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A contribute to the knowledge of the climatophilous cork-oak woodlands from Iberian southwest

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Abstract.- This work results as an in-depth study of climatophilous cork-oak woodlands from Iberian southwest, by the necessity to profound the knowledge of this West-Mediterrenean vegetal formations, particularly in the most atlantic territories. Accordingly, we describe a new cork-oak forest association subhumid to humid, thermomediterranean, siliceous, from « Marianico-Monchiquense » sector as a climatophilous serie, named *Lavandulo viridis-Quercetum suberis* new ass. Their floristic, ecologic and dynamic particularities are exposed. It's also presented a comparison with the rest of the cork-oak communities described to the *Querco rotundifoliae-Oleion sylvestris* Barbéro, Quézel & Rivas-Martínez *in* Rivas-Martínez, Costa & Izco 1986 alliance. Finally, some considerations are made about the conservation status of these sclerophyllous formations and highlighted the most important management policies that aim to protect, recover and increase the value of cork-oak forests.

Key words : phytosociology - climatophilous vegetation - Iberian Southwest - cork-oak woodlands - Marianic-Monchiquensean Sector.

Résumé.- Ce travail présente le résultat d'une étude des subéraies climatophiles du Sud-Ouest ibérique afin de mieux comprendre ces formations typiques de Méditerranée occidentale, en particulier dans les territoires atlantiques. En conséquence, nous décrivons une nouvelle association forestière de chêne-liège subhumide à humide, thermoméditerrannéenne, silicicole, du secteur « Mariânico-Monchiquense » de caractère climatophile, le *Lavandulo viridis-Quercetum suberis*. Ses particularités floristiques, écologiques, chorologiques et dynamiques sont aussi présentées. Suit une comparaison avec les divers groupements de chêne-liège déjà décrits au sein du *Querco rotundifoliae-Oleion sylvestris* Barbéro, Quézel & Rivas-Martínez *in* Rivas-Martínez, Costa & Izco 1986. Enfin, certaines considérations sont données sur l'état de conservation de ces formations sclérophylles et mettent en évidence les politiques de gestion les plus importantes visant à protéger, restaurer et augmenter la valeur de ces subéraies.

Mots clés : phytosociologie - végétation climatophile - Sud-Ouest ibérique - forêts de chêne-liège - secteur « Mariânico-Monchiquense ».

I. INTRODUCTION

Southwest of Portugal, in the administrative transition between Algarve and Alentejo, has three geomorphologic structures, i) Caldeirão, ii) Monchique and iii) Cercal and São Luis mountain rates, that give the climatic difference among coastal systems and elongate rises and hollows of Alentejo (rolling topography), and comprise the potential distribution limits of a new climacic cork forest association from SW Iberia. Also Portel (iv) and Aracena (v) hills have been included in this study, ground of it similar specificities, like geographic and similar edapho-climatic regimes, that gives them all remarkable flora and vegetation communities.

These territories are integrated in the low, gently hilly lands to moderately relief of « Monchiquense » and « Aracenense » districts (Rivas-Martínez, 2005) which region occupies the south-western part of the large Iberian structural unit called Ancient Massif, where metamorphic Palaeozoic formations are dominant (Feio, 1951).

The Caldeirão, Monchique and Cercal systems constitute the mountainous barriers that mark the transition between the littoral oceanic platform, to the west the rolling topography of Alentejo and the Guadiana valley, to the northeast and to the east being delimited to the south by the « Barrocal Algarvio » and to the north by the sedimentary basin of Sado River.

In general, these geosystems have a roughest surface (Caldeirão – 589 m; Monchique – 902 m; Cercal – 373 m) created by tectonic activity and increased by superficial runoff action creating a drainage network deep intruded in the relief. The mountain rates integrated in Serrano Monchiquense district are embed on Baixo Alentejo carboniferous flysh, more exactly on Mértola formation (HMt – upper Viséan) and Mira formation (HMi – Namurian), which correspond a turbiditic sequence of schist or greywacke (Manupella *et al.*, 1992) interrupted by Monchique massif, a intrusive sienitic, nefelinic batholith (Malato-Beliz, 1982).

Finally, the Serra de Portel (421 m) is a raised fault block (horst), clearly differentiated from the surrounding rolling topography of Central Alentejo. With an orientation E-N, this horst creates the morphological boundary between Baixo Alentejo and Alto Alentejo. In terms of geomorphology, this region occupies the Ossa Morena zone with Silurian schistous series (Feio & Daveau, 2004; Malato-Beliz, 1990).

The study area is characterized by slight developed soils from schists and greywackes. Despite the low pedologic diversity, the thermo-pluviometric and biogeographic characteristics, concerted with the intense and continuing human action, have strongly influenced the existing of rich vegetal communities and an original flora.

In a biogeographical context and following Rivas Martínez (2005), the study area includes the biogeographical « Monchiquense », « Alentejano » and « Aracenense » Districts, which belong to the « Mariânico-Monchiquense » sector, « Luso-Extremadurense » sub-province, « Mediterrânica Ibérica Ocidental » province, « Mediterrânica Ocidental » sub-region, « Mediterrânea » region and « Holártico » kingdom.

Bioclimaticly (Table I), the study area has a strong oceanic influence, dominating the thermomediterranean thermotype. However, the dominant thermotype in the central and northern parts of the Sierra de Aracena and the rolling topography surrounding the Serra de Portel is mainly mesomediterranean. The most relevant ombrotypes are the subhumid and humid.

Table I.- Climatic variables and bioclimatic parameters of the region (Rivas-Martínez, 2005).
Tableau I.- Variables climatiques et indices bioclimatiques de la région (Rivas-Martínez 2005).

Station	Alt.	T	M	m	Tp	It/Itc	Ic	Io	P	Bioclimatic diagnosis
Faro	8	17.0	16.1	7.9	204,0	410	11.2	2,52	514	Mediterranean, Pluvistational, Semihiperoceanic, Lower thermomediterranean, Lower dry
Quarteira	4	16.6	14.4	7.8	198,8	387	11.7	2,27	450	Mediterranean, Pluvistational Semihiperoceanic, Upper thermomediterranean, Lower dry
Tavira	25	16,9	15,4	7,3	203,0	396	12,3	2,89	587	Mediterranean, Pluvistational Semihiperoceanic, Upper thermomediterranean, Upper dry
S. Brás de Alportel	240	15,9	13,8	6,2	190,9	359	13,2	4,58	874	Mediterranean, Pluvistational, Euoceanic, Upper thermomediterranean, Lower subhumid
Ameixial	260	16,9	13,0	4,7	202,8	346	14,8	2,40	488	Mediterranean, Pluvistational, Euoceanic, Lower mesomediterranean, Lower Dry
Caldas de Monchique	-	17,0	15,2	7,5	204,0	397	12,8	5,3	1076,9	Mediterranean, Pluvistational Semihiperoceanic, Lower thermomediterranean, Upper subhumid
Fóia	-	12,2	9,1	4,5	146,4	258	12,7	10,4	1526,1	Mediterranean, Pluvistationa, Semihiperoceanic, Upper mesomediterranean, Upper humid
Monchique	-	15,2	12,9	7,0	182,4	351	12,0	7,1	1300,9	Mediterranean, Pluvistational Semihiperoceanic, Lower thermomediterranean Lower humid
Praia da Rocha	-	16,9	15,5	8,0	202,4	404	11,3	2,2	454,6	Mediterranean, Pluvistational Semihiperoceanic, Lower thermomediterranean, Lower dry
Sagres	-	16,3	15,5	10,3	195,6	421/ 414 (C=7)	7,3	2,5	483,2	Mediterranean, Pluvistational, Euhyperoceanic, Upper inframediterranean, Lower dry
Alcácer do Sal	51	16,3	15,2	5,4	195,6	369	12,7	2,9	574,5	Mediterranean, Pluvistational Semihiperoceanic, Upper thermomediterranean, Upper dry
Alvalade	-	16,1	14,8	4,4	193,2	353	13,6	2,7	521,1	Mediterranean, Pluvistational, Euoceanic, Upper thermomediterranean, Lower dry
Grândola	95	16,4	15,4	3,2	194,4	350	14,7	3,4	661,1	Mediterranean, Pluvistational, Semihiperoceanic, Upper thermomediterranean, Upper dry
B. de Campilhas (Cercal)	108	15,9	14,0	5,9	190,8	358	13,2	3,3	642,3	Mediterranean, Pluvistational, Euoceanic, Upper thermomediterranean, Upper dry
Valdemusa	340	16,6	13,9	4,6	199,4	351	16,3	4,3	850,0	Mediterranean, Pluvistational, Euoceanic Upper thermomediterranean, Lower subhumid
Cabezas Rubias	225	17,9	14,4	5,9	214,2	382	16,6	3,2	693,0	Mediterranean, Pluvistational, Euoceanic, Upper thermomediterranean, Upper dry
Encinasola	433	17,4	13,8	3,4	17,4	353	19,4	3,4	721,0	Mediterranean, Pluvistational, Semicontinental, Upper thermomediterranean, Upper dry

Concerning the climatofilous series, there is predominance for potential formations of *Quercus suber* L., especially in the thermomediterranean, subhumid to humid, siliciceous, « Monchiquense » and « Aracenense » territories, which are the subject of this document. Currently, the occurrence of such mature grove formations in these mountains is becoming exceptionally rare, which can be attributed to the long-lasting impact of the human agro-forestry and grazing land use practices. Indeed, both the mountainous areas and the sur-

rounding plains and plateaus have been continuously impacted and modeled over the past centuries by these practices. More recently, important changes in land use have taken place, specially the fast development of intensive dry-land cereal culture during the XXth century « Wheat campaigns » and the proliferation of fast-growing forests to feed the wood industry, both negatively affecting the traditional cork-exploitation activity and leading to a higher homogenization of the landscape. In particular, the wood production has subtracted most of the ancient groves and accelerated the erosive processes, and eventually introduced new problems such as the loss of biodiversity and the increasing strength of fire cycles.

Thus, these fragments of *Quercus suber* grooves still persist in certain areas, the majority degraded and forming patchy mosaics with *Cytisetea scopario-striati, Calluno-Ulicetea* and *Cisto-Lavanduletea* formations. The particularity of these grove formations lies essentially on the originality of their floristic compositions, which are clearly differentiated from other climatophilous series of the *Querco rotundifoliae-Oleion sylvestris*, the alliance that encompasses the thermomediterranean *Quercus suber* forests of « Mediterrânea Ocidenta » sub-region (Rivas-Martínez *et al.*, 2002).

Here we describe, based on phytosociologic relevés, the thermomediterranean, silicious, cork-oak forests from « Monchiquense » and « Aracenence » territories, comparing them with other formations of thermomediterranean cork-oak forests from the above mentioned alliance.

II. METHODOLOGY

The flora identification was fundamentally based on the work of Aedo & Herrero (2005), Garmendia *et al.* (1986a, b), Castroviejo *et al.* (1993a, b, 1997, 1999), Talavera *et al.* (1986), Franco (1971-1984), Franco & Rocha-Afonso (1994-2003), Coutinho (1939) and Tutin *et al.* (1964-1980).

The vegetation analysis was performed following the phytosociologic methodology, also known as Zürich-Montpellier or sigmatist phytosocioloy school (Rivas-Martínez, 1976; Géhu & Rivas-Martínez, 1981).

The selected phytosociologic relevés are located along the mountain systems (Fig. 1). In what concerns to the biogeographic, bioclimatic and chorological characterization, we followed the works of Rivas-Martínez (1987, 2005), Rivas-Martínez *et al.* (2002), Pinto-Gomes & Paiva-Ferreira (2005) and Costa *et al.* (1998).

For the execution of the main goal related on this paper, which is the recognition of the specificity and identity of the studied cork-oak forests, we based ourselves on the works of Costa *et al.* (2002), Díez-Garretas *et al.* (1986) and Rivas-Martínez (1987), and developed a comparative table synthesizing the thermomediterranean cork-oak forests, already described in the alliance *Querco rotundifoliae-Oleion sylvestris* Barbéro, Quezel & Rivas-Martínez *in* Rivas-Martínez, Costa & Izco 1986.

III. RESULTS AND DISCUSSION

In the mountain grounds of the SW Iberian Peninsula, over highly crumpled soils of schist and greywackes, apears a different climatophilous community dominated by *Quercus suber*. Because of its floristic composition, as well as its ecological and chorological pro-

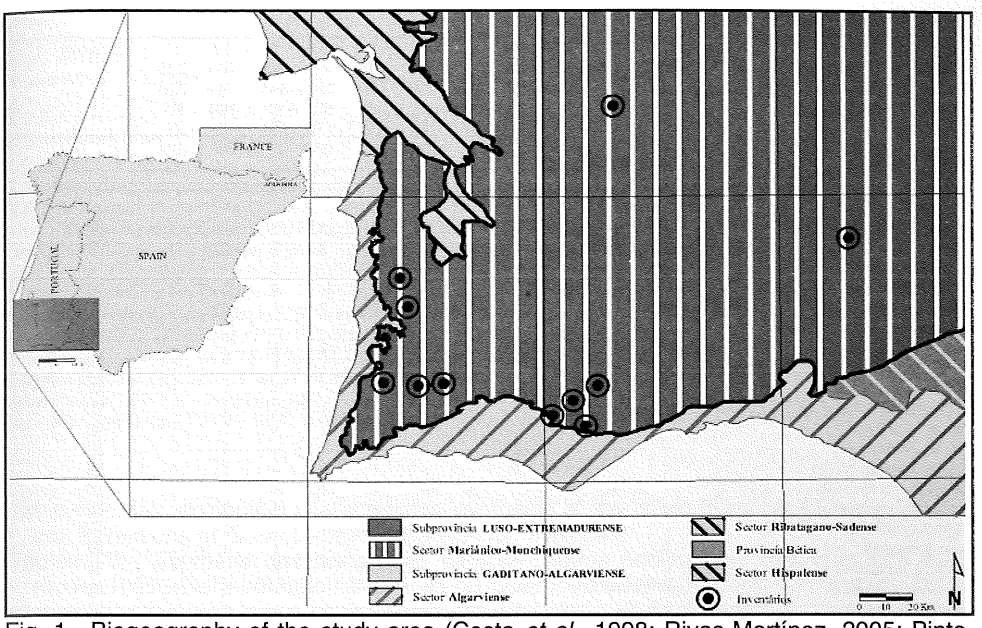

Fig. 1.- Biogeography of the study area (Costa *et al.*, 1998; Rivas-Martínez, 2005; Pinto-Gomes & Paiva-Ferreira, 2005) and relevés localization.

Fig. 1.- Biogéographie de l'aire d'étude (Costa *et al.*, 1998; Rivas-Martínez, 2005; Pinto-Gomes & Paiva-Ferreira, 2005) et localisation des relevés effectués.

perties, it was considered the presence of a new climatophilous forest formation of cork-oak, standing over schist and greywackes soils of the carbonic, thermomediterranean, sub-humid to humid territories: *Lavandulo viridis-Quercetum suberis ass. nov. hoc loco* (Table II, rel. 1 to 11; *typus nominis*: rel. 9), with ecological optimum in the Mountains of Caldeirão, Monchique and Cercal, reaching the mountains of Portel and Aracena (Table II).

In Table III, we emphasize the specificities of the referred cork-oak forests, comparing these against other climatophilous communities of *Quercus suber*, described for the thermomediterranean thermotype, within the alliance *Querco rotundifoliae-Oleion sylvestris*. Thus, basing on a comparative diagnosis it is possible to delimit the potential areas of distribution areas of the different associations. The litologic formation, soil typology and the different chorology are the main factors controlling the distribution of these potential cork-oak forests and respective subserial stages.

By analyzing Table III, the proposed association demarks edaphically from the series described for the following substrates: sandy, sandy to mossy and mossy, poorly or totally incoherent, and also from more consolidated sandstone and conglomerate soils, specifically the *Oleo sylvestris-Quercetum suberis* and *Asparago aphylli-Quercetum suberis* formations. The same table allows us to clearly discriminate the new association from the *Teucrio baetici-Quercetum suberis*, which has a different chorology and is enriched with several elements that are absent from the newly described association, such as *Calicotome villosa, Phyllirea latifolia, Clematis cirrhosa, Teline monspessulana, Genista tridens, Teucrium fruticans* among others.

Table II, Tableau II.- *Lavandulo viridis-Quercetum suberis ass. nov.*

Relevé nº	1	2	3	4	5	6	7	8	9	10	11	Presence
Area (m^2)	200	400	300	400	600	300	400	400	500	400	200	
Altitude (m)	500	450	115	583	100	150	210	250	345	30	220	
Cover (%)	75	80	95	80	100	85	90	95	95	100	85	
Exposure	N	N	E	SW	W	NE	NW	NW	N	S	N	
Slope (°)	20	20	35	12	15	20	35	25	15	30	35	
Species nº	24	26	31	25	24	26	25	34	45	25	41	
Characteristic species												
Quercus suber	3	4	3	4	3	3	3	4	5	4	4	V
Arbutus unedo	2	3	2	2	2	1	2	3	3	3	2	V
Lavandula viridis	+	1	1	1	2	1	-	( )	2	+	2	V
Erica arborea	+	3	1	1	+	1	-	-	1	1	2	V
Viburnum tinus	+	-	2	1	-	2	2	2	+	1	1	V
Smilax aspera var. *altissima*	+	+	+	-	1	+	+	-	+	2	+	V
Deschampsia stricta	-	-	+	+	1	-	+	1	+	1	+	IV
Rubia peregrina subsp. *longifolia*	-	+	-	-	1	+	+	+	1	-	1	IV
Lonicera implexa	-	+	1	1	-	+	-	+	+	-	+	IV
Rubia peregrina subsp. *peregrina*	-	-	+	+	-	+	-	-	1	1	1	III
Ruscus aculeatus	-	-	+	-	-	+	+	1	-	2	+	III
Myrtus communis	+	-	-	2	-	-	-	+	+	1	+	III
Phillyrea angustifolia	-	-	+	1	-	-	+	+	-	1	+	III
Sanguisorba hybrida	-	-	+	+	1	-	-	1	+	-	-	III
Asplenium onopteris	-	-	+	-	-	+	+	-	+	2	-	III
Daphne gnidium	-	+	r	-	-	-	-	1	+	-	+	III
Olea sylvestris	+	-	-	+	-	-	-	+	+	+	-	III
Quercus lusitanica	-	+	-	-	+	-	-	-	+	-	+	II
Rhamnus alaternus	-	-	+	-	-	+	-	-	-	2	+	II
Pistacia lentiscus	-	-	-	-	-	-	-	+	+	1	+	II
Quercus broteroi	-	-	-	-	-	-	+	-	+	1	-	II
Luzula forsteri subsp. *baeticum*	+	-	-	-	-	+	-	-	-	1	-	II
Hyacinthoides hispanica	-	-	-	-	-	-	-	2	+	-	1	II
Scilla monophyllos	-	+	-	-	-	-	-	1	-	-	+	II
Quercus rotundifolia	-	-	-	+	-	-	-	+	-	-	+	II
Teucrium scorodonia subsp. *baeticum*	-	-	-	-	1	-	+	+	-	-	-	II
Aristolochia baetica	+	-	-	-	-	-	-	+	-	-	-	I
Lonicera etrusca	-	-	-	-	-	-	-	-	1	-	+	I
Phillyrea media	-	-	-	-	-	-	-	-	-	1	-	+
Ceratonia siliqua	-	-	-	-	-	-	-	-	+	-	-	+
Osyris lanceolata	-	-	-	-	-	-	-	-	-	-	+	+
Asparagus aphyllus	-	-	-	+	-	-	-	-	-	-	-	+
Neotinea maculata	-	-	-	+	-	-	-	-	-	-	-	+
Companion species												
Cistus populifolius	-	2	+	1	+	+	+	1	+	-	1	V
Cistus salviifolius	-	1	1	-	-	1	2	1	+	+	+	IV
Dactylis lusitanica	+	+	-	1	-	+	-	-	+	1	+	IV
Lonicera periclymenum subsp. *hispanica*	-	+	-	-	1	+	+	+	-	1	+	IV
Genista triacanthos	-	1	+	-	1	-	1	-	+	-	+	III
Picris echioides	+	+	+	-	+	-	-	-	+	-	+	III
Tamus communis	1	-	+	-	-	-	+	1	1	-	+	III
Cytisus striatus	+	+	-	-	-	2	-	-	( )	-	-	II
Pteridium aquilinum	+	-	+	-	-	+	+	-	-	-	-	II
Ulex argenteus	+	1	-	-	+	-	-	-	+	-	-	II
Sedum forsterianum	-	-	-	-	-	+	-	1	+	-	+	II
Lithodora lusitanica	-	1	-	-	-	-	+	-	+	-	+	II
Phlomis purpurea	-	+	+	-	+	-	-	-	-	1	-	II
Rubus ulmifolius	1	-	-	-	-	+	+	-	+	-	-	II
Lavandula luisieri	-	+	+	-	-	-	-	+	-	+	-	II
Genista hirsuta	-	-	+	-	-	-	-	+	+	-	+	II
Stauracanthus boivinii	-	1	+	-	+	-	-	-	-	-	-	II
Thapsia villosa	-	+	-	-	-	-	-	-	1	-	1	II
Aristolochia paucinervis	1	-	+	-	-	-	-	-	+	-	-	II
Digitalis purpurea	-	-	-	-	+	-	-	+	-	+	-	II
Brachypodium phoenicoides	+	-	-	-	1	-	-	-	-	-	+	II
Brachypodium sylvaticum	-	-	-	+	-	-	-	-	+	-	+	II
Pterospartum tridentatum	-	-	+	+	+	-	-	-	-	-	-	II
Cistus ladanifer	-	-	-	+	+	-	-	+	-	-	-	II
Calamintha baetica	-	-	-	-	-	-	-	+	+	-	+	II

Thapsia garganica	-	-	+	-	-	+	+	-	-	-	-	II
Origanum virens	+	-	-	-	-	-	-	+	-	-	-	I
Bellis sylvestris	-	-	-	-	-	-	-	2	+	-	-	I
Clinopodium arundanum	-	-	-	+	1	-	-	-	-	-	-	I
Elaeoselinum foetidum	-	-	-	-	-	-	-	1	-	-	+	I
Carlina corymbosa	-	-	+	-	-	-	-	-	+	-	-	I
Allium massaesylum	-	-	-	-	-	-	-	1	-	-	+	I
Lavandula xalportelensis	-	-	-	-	-	-	-	+	+	-	-	I

Other taxa: *Cistus crispus* + (1); *Calluna vulgaris* + (2); *Thymus mastichina* + (2); *Dittrichia viscosa* subsp. *revoluta* + (3); *Avena sativa* subsp. *macrantha* + (4); *Ulex eriocladus* 1 (4); *Tuberaria lignosa* + (4); *Limodorum abortivum* + (4); *Crataegus monogyna* + (5); *Cynara algarbiensis* + (5); *Magydaris panacifolia* + (5); *Vitis vinifera* subsp. *sylvestris* + (6); *Erica scoparia* + (7); *Arenaria montana* + (7); *Quercus faginea* + (9); *Quercus* xcoutinhoi + (9); *Quercus broteroi* x *Quercus robur* + (9); *Hypericum perforatum* + (9); *Pulicaria odora* 1 (10); *Asphodelus aestivus* + (10); *Erophaca baetica* + (11); *Sanguisorba minor* + (11); *Scrophularia auriculata* + (11).

Localities: (Coordinate Reference System Datum WGS84): 1 – Fonte da Rata (Prx. Feiteira; lat 37º16'23.45"N, long 7º52'16.88"W); 2 – Bispo (lat 37º11'50.21"N, long 7º55'34.27"W); 3 – Foz do Açor (lat 37º20'47.95"N, long 8º26'18.54"W); 4 – Prx. Alajár (Aracena; lat 37º51'55.33"N, long 6º41'28.95"W); 5 – Bemposta (lat 37º35'54.41"N, long 8º35'08.46"W); 6 – Moinho de Baixo (Prx. Alferce; lat 37º20'30.04"N, lon 8º29'23.68"W); 7 – Cerro do Penedo (Prx. Besteiro; lat 37º20'54.42"N, long 8º40'58.74"W); 8 – Portel (lat 38º20'16.08"N, long 7º41'34.85"W); 9 – Gavião (lat 37º12'27.91"N, long 7º56'23.17"W); 10 – Rib.ª Torgal (lat 37º37'59.35"N , long 8º37'18.66"W); 11 – Negro (lat 37º11'54.47"N, long 7º58'0.32"W).

Table III.- Main ecological characteristics synthesis of the meso-thermomediterranean cork oak formations of *Querco rotundifoliae-Oleion sylvestris*.

Tableau III.- Synthèse des principales caractéristiques écologiques des chênaies subéreuses méso-thermoméditerranéennes du *Querco rotundifoliae-Oleion sylvestris*.

Communities	Typology	Thermotype	Ombrotype	Substrata	Chorology
A. *Asparago aphylli-Quercetum suberis*	climatophilous	meso-thermomediterranean	Subhumid to humid	Siliceous conglomerate soils and consolidated sandstone	« Ribatagano-Sadense » and « Alto Alentejano » Sectors
B. *Oleo sylvestris-Quercetum suberis*	climatophilous and edaphoxerophilous	thermomediterranean	Dry to subhumid	Siliceous sandy, sandy to mossy and mossy, poorly or totally incoherent	« Lusitano-Andaluza Litoral » Province
C. *Teucrio baetici-Quercetum suberis*	climatophilous	meso-thermomediterranean	Humid to hyperhumid	Siliceous schists and sandstone	« Bética » Province; « Gaditano-Algarviense » Subprovince and « Aljíbico » Sector
D. *Lavandulo viridis-Quercetum suberis*	climatophilous	thermomediterranean	Subhumid to humid	Siliceous schist and greywacke complex	« Mariânico-Mochiquense » Sector; « Monchiquense », « Alentejano » and « Aracenense » Districts

The *Lavandulo viridis-Quercetum suberis* is an association that develops under thermomediterranean, subhumid to humid ombrotype, on siliceous substrate. It is typical of the schist/greywackes soils that characterize the mountainous systems (Caldeirão, Monchique, and Cercal) from Iberian southwest, extending its distribution to the siliceous, thermomediterranean, subhumid to humid Serra de Portel and, occurring in its eastern limit, at Serra de Aracena.

These grove formations, present in « Monchiquense », « Alentejano » and « Aracenense » districts (Rivas-Martínez, 2005), are characterized by the dominance of *Quercus suber* and the constant presence of *Lavandula viridis*, an exclusive endemism from the Iberian Southwest that finds its ecologic optimum in these mountainous systems and that we consider a characteristic species of this association. The presence of differential plants such as *Cytisus striatus, Stauracanthus boivinii, Ulex argenteus, Genista triacanthos, Cistus populifolius, Deschampsia stricta*, among others, segregates corologically this association from the remaining, and restricts its distribution to the « Monchiquense » and « Aracenense » territories.

Equally common are the plants characteristic of the subserial stages from *Cytisetea scopario-striati, Calluno-Ulicetea, Cisto-Lavanduletea* and *Helianthemion guttati*, and resultant from the destruction of the potential grove formation by natural or anthropogenic causes. In the edge and corresponding to the first stage of substitution of this cork oak formations we have a strawberry-tree grove of *Cisto populifolii-Arbutetum unedonis* Br.-Bl., P.Silva & Rozeira 1964 *nom. inv.*, dominated by *Arbutus unedo, Cistus populifolius, Phillyrea angustifolia, Daphne gnidium, Erica arborea, Viburnum tinus, Paeonia broteroi* and *Quercus lusitanica* among others. Following the destruction of the arboreal and shrubby elements, the strawberry tree grove can, in deep soils, be replaced by a community of *Cytisus striatus*, frequently associated by a lategraminetum dominated by *Deschampsia stricta*. The increasing soil degradation will favor the development of a scrubland with *Ulex argenteus* and *Stauracanthus boivinii*, and a dwarf scrub community.

Finally, concerning the most distant steps from the potential climax, we emphasize the presence of perennial grasslands and ephemeral grasslands of *Helianthemion guttati*.

Table IV shows that the floristic composition of the newly described association is original and well differentiated from the remaining thermomediterranean, climatophilous communities of *Quercus suber* of the *Querco rotundifoliae-Oleion sylvestris* alliance, from *Teucrio baetici-Quercetum suberis*, the association with which it shares the closest proximity from the chorological point of view.

IV. CONCLUSIONS

Considering the undertaken work within a doctoral research study, it was shown a new climatophilous cork-oak forest association, thermomediterranean, siliceous, typical from mountain territories of Serra do Caldeirão, Monchique, Cercal, Portel and Aracena, exclusive from « Mariânico-Monchiquense » Sector, across « Monchiquense », « Alentejano » and « Aracenense » districts: *Lavandulo viridis-Quercetum suberis*. The presence of differential and endemic species from Iberian southwest, like *Lavandula viridis, Stauracanthus boivinii, Ulex argenteus, Deschampsia stricta* among others, linked to a strong originality of this woodland's dynamic, distinguishes this cork-oak forests from others within *Querco rotundifoliae-Oleion sylvestris* already described. Although it shows a considerable occurrence area, the higher stage of this new climatophilous series occurs often damaged, mainly by the intensive land use where forestry plays a huge part shown by the pine and eucalyptus plantations. In fact this land use promoted a residual presence of this cork-oak woodlands, in the Iberian Southwest, evidenced by the almost absence of this formations under the studied territories. The continuity of this land use and such practices will feed the fire cycles in this mediterrenean areas and they will became the past of the Algarve and lower-Alentejo landscapes (Pinto-Gomes & Paiva-Ferreira, 2005). Thus, given the frag-

Table IV.- Synthetic table of the meso-thermomediterranean cork-oak formations of *Querco rotundifoliae-Oleion sylvestris*. A - *Lavandulo viridis-Quercetum suberis* : 11 rel.; B - *Oleo sylvestris-Quercetum suberis* (Rivas-Martínez *et al.*, 1980, 1 rel.); C - *Teucrio baetici-Quercetum suberis* (Díez-Garretas, Cuenca & Asensi, 1986, Table 1, 6 rel.); D - *Asparago aphylli-Quercetum suberis* (Costa *et al.*, 2002, Table II, 30 rel.).

Tableau IV.- Synthèse des chênaies subéreuses méso-thermoméditerranéennes du *Querco rotundifoliae-Oleion sylvestris*.

	A	B	C	D
Characteristic species				
Quercus suber	V	5	V	V
Arbutus unedo	V	-	IV	III
Lavandula viridis	V	-	-	-
Smilax aspera var. *altissima*	V	1	-	V
Deschampsia stricta	IV	-	-	II
Lonicera implexa	IV	-	-	I
Rubia peregrina subsp. *peregrina*	III	-	-	-
Sanguisorba hybrida	III	-	-	+
Quercus lusitanica	II	-	-	III
Rhamnus alaternus	II	-	-	IV
Scilla monophyllos	II	-	-	II
Quercus rotundifolia	II	-	-	-
Quercus broteroi	II	-	-	IV
Luzula forsteri subsp. *baeticum*	II	-	-	I
Hyacinthoides hispanica	II	-	-	+
Asplenium onopteris	III	-	-	II
Myrtus communis	III	+	-	III
Lonicera etrusca	I	-	-	III
Erica arborea	V	-	III	II
Viburnum tinus	V	-	II	II
Rubia peregrina subsp. *longifolia*	IV	1	V	V
Ruscus aculeatus	III	2	V	III
Phillyrea angustifolia	III	-	IV	II
Daphne gnidium	III	-	I	IV
Olea europaea var. *sylvestris*	III	1	V	III
Pistacia lentiscus	II	3	IV	III
Teucrium scorodonia subsp. *baeticum*	II	-	V	III
Aristolochia baetica	I	2	1	-
Asparagus aphyllus	+	1	II	V
Smilax aspera var. *aspera*	-	2	-	V
Quercus coccifera	-	2	III	III
Asparagus acutifolius	-	1	-	I
Calicotome villosa	-	+	III	-
Clematis cirrhosa	-	2	II	-
Teucrium fruticans	-	1	III	-
Phillyrea latifolia	-	-	III	II
Arisarum vulgare	-	-	III	-
Rhamnus lycioides	-	-	I	-
Hedera iberica	-	-	-	IV
Rosa sempervirens	-	-	-	III
Vinca difformis	-	-	-	III
Euphorbia characias	-	-	-	III
Osyris alba	-	-	-	III
Arisarum clusi	-	-	-	III
Epipactis tremolsii	-	-	-	II
Carex distachya	-	-	-	II
Cephalanthera longifolia	-	-	-	I
Biarum galiani	-	-	-	I
Laurus nobilis	-	-	-	I
Cheirolophus sempervirens	-	-	-	I
Companion species				
Cistus populifolius	V	-	-	-
Cytisus striatus	II	-	-	-
Ulex argenteus	II	-	-	-
Stauracanthus boivinii	II	-	-	-
Genista hirsuta	II	-	-	-
Phlomis purpurea	II	-	-	-
Sedum forsterianum	II	-	-	-
Digitalis purpurea	II	-	-	-
Picris echioides	III	-	-	-
Pterospartum tridentatum	II	-	-	-
Cistus ladanifer	II	-	-	-
Thapsia garganica	II	-	-	-
Bellis sylvestris	I	-	-	-
Elaeoselinum foetidum	I	-	-	-
Carlina corymbosa	I	-	-	-
Allium massaesylum	I	-	-	-
Lavandula xalportelensis	I	-	-	-
Dactylis lusitanica	IV	-	-	II
Genista triacanthos	III	-	-	II
Tamus communis	III	-	-	IV
Thapsia villosa	II	-	-	II
Lithodora lusitanica	II	-	-	II
Brachypodium phoenicoides	II	-	-	III
Calamintha baetica	II	-	-	III
Pteridium aquilinum	II	-	-	II
Aristolochia paucinervis	II	-	-	II
Origanum virens	I	-	-	III
Clinopodium arundanum	I	-	-	I
Pulicaria odora	+	-	-	II
Cistus crispus	+	-	-	II
Erica scoparia	+	-	-	II
Calluna vulgaris	+	-	-	I
Crataegus monogyna	+	-	V	III
Brachypodium sylvaticum	II	-	II	+
Rubus ulmifolius	II	-	IV	V
Lavandula luisieri	II	-	III	II
Lonicera pericl. subsp. *hispanica*	IV	-	IV	III
Cistus salviifolius	IV	-	V	IV
Arum italicum	-	1	II	II
Iris foetidissima	-	+		III
Piptatherum miliaceum subsp. *m.*	-	+	IV	II
Calamintha sylvatica subsp. *ascendens*	-	1	II	-
Piptatherum miliaceum subsp. *thomasii*	-	2	-	-
Teline monspessulana	-	-	V	-
Cistus monspeliensis	-	-	IV	-
Genista tridens	-	-	IV	-
Brachypodium retusum	-	-	II	-
Ulex jussiaei	-	-	-	IV
Prunus insititioides	-	-	-	III
Urginea maritima	-	-	-	III
Erica cinerea	-	-	-	II
Cistus psilosepalus	-	-	-	II
Ulex airensis	-	-	-	I
Prunella estremadurensis	-	-	-	I
Rosa canina	-	-	-	I
Quercus pyrenaica	-	-	-	I
Pseudarrhenatherum longifolium	-	-	-	I
Castanea sativa	-	-	-	I
Stachys lusitanica	-	-	-	I
Geum sylvaticum	-	-	-	I
Agrimonia eupatoria	-	-	-	I
Lathyrus clymenum	-	-	-	I

mentary nature of these formations and the high natural heritage associated, it is imperative to promote conservation and management measures in order to preserve and enhance the unique cork-oak climatophilous woodlands in these territories, such as selective elimination of the subserial scrublands or pyrophyte edges, decreasing the fuel loading, reforestation with tree specimens such as *Quercus suber* and promoting the natural regeneration and at the same time the sucessional dynamics, active monitoring; awareness and environmental education, highlighting the value of the flora and plant communities of these territories. This new association also incorporates the 9330 habitat - Forests of *Quercus suber*, Annex I from Council Directive 92/43/EEC of 21 May 1992 (Habitats Directive).

Syntaxonomic scheme

Quercetea ilicis Br.-Bl. *ex* A. & O. Bolòs 1950

* *Quercetalia ilicis* Br.-Bl. *ex* Molinier 1934 *em.* Rivas-Martínez 1975

- *Querco rotundifoliae-Oleion sylvestris* Barbéro, Quézel & Rivas-Martínez *in* Rivas-Martínez, Costa & Izco 1986

1 - *Asparago aphylli-Quercetum suberis* J.C. Costa, Capelo, Lousã & Espírito Santo 1996

2 - *Oleo sylvestris-Quercetum suberis* Rivas Goday, Galiano & Rivas Martínez *ex* Rivas-Martínez 1987

3 - *Teucrio baetici-Quercetum suberis* Rivas-Martínez *ex* Díez-Garretas, Cuenca & Asensi 1988

4 - *Lavandulo viridis-Quercetum suberis* new ass.

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