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PHYTOGEOGRAPHICAL CHARACTERIZATION OF SW CADIZ (SPAIN) AND ITS RELATIONSHIP WITH THE TINGITANEAN PENINSULA (MOROCCO)

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Abstract

A phytogeographical study of SW Cadiz (Spain) have been made using characteristic taxa and syntaxa distribution. Chorological relationships have been established between SW Cadiz (Spain) and NW Africa (Morocco).

Introduction

This study is a phytogeographical synthesis of SW Cadiz province (Spain). It includes coastal sandy spots, the countryside and the Aljibe mountains.

Cadiz province is a peninsula which goes into the sea. This conditions its climatology, with hard humid air masses from the Atlantic Ocean and the Mediterranean Sea which mark an ombroclimate between arid and hyperhumid (RIVAS-MARTÍNEZ, 1987). Using I_t index of Rivas-Martínez, we can distinguish two bioclimatic belts: thermomediterranean and mesomediterranean (this one on hills over 800 m). On the other hand, an interesting aspect is the proximity between this region and the Tingitanean Peninsula (Morocco), with a similar litology, flora and vegetation.

The objet of this study is the sectorization of SW Cadiz by bioindicators, including the diferences and similarities with the Tingitanean Peninsula in N Africa.

Material and methods

S Iberian Peninsula, N Africa and other european and atlantic important references have been used for taxa and syntaxa chorological characterization: WILLKOMM & LANGE (1861-1880), PÉREZ LARA (1886-1903), JAHANDIEZ & MAIRE (1931-1934), MAIRE (1953-1987), QUÉZEL (1957, 1978), DUPONT (1962), TUTIN & al. (1964-1980), DAHLGREN & LASSEN (1972), GREUTER & al. (1984-1989), GIL & al. (1985), CASTROVIEJO & al. (1986-1993), VALDÉS & al. (1987), PEINADO LORCA & RIVAS-MARTÍNEZ (1987), PICHI SERMOLLI & al. (1988), RIVAS-MARTÍNEZ (1988), RIVAS-MARTÍNEZ & al. (1990), BOLÒS & al. (1990), OBERDORFER (1990), GÉHU (1991), VALDÉS (1991), GALÁN DE MERA (1993), CARAZO MONTIJANO & FERNÁNDEZ LÓPEZ (1994), DEIL (1994) and NEZADAL & al. (1994).

Nomenclature and phytogeographical typology were taken from RIVAS-MARTÍNEZ (1987) and RIVAS-MARTÍNEZ & al. (1993).

Results

It is proposed the following phytogeographical sectorization for SW Cadiz province (Fig. 1):

A. Mediterranean Region: Aa. Occidental Mediterranean Subregion: Aa1. Iberoatlantic Superprovince, with two provinces:

1, Betica Province: I. Hispalense Sector, Ia. Jerezano Subsector

2, Gaditano-Onubo-Algarviense Province: II. Gaditano-Onubense Sector, IIa. Gaditano Litoral Subsector; III. Aljibico Sector

Figure 1 shows also the phytogeographical sectorization of Tingitanean Peninsula according to Hammoumi (REFASS, 1993).

Aa1. Iberoatlantic Superprovince

Territories of Iberian Peninsula and N Africa with a Mediterranean-atlantic raining regime. This is near to the SW Mediterranean unity of TAKHTAJAN (1986). Following the plant list proposed by QUEZEL (1957) for linking eurosiberian and mediterranean worlds, and the distribution of atlantic elements in N Africa (DAHLGREN & LASSEN, 1972), we can say that this superprovince means a migratory space of atlantic taxa to the S Iberian Peninsula and N Africa.

Iberoatlantic territorial taxa

Agrostis castellana *, *Agrostis pourretii* *, *Agrostis reuteri* *, *Allium scorzonerifolium*, *Avenula sulcata* subsp. *albinervis* * , *Biscutella baetica* *, *Brassica barrelieri* *, *Cistus populifolius* subsp. *major* *, *Coronilla dura* *, *Cytisus baeticus* *, *Delphinium pentagynum* *, *Deschampsia stricta*, *Erica australis* *, *Festuca ampla* subsp. *ampla* *, *Frangula alnus* subsp. *baetica*, *Galium viscosum* *, *Genista triacanthos subsp. triacanthos* *, *Genista tridentata* *, *Halimium commutatum* *, *Halimium alysoides* subsp. *lasianthum* *, *Lavandula luisieri*, *Leucojum trichophyllum* *, *Linaria viscosa*, *Lithodora prostrata* subsp. *lusitanica* *, *Lotus glareosus*, *Luzula forsteri* subsp. *baetica* *, *Malcolmia triloba* *, *Misopates orontium* var. *grandiflorum* *, *Myosotis welwitschii* *, *Odontites tenuifolia*, *Ononis pinnata* *, *Ornithopus sativus* subsp. *isthmocarpus* *, *Pedicularis sylvatica* subsp. *lusitanica* *, *Polygala microphylla*, *Pistorinia brevifolia* *, *Pyrus bourgaeana*, *Quercus lusitanica* *, *Ranunculus bulbosus* subsp. *adscendens*, *Reseda media*, *Salvia barrelieri* *, *Salvia sclareoides*, *Scabiosa simplex* subsp. *dentata* *, *Scilla monophyllos*, *Scrophularia lyrata*, *Scrophularia sambucifolia* subsp. *sambucifolia* *, *Senecio lopezii*, *Serratula monardii*, *Silene scabriflora* subsp. *tuberculata*, *Stipa gigantea* *, *Thymelaea villosa* *, *Thymus zygis subsp. sylvestris*, *Trifolium isthmocarpum subsp. isthmocarpum* *, *Trisetaria scabriuscula*, *Xolantha macrosepala* *

(*) Taxa which reach the Tingitanan Peninsula.

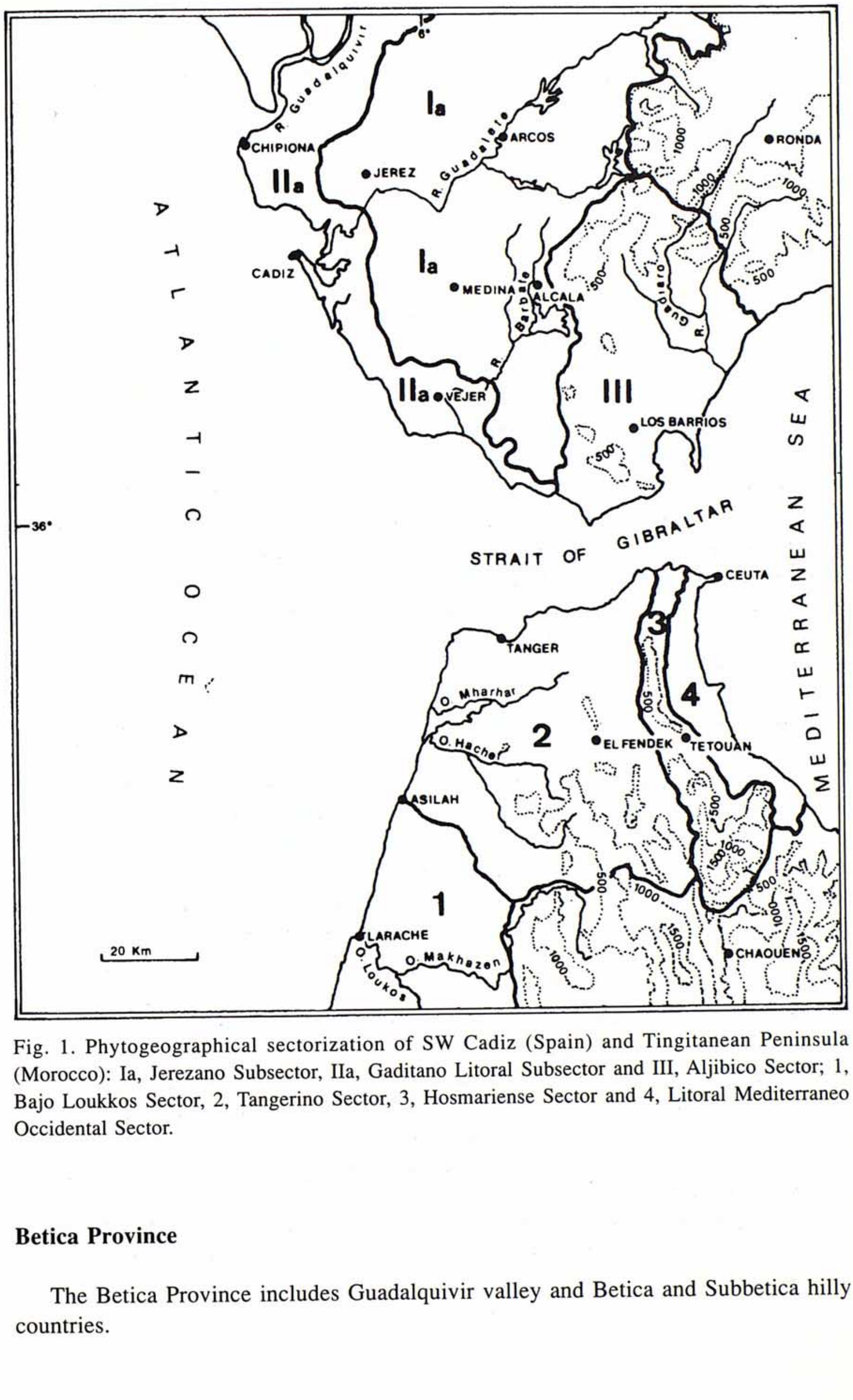

Fig. 1. Phytogeographical sectorization of SW Cadiz (Spain) and Tingitanean Peninsula (Morocco): Ia, Jerezano Subsector, IIa, Gaditano Litoral Subsector and III, Aljibico Sector; 1, Bajo Loukkos Sector, 2, Tangerino Sector, 3, Hosmariense Sector and 4, Litoral Mediterraneo Occidental Sector.

Betica Province

The Betica Province includes Guadalquivir valley and Betica and Subbetica hilly countries.

Hispalense Sector, with a general marly character, is represented in this territory by the Jerezano Subsector.

The Jerezano Subsector is the territory occupied by the gentle hills which separate the Guadalquivir valley and the Aljibe mountains. Vertic soils are placed on plains while vertic cambisols or calcareous are on hills, where marls and gypsums of Keuper have a relevant importance.

Betica territorial taxa

Anchusa puechii, Anthemis bourgaei ++, *, *Arenaria hispanica* *, *Avena murphyi, Carduncellus caeruleus* subsp. *tingitanus* *, *Centranthus macrosiphon* subsp. *macrosiphon* *, *Echium boissieri* *, *Festuca arundinacea* subsp. *atlantigena* *, *Fumaria macrosepala* *, *Fumaria rupestris* *, *Glossopappus macrotus* *, *Hippocrepis scabra* *, *Hypochaeris radicata* subsp. *platylepis* *, *Lavatera maroccana* *, *Leontodon maroccanus* *, *Malope trifida* *, *Narcissus cavanillesii* *, *Narcissus x perez-larae* +, *Ononis viscosa* subsp. *porrigens* *, *Ononis viscosa* subsp. *subcordata* *, *Onopordum nervosum* subsp. *nervosum, Origanum compactum* *, *Otospermum glabrum* *, *Picris comosa* subsp. *comosa, Ptilostemon hispanicus* *, *Salvia tingitana* ++, *, *Scorzonera baetica, Scrophularia sambucifolia* subsp. *mellifera* *, *Sideritis grandiflora* *, *Sideritis reverchonii, Silene stockeni* ++, *Silene tomentosa* ++, *Stachys circinata* *, *Teucrium resupinatum* *, *Thymus willdenowii* *, *Trifolium baeticum* *, *Triguera osbeckii* *, *Ulex baeticus* subsp. *scaber* ++, *Verbascum erosum, Verbascum giganteum* subsp. *giganteum, Vicia lutea* subsp. *cavanillesii* *.

(*), + Hispalense endemisms, ++ Jerezano endemisms, * taxa which reach the Tingitanean Peninsula.

Two series come first in the vegetation of this subsector: thermo–mesomediterranean serie of the wild olive tree ("acebuchales") [*Tamo communi–Oleeto sylvestris sigmetum*], and the thermomediterranean serie of the evergreen oaks ("carrascales") [*Smilaco mauritanicae-Querceto rotundifoliae sigmetum*]. The first serie is the more extensive one and in this serie stand out the endemic thorny shrubs ("ahulagares") of *Ulex baeticus* subsp. *scaber,* as a substitution stage.

Betica territorial syntaxa

Tamo communi-Oleetum sylvestris C, *; *Asparago albi-Rhamnetum oleoidis* 1ª, *; *Asperulo hirsutae-Ulicetum scabri* 2ª, ++; *Convolvulo meonanthi-Hedysaretum coronarii* P; *Smilaco mauritanicae-Quercetum rotundifoliae quercetosum jahandiezii* C, ++; *Asparago albi-Rhamnetum oleoidis* 1ª, *; *Teucrio lusitanici-Coridothymetum capitati* 2ª; *Plantagini serrariae-Trifolietum subterranei* P, *.

(*) C headserie, 1ª substitution stage, 2ª substitution stage, P pasture, + Hispalense endemisms, ++ Jerezano endemisms, * syntaxa which reach the Tingitanean Peninsula.

Gaditano-Onubo-Algarviense Province

It includes a large territory from Costa del Sol sandy spots to Vouga river in Aveiro (Portugal) (RIVAS-MARTÍNEZ & al., 1990). In the studied area this province is divided in two sectors. One is the Gaditano-Onubense Sector (Gaditano Litoral Subsector), represented by sandy spots and swamps from Tarifa to the Gaudalquivir river mouth in Chipiona.

The other one is the Aljibico Sector, represented by the miocenic sandstones of the Aljibe and Campo de Gibraltar mountains.

Gaditano-Onubo-Algarviense taxa

Anchusa calcarea var. calcarea +; *Arenaria algarbiensis*; *Armeria gaditana* *; *Armeria hirta* **, *; *Armeria macrophylla* +; *Armeria velutina* +; *Asphodelus roseus* **, *; *Bellis rotundifolia* **, *; *Bupleurum foliosum* **, *; *Calendula suffruticosa* subsp. *algarviensis*; *Calendula suffruticosa* subsp. *lusitanica* *; *Carduus lusitanicus* subsp. *santacreui* **; *Carduus meonanthus* subsp. *meonanthus* *; *Carex elata* subsp. *mauritanica* **, *; *Centaurea aspera* subsp. *scorpiurifolia* +; *Centaurea exarata*; *Centaurea uliginosa*; *Cheilanthes guanchica* ◆; *Coincya oxyrrhina* *; *Corynephorus divaricatus* subsp. *macrantherus* *; *Crepis erythia* ❤, *; *Crepis tingitana* **, *; *Culcita macrocarpa* ◆; *Cytisus striatus* subsp. *welwitschii* **; *Cytisus tribracteolatus* **; *Davallia canariensis* ◆; *Dianthus broteri* subsp. *hinoxianus* +; *Digitalis purpurea* subsp. *bocquetii* **; *Echium gaditanum* +; *Euphorbia baetica*; *Festuca baetica* **, *; *Festuca boissieri* **, *; *Fumaria sepium* *; *Genista tridens* *; *Hedypnois arenaria* *; *Heteranthemis viscidehirta* +, *; *Hippocrepis salzmannii* *; *Holcus grandiflorus* **; *Hymenostema pseudoanthemis*; *Juncus x donyanae* ++, **; *Leontodon tingitanus* **, *; *Limonium algarvense* *; *Limonium emarginatum* **, *; *Linaria munbyana var. pygmaea* *; *Linaria tursica* +; *Narcissus bulbocodium* subsp. *obesus* *; *Narcissus viridiflorus* **, *; *Ononis azcaratei* ❤; *Ononis baetica* *; *Ononis broteriana*; *Ononis cossoniana* *; *Ononis tournefortii* ❤, *; *Polygala baetica* **, *; *Psilotum nudum* ◆; *Pteris incompleta* ◆; *Pterocephalus intermedius*; *Reichardia gaditana* *; *Romulea ramiflora* subsp. *gaditana* ❤, *; *Satureja salzmannii* **, *; *Scorzonera fistulosa*; *Scrophularia laevigata* **, *; *Sedum hirsutum* subsp. *winkleri* **, *; *Serratula alcalae* **, *; *Sideritis perezlarae* ❤; *Silene gaditana* **; *Stauracanthus boivinii* subsp. *boivinii* *; *Stauracanthus genistoides* subsp. *genistoides*; *Taraxacum gaditanum* ❤; *Teucrium scorodonia* subsp. *baeticum* **, *; *Thymus albicans* +; *Tolpis nemoralis* **, *; *Trisetaria dufourei*; *Ulex australis* subsp. *australis* +; *Ulex borgiae* **, *; *Verbascum giganteum* subsp. *martinezii* ❤; *Verbascum masguindali* +, *; *Verbascum pseudocreticum* ❤, *; *Xolantha echioides* *.

(*) + Gaditano-Onubense endemisms, ❤ Gaditano-Litoral endemisms, ** Aljibico endemisms, * taxa which reach the Tingitanean Peninsula or Aljibico-Tingitano, ◆ paleomediterranean and tropical relics).

The coastal gaditano climatofilous vegetation is formed by psamofilous cork tree forests ("alcornocales") and its substitution stages (*Oleo sylvestris-Querceto suberis sigmetum*), and the halofilous and helophytic swamp vegetation.

The Aljibico Sector vegetation presents three type of characteristic forests derived from humid-hyperhumid ombroclimate in the Aljibe and Campo de Gibraltar mountains: cork tree forests ("alcornocales") [*Teucrio baetici-Querceto suberis sigmetum*], African gall-oak groves ("quejigares") [*Rusco hypophylli-Querceto canariensis sigmetum*] and alder groves with "ojaranzos" (*Frangulo baetici-Rhododendreto baetici sigmetum*). The African gall-oak groves and the alder groves are ancient forests with many of shrubs and nanophanerophytes with wide leaves (*Frangula alnus* subsp. *baetica, Rhododendron ponticum, Viburnum tinus*) and a pteridologic background with a Tertiary relictic character (PICHI SERMOLLI, & al. 1988).

Gaditano-Onubo-Albarviense territorial syntaxa

Teucrio baetici-Quercetum suberis C, **, *; *Rusco hypophylli-Quercetum canariensis* C, **, *; *Asparago aphylli-Calicotometum villosae* 1ª, *; *Genisto tridentis-Stauracanthetum boivinii* 2ª, **; *Trifolio pallidi-Vulpietum geniculatae* P, **; *Oleo sylvestris-Quercetum suberis* C, *; *Asparago aphylli-Calicotometum villosae* 1ª, *; *Thymo albicantis-Stauracanthetum genistoidis* 2ª, ++; *Ononido variegatae-Linarietum pedunculatae* P, +; *Frangulo baeticae-Rhododendretum baetici* E, **; *Equiseto telmateiae-Salicetum pedicellatae* E, **; *Genisto anglicae-Ericetum ciliaris* E, **, *; *Juncetum rugoso-effusi* E, *; *Centaureo exaratae-Armerietum gaditanae* E, +; *Laurentio-Juncetum tingitani* E, **; *Loto subbiflori-Chaetopogonetum fasciculati* E, *; *Junco emmanuelis-Eleocharitetum multicaulis* E, +, **, *; *Caricetum mauritanicae* E, **, *; *Rhamno oleoidis-Juniperetum macrocarpae* E, +; *Pycnocomo rutifolii-Retametum monospermae* 1ª +; *Davallio canariensis-Sedetum baetici* E, **, *; *Sedo brevifolii-Cytisetum tribracteolati* E, **.

(*) C headserie, 1ª substitution stage, 2ª substitution stage, P pasture, E edaffofilous vegetation, + Gaditano–Onubense endemisms, ++ Gaditano–Litoral endemisms, ** Aljibico endemisms, * syntaxa which reach the Tingitanean Peninsula.

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