	Paleotem
Marrubium vulgare L.	Lamiaceae	Ch	Euras
Melica ciliata L. subsp. *ciliata*	Poaceae	Th	SubCosm
Melica minuta subsp. *minuta* L.	Poaceae	Hem	Med
Melica uniflora Retz.	Poaceae	Hem	Paleotem

Mentha pulegium subsp. *pulegium* L.	Lamiaceae	Th	Euras Med
Mentha suaveolens subsp. *suaveolens* Ehrh	Lamiaceae	Hyd	Eurpe Med
Mercurialisambigua L.	Euphorbiaceae	Th	Subcosm
Mesembryanthemum nodiflorum L.	Aizoaceae	Th	Circummed
Micromeria graeca (L.) Reichenb.	Lamiaceae	Ch	Holar
Moehringia trinervia subsp. *pentandra* Nyma.	Caryophyllaceae	Th	Med Atl
Moraea sisyrinchium (L.) Ker Gawl.	Iridaceae	Geo	Circummed
Myosotis ramosissima (Murb.) Greuter	Boraginaceae	Th	Holar
Myrtus communis L.	Myrtaceae	Ph	Med
Narcissus elegans (Haw.) Spach	Amaryllidaceae	Geo	Med Occ
Narcissus tazetta L.	Amaryllidaceae	Geo	Med
Neotinea lactea (Poiret) Bateman, Pridgeon & Chase	Orchidaceae	Geo	Stenomed
Nerium oleander L.	Apocynaceae	Ph	Med
Nicotiana glauca Graham	Solanaceae	Ph	Intr
Oenanthe globulosa L.	Apiaceae	Hem	Med Occ
Olea europaea L.	Oleaceae	Ph	Med
Oncostema peruviana (L.) Speta	Hyacinthaceae	Geo	Med Occ
Ononis alba L	Fabaceae	Th	Med
Ophioglossum lusitanicum L.	Ophioglossaceae	Th	Med Atl
Ophrys apifera Hudson	Orchidaceae	Geo	Med
Ophrys bombyliflora Link	Orchidaceae	Geo	Med
Ophrys lutea Cav. subsp. *lutea*	Orchidaceae	Geo	Med
Ophrys scolopax Cav. subsp. *scolopax*	Orchidaceae	Geo	Med
Ophrys speculum Link	Orchidaceae	Geo	Med
Ophrys tenthredinifera Willd.subsp. *tenthredinifera*	Orchidaceae	Geo	Med
Opuntia maxima Miller	Cactaceae	Ph	Intr
Ornithogalum algeriense Jord. & Fourr.	Hyacinthaceae	Geo	Circummed
Ornithopus compressus L.	Fabaceae	Th	Med
Orobanche minor Sm.	Orobanchaceae	Th	Med
Oxalis corniculata subsp. *corniculata* L.	Oxalidaceae	Th	Intr
Oxalis pes-caprae L.	Oxalidaceae	Th	Intr

Phagnalon saxatile subsp. *sexatile* (L.) Cass.	Asteraceae	Hem	Med Occ
Phillyrea latifolia L.	Oleaceae	Ph	Med
Phleum pratense subsp. *serotinum* Jord.Berher	Poaceae	Th	Circumbor
Phragmites australis (Cav.) Steudel	Poaceae	Geo	Subcosm
Phyllitis sagittata (DC.) Guinea & Heywood	Asplenaceae	Hem	Med
Pinus pinaster Aiton	Pinaceae	Ph	Med Atl
Piptatherum miliaceum (L.) Cosson	Poaceae	Ch	Circummed
Pistacia lentiscus L.	Anacardiaceae	Ph	Med
Plagius maghrebinus Vogt & Greuter	Asteraceae	Ch	End Mag
Plantago coronopus L subsp. *coronopus*	Plantaginaceae	Th	Med
Plantago lagopus L.	Plantaginaceae	Th	Med Occ
Plantago lanceolata subsp. *lanceolata* L.	Plantaginaceae	Hem	Med Occ
Plantago macrorrhiza subsp. *macrorrhiza*Poiret	Plantaginaceae	Hem	Holar
Plantago serraria L.	Plantaginaceae	Hem	Med
Poa annua L. subsp. *annua*	Poaceae	Th	Cosm
Poa trivialis subsp. *trivialis* L.	Poaceae	Th	Euras
Polycarpon polycarpoides (Biv.) Fiori	Caryophyllaceae	Ch	Ibero Mag
Polygala rupestris Pourret	Polygalaceae	Th	Med
Polygonum aviculare L.	Polygonaceae	Th	Med
Polygonum maritimum L.	Polygonaceae	Th	Holar
Polypodium cambricum subsp. *cambricum* L.	Polypodiaceae	Geo	Med Atl
Polypogon maritimus Willd.	Poaceae	Th	Med Atl
Portulaca oleracea L.	Portulacaceae	Th	Subcosm
Prasium majus L.	Lamiaceae	Ch	Holar
Prospero autumnale (L.) Speta	Hyacinthaceae	Geo	Circummed
Prunella vulgaris L.	Lamiaceae	Hem	Euras
Pteridium aquilinum (L.) Kuhn	Hypolepidaceae	Geo	Subcosm
Pulicaria odora (L.) Reichenb.	Asteraceae	Hem	Med
Quercus coccifera L.	Fagaceae	Ph	Med Occ
Quercus suber L.	Fagaceae	Ph	Med Atl
Ranunculus arvensis	Ranunculaceae	Th	Medi

Ranunculus macrophyllus Desf.	Ranunculaceae	Geo	Med
Raphanus raphanistrum subsp. *raphanistrum* L.	Brassicaceae	Th	Circummed
Reichardia picroides subsp. *picroides* L. Roth	Asteraceae	Hem	Med
Reseda alba subsp. *alba* L.	Resedaceae	Th	Circummed
Rhamnus alaternus subsp. *alaternus* L.	Rhamnaceae	Ph	Med
Rhaponticum acaule (L.) DC.	Asteraceae	Hem	Med
Ricinus communis L. (Tourn.)	Euphorbiaceae	Ch	Intr
Romulea leichtliniana Heldr. ex halácsy	Iridaceae	Geo	SubEnd
Romulea ligustica Parl.	Iridaceae	Geo	Med
Rubia peregrina subsp. *longifolia* Poiret Bolòs	Rubiaceae	Ch	Med Atl
Rubus ulmifolius Schott	Rosaceae	Ph	Med
Rumex bucephalophorus subsp. *gallicus* Rech.	Polygonaceae	Th	Med
Rumex conglomeratus Murray	Polygonaceae	Th	Euras
Ruscus hypophyllum L.	Ruscaceae	Ch	Med Occ
Ruta chalepensis L.	Rutaceae	Ch	Med
Salvia verbenaca subsp. *verbenaca* L.	Lamiaceae	Ch	Med Atl
Samolus valerandi L.	Primulaceae	Hem	Subcosm
Sanguisorba verrucosa (G. Don) Ces.	Rosaceae	Hem	Circummed
Sarcocornia fruticosa (L.) A.J. Scott	Rosaceae	Hem	Circummed
Schoenoplectus supinus (L.) Palla	Cyperaceae	Th	Cosm
Schoenus nigricans L.	Cyperaceae	Hyd	Subcosm
Scolymus hispanicus L.	Asteraceae	Hem	Med
Scorpiurus muricatus subsp. *muricatus* L.	Fabaceae	Th	Med
Scorzonera undulata subsp. *deliciosa* Guss.	Asteraceae	Hem	Holar
Sedum caeruleum L.	Crassulaceae	Th	Med
Sedum sediforme (Jacq.) Pau	Crassulaceae	Geo	Circummed
Selaginella denticulata (L.) Spring	Selaginellaceae	Hem	Med
Senecio leucanthemifolius Poiret subsp. *leucanthemifolius*	Asteraceae	Th	Med Atl
Senecio vulgaris L.	Asteraceae	Th	Subcosm
Serapias lingua subsp. *stenopetala* (R.C.J. Maire & Stephenson) R.C.J. Maire & A. Weiller	Orchidaceae	Geo	End Alg- Tun
Serapias strictiflora Da Veiga	Orchidaceae	Geo	Med

Seseli praecox Guss.	Apiaceae	Hem	Subend
Sherardia arvensis L.	Rubiaceae	Th	Eur Med
Silene gallica L.	Caryophyllaceae	Th	Subcosm
Silene nocturna subsp. *nocturna* L.	Caryophyllaceae	Th	Holar
Simethis mattiazzii (Vandelli) López & Jarvis	Asphodelaceae	Geo	Med Atl
Sinapis arvensis L. subsp. *arvensis*	Brassicaceae	Th	Holar
Sisymbrium officinale (L.) Scop.	Brassicaceae	Th	Cosm
Smilax aspera L.	Smilacaceae	Ch	Med Atl
Smyrnium olusatrum L.	Apiaceae	Th	Med Atl
Solanum nigrum L.	Solanaceae	Th	Cosm
Sonchus oleraceus L.	Asteraceae	Th	Cosm
Spergula arvensis L.	Caryophyllaceae	Th	Cosm
Stachys arvensis (L.) L.	Lamiaceae	Th	Med Atl
Stellaria media (L.) Vill.	Caryophyllaceae	Th	Subcosm
Tetragonolobus biflorus (Desr.) DC.	Fabaceae	Th	Med
Teucrium fruticans L. subsp *fruticans*	Lamiaceae	Ch	Med Occ
Thymelaea hirsuta (L.) Endl.	Thymelaeaceae	Ph	Med
Thymus munbyanus subsp. *coloratus* Greuter	Lamiaceae	Ch	End Mag
Torilis arvensis subsp. *neglecta* (Sreng.) Thell.	Apiaceae	Th	Paleotem
Torilis webbii S. L. Jury	Apiaceae	Th	Med
Trifolium angustifolium subsp. *angustifolium* L.	Fabaceae	Th	Eur Med
Trifolium arvense subsp. *arvense* L.	Fabaceae	Th	Med
Trifolium campestre Schreber	Fabaceae	Th	Med Atl
Trifolium glomeratum L.	Fabaceae	Th	Med
Trifolium ligusticum Loisel.	Fabaceae	Th	Med
Trifolium micranthum Viv.	Fabaceae	Th	Med
Trifolium repens L	Fabaceae	Th	Med
Trifolium scabrum L.	Fabaceae	Th	Paleotem
Trifolium squarrosum L.	Fabaceae	Th	Euras
Tuberaria guttata subsp. *guttata* (L.) Fourr.	Cistaceae	Th	Med Atl
Tulipa sylvestris subsp. *australis* (Link) Pamp.	Liliaceae	Geo	Med Occ

Typha angustifolia L.	Typhaceae	Hyd	Holar
Umbilicus rupestris (Salisb.) Dandy	Crassulaceae	Hem	Med Atl
Urospermum dalechampii (L.) F.W. Schmidt	Asteraceae	Th	Med Occ
Urtica membranacea Poiret	Urticaceae	Th	Cosm
Urtica pilulifera L.	Urticaceae	Th	Circummed
Vaillantia hispida (L.) DC.	Rubiaceae	Th	Med Atl
Verbena officinalis L.	Verbenaceae	Hem	Holar
Veronica arvensis L.	Plantaginaceae	Th	Med
Veronica cymbalaria Bodard	Plantaginaceae	Th	Med

Bio. : Biological, Biogeograp : biogeographical, Med : Mediterranean, Intr : Introduced, Atl : Atlantique, Holar: Holarctic, Cosm : cosmopolitan, Eur : European, End Alg-Tun : Endemic Algerian-Tunisian, Euras : Eurasian, Bor : Boreal, Paleotemp : Paleo-Tempered, Irano Tor : Iranian touranienne, Mag : Maghreb, Hem : Hemicryptophyte, Geo : Geophyte, Th : Therophyte, Ph : Phanerophyte, Ch : Chamaephyte.

These results are comparable to those of Khellaf (2014) in his research on the vascular vegetation of the Gouraya National Park (North-East Algeria).

The biological spectrum of the Cap de Garde presents the following diagram: Therophyte (168 taxa) > Hemicryptophyte (57 taxa) > Phanerophyte (43 taxa) > Geophyte (42 taxa) > Chamaephyte (29 taxa) > Hydrophyte (10 taxa) (Fig. 2).

The dominance of Therophytes is explained by the final stage of ecosystem degradations with sub-nitrophilous species linked to overgrazing (Barbero *et al.*, 1989).

Table 3. Measurement of the plant diversity in the three sampled stations of Cap de Garde.

Diversity measure	Cap de Gardecave	Sidi Aissa	Sidi Abderrahmen
Alpha diversity (αaverage)	18.59 ±1.22	15.98 ±0.33	19.72 ±1.53
Beta Diversity (β= γ/ αaverage)	3.078	2.152	3.305
Gamma diversity (γ)	183	113	191
Simpson (D-1)	0.932±0.008	0.848±0.017	0.945±0.005
Shannon-Weiner (H')	2.53±0.082	2.33±0.072	2.58±0.088

This therophytisation is also due to the adaptation of the winter cold (Raunkier, 1934) or the summer drought (Daget, 1980; Floret *et al.*, 1992).

Hemicryptophytes are second with 57 taxa. In this regard Barbéro *et al.* (1990) reported an abundance effect of hemicryptophytes in the Maghreb, due to the richness of organic matter and moisture.

The phanerophytes are well represented with 43 taxa, such plants are gaining more and more overlap with age, causing the elimination of undergrowth (Madoui *et al.*, 2006).

Fourth are the geophytes with 42 species. These species evolve in environments characterized by rainfall and cold (Danin and Orshan, 1990). It is followed by far by chamaephytes and Hydrophytes.

The studied flora represents a set of heterogeneous biogeographic value that the establishment meets in fact the extreme paleogeographic and

paleoclimaticcomplexity of the Mediterranean region (Quézel *et al.*, 1980) (Fig. 3).

The whole Mediterranean dominates with 173 taxa. It shows in accordance with the observations of Quézel (1983).

The Nordic element (Eurasian, European, Paleotempere, Circumboreal) includes 35 taxa, that is to say 10.02%. These species conceal a large contingent that is commonly located in the wetter areas of the North African Tell (Quézel, 1978).

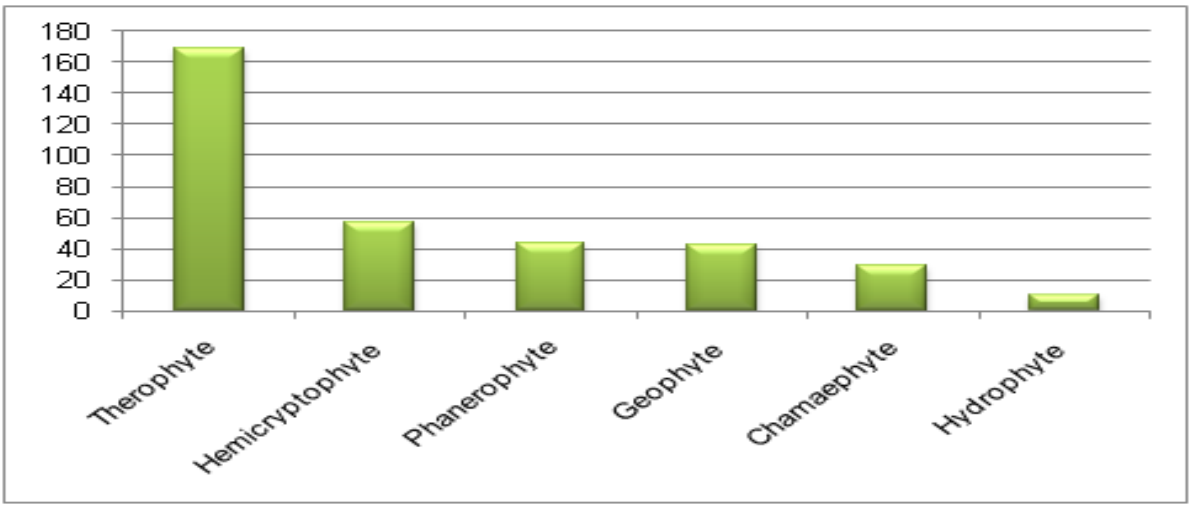

Fig. 2. The biological types present in the study area.

Endemics recorded in the flora if the Cap de Garde represents a rate of 6.3% corresponding to 22 species which are mostly Algerian-Tunisian endemics (10 species).

These border endemisms with Tunisia, correspond to less specialized areas of hyperendemic (Véla and Benhouhou, 2007).

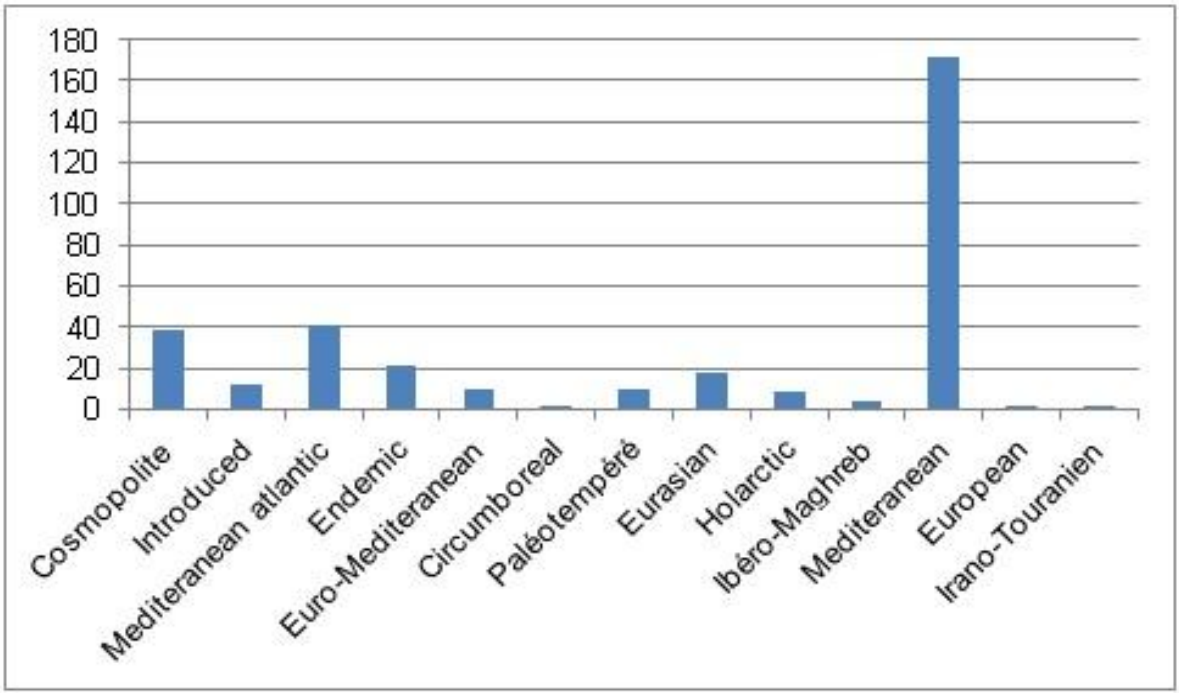

Fig. 3. Biogeographic types of the study area.

The Iranian-Turanian element is represented by a single species. Quézel (1978) considers that the low representation of Iranian-Turanian taxa renders impossible the individualization of the Irano-Turanian floristic region in North Africa.

Measurements of the plant diversity in the study area are very remarkable in the two stations of Sidi Abderahmen and the Cap de Gardecave, which is explained by the Shannon-Weiner Index (H ') and Alpha diversity (αaverage) are very high (Tab. 4).

Sidi Abderahmen station contains 191 species while the Cap de Garde Cave station has 183 species. Thus, the value of Beta diversity (β = γ / αaverage) is very high in Sidi Abderahmen station followed by the Cap de Garde Cave with (3.305 and 3.078 respectively). Indeed, the Numidia region (where our sites are displayed) and other areas such as the Kabylie and Kroumirie in Tunisia, which have a great floristic richness, are classified according to Médail and Diadema (2006) ; Véla and Benhouhou (2007) as the new hotspots with 10 other regional hotspots of the Mediterranean biodiversity already identified by Médail and Quézel (1997; 1999).

Conclusion

The floristic study of the Cap de Garde showed that species richness 8.72% of the vascular flora of Algeria, that is 349 taxa of which 22 are endemic.

All the studied formations are characterized by Therophytes dominancec, followed by hemicryptophytes.

This first analysis has highlighted the floristic and phytogeographic interest of the Cap de Garde. It deserves to be deepened by more targeted studies on the dynamics of the major plant groups.

On the conservation plan, this plant must benefit from protective measures. This is only possible through the creation of a wildlife park. For efficiency reasons, it is necessary that the conservation efforts are focused on the habitat where the taxa are and not only on species. For this reason, knowledge about the Cap de Garde habitats is very important.

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