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Artigo

THE SCRUBLAND OF LIMESTONE-DERIVED DECARBONATED SOILS OF THE WESTERN IBERIAN PENINSULA

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ABSTRACT – In the present article, the proposal of a new suballiance, *Lavandulo luisieri-Cistenion albidi*, is presented, constituted by chamaephytic and nanophanerophytic communities in eroded decarbonated soils derived from limestones (leptosols, chromic luvisols and cambisols) in the dry to lower hyperhumid, thermo-mesomediterranean bioclimatic levels. It is distributed throughout the western Iberian Peninsula in the Coastal Lusitan-Andalusian and Lusitan-Extremadurean biogeographical territories. It is positioned in the *Ulici argentei-Cistion ladaniferi, Lavanduletalia stoechadis, Cisto-Lavanduletea*. The new

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associations *Anthyllido maurae-Ulicetum jussiaei, Sedo albi-Cistetum crispi* and *Thymetum congesti* are also described. The multivariate analysis confirmed the segregation of this new suballiance, as well as the new associations.

Keywords: *Cistus*; plant communities; phytosociology; PCoA; UPGMA; mediterranean shrub communities.

RESUMO – AS COMUNIDADES VEGETAIS ARBUSTIVAS CARACTERÍSTICAS DE SOLOS DESCARBONATADOS DERIVADOS DE CALCÁRIOS DO OESTE DA PENÍNSULA IBÉRICA. No presente artigo apresentamos uma nova subaliança *Lavandulo luisieri-Cistetum albidi*, constituída por um conjunto de comunidades vegetais arbustivas (camefíticas e nanofanerofíticas) características de solos descarbonatados e submetidos a erosão, derivados de calcários (leptossolos, luvissolos crómicos e cambissolos). Tratam-se de comunidades vegetais que ocorrem no ocidente da Península Ibérica, nos territórios biogeográficos Costeiro Lusitano-Andaluz e Luso-Extremadurense e nos andares bioclimáticos termo-mesomediterrânico seco a hiper-húmido inferior. Estas comunidades vegetais inserem-se nos seguintes *syntaxa*: *Ulici argentei-Cistion ladaniferi, Lavanduletalia stoechadis, Cisto-Lavanduletea*. Para além da nova subaliança, são, também, descritas três novas associações: *Anthyllido maurae-Ulicetum jussiaei, Sedo albi-Cistetum crispi* e *Thymetum congesti*. A análise multivariada confirmou a segregação da nova subaliança descrita assim como das novas associações.

Palavras-chave: *Cistus*; comunidades vegetais; fitossociologia; PCoA; UPGMA; comunidades arbustivas mediterrânicas.

RÉSUMÉ – LES COMMUNAUTÉS VÉGÉTALES ARBUSTIVES CARACTÉRISTIQUES DES SOLS DÉCARBONATÉES DÉRIVÉS DU CALCAIRE DE L'OUEST DE LA PÉNINSULE IBÉRIQUE. Dans le présent article, nous présentons une nouvelle sous-alliance *Lavandulo luisieri-Cistetum albidi*, constituée par un ensemble de communautés végétales arbustives (Chamaephytes et Phanérophytes) caractéristiques des sols décarbonatés et érodés dérivés de calcaires (*leptosols chromic luvisols* et *cambisols*). Is s'agit de communautés de plantes qui se trouvent dans l'ouest de la Péninsule Ibérique dans les territoires biogéographiques *Costeiro Lusitano-Andaluz* et *Luso-Extremadurense* et dans les étages bioclimatiques thermo-mesoméditerranéens sec jusqu'au hyperhumide inférieur. Ces communautés végétales sont insérées dans les *syntaxa* suivantes: *Ulici argentei-Cistion ladaniferi, Lavanduletalia stoechadis, Cisto-Lavanduletea*. En plus de la nouvelle sous-alliance, sont également décrites trois nouvelles associations: *Anthyllido maurae-Ulicetum jussiaei, Sedo albi-Cistetum crispi* et *Thymetum congesti*. L'analyse multivariée a confirmé la ségrégation de la nouvelle sous-alliance décrite ainsi que des nouvelles associations.

Mot clés: *Cistus*; communautés végétales; phytosociologie; PCoA; UPGMA; communautés arbustives méditerranéennes.

RESUMEN – COMUNIDADES VEGETALES ARBUSTIVAS CARACTERÍSTICAS DE LOS SUELOS DESCARBONATADOS DERIVADOS DE CALIZA DEL OESTE DE LA PENÍNSULA IBÉRICA. En este artículo, se presenta una nueva subalianza *Lavandulo luisieri-Cistetum albidi*, constituida por un conjunto de comunidades vegetales arbustivas (camafíticas y nanofanorofíticas) características de los suelos descarbonatados y erosiona-

dos, derivados de las calizas (leptosoles, luvisoles crómicos y cambisoles). Se tratan de comunidades vegetales que se dan en el oeste de la Península Ibérica, en los territorios biogeográficos costeros lusitano-andaluces y luso-extremadurenses y en los pisos bioclimáticos secos a hiperhúmedos inferiores del termo-mediterráneos. Estas comunidades forman parte de la siguiente *syntaxa*: *Ulici argentei-Cistion ladaniferi, Lavanduletalia stoechadis, Cisto-Lavanduletea*. Además de la nueva subalianza, se describen también tres nuevas asociaciones: *Anthyllido maurae-Ulicetum jussiaei, Sedo albi-Cistetum crispi y Thymetum congesti.* El análisis multivariado confirmó la segregación de la nueva subalianza descrita, así como las nuevas asociaciones.

Palabras clave: *Cistus*; comunidades vegetales; fitosociología; PCoA; UPGMA; comunidades de arbustos mediterráneos.

I. INTRODUCTION

The calcareous territories in the western Iberian Peninsula possess great originality regarding flora and vegetation (Costa *et al.*, 1998, 2001, 2002; Lousã *et al.*, 1994, 2002; Neto *et al.*, 2009). Among the main reasons for this originality, stands out the pedological factor associated with the ombrotype horizon, which promotes decarbonation by lixiviation. As a result of these biophysical particularities, it is not strange that communities of complex phytosociological affiliation occur here. The *Cistus* scrub communities in eroded, decarbonated, limestone-derived soils, present in the Iberian Southwest, have been placed in the *Ulici argentei-Cistion ladaniferi* alliance (*Lavanduletalia stoechadis, Cisto-Lavanduletea*; Rivas-Martínez *et al.*, 1990). However, heathlands from the Dividing Portuguese biogeographic sector, dominated by *Ulex airensis* and *Erica scoparia,* were put together with the *Ericenion umbellatae, Ericion umbellatae, Ulicetalia minoris* and *Calluno-Ulicetea* communities (Costa *et al.*, 2002; Espírito-Santo *et al.*, 2000). These communities have some floristic affinities with the *Cistaceae* dominated scrublands.

Furthermore, Rivas Goday (1964) proposed gathering the classes *Cisto-Lavanduletea* and *Ononido-Rosmarinetea* into a single class, *Cisto-Rosmarinetea*, for the Iberian Peninsula western territories, even though they possess different soil pH levels, due to the fact that these scrublands contain a set of common plants, including: *Rosmarinus officinalis, Carex hallerana, Lithodora prostrata* subsp. *lusitanica, Teucrium capitatum, Teucrium fruticans, Coronilla juncea, Ulex eriocladus, Cistus salviifolius, Cistus albidus, Cistus monspeliensis, Helichrysum stoechas, Helichrysum serotinum, Ruta chalepensis, Ruta montana, Thymus zygis, Thymus mastichina* and *Phlomis purpurea*, among many others.

Facing such a background, this article studied the scrublands occurring in eroded, decarbonated, limestone-derived soils from the Iberian western and southwestern territories, as well as their phytosociological affiliation.

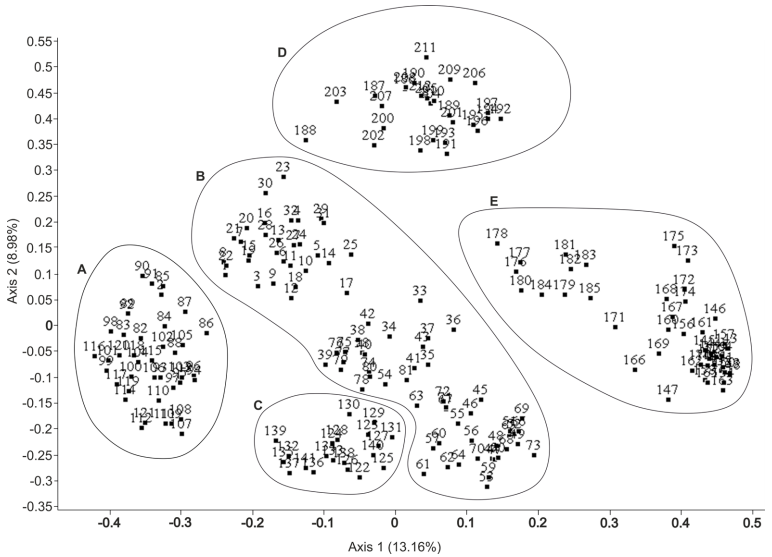
II. MATERIAL AND METHODS

The vegetation relevés were collected according to the sigmatist and dynamic-catenal phytosociology approach (Braun-Blanquet, 1979; Géhu & Rivas-Martínez, 1981; Rivas-Martínez, 2005b). The biogeographical and bioclimatological typologies used in the description of syntaxa followed Costa *et al.* (1998, 2012), Rivas-Martínez (2007), and Rivas-Martínez *et al.* (2001, 2002), while the syntaxa nomenclature followed the fourth edition of the International Code of Phytosociological Nomenclature (ICPN; Theurillat *et al.*, 2021). A floristic-statistical group analysis (Müller-Dombois & Ellenberg, 1974) was used for community definitions and synthetic table arrangements.

Ordination and clustering methods were used to describe the circumscription of the new suballiance and plant communities. For community comparisons, the original relevés were obtained from different authors: *Lavandulo sampaioanae-Cistetum albidi* relevés 1-6 from Santos and Ladero (1988), relevés 7-19 from Belmonte (1986); *Phlomido purpureae-Cistetum albidi* relevés 20-22 from Rivas-Martínez *et al.* (1990), relevés 23-32 from Pinto-Gomes and Paiva-Ferreira (2005); *Ulici airensis-Ericetum scopariae* relevé 44 from Espírito-Santo *et al.* (2000), relevés 45-53 from Costa *et al.* (2002), relevés 54-57 from Lopes (2001), relevés 58-60 from Gaspar (2003); *Cisto ladaniferi-Ulicetum argentei* relevés 82-87 from Braun-Blanquet *et al.* (1964), relevés 88-91 from Rivas-Martínez *et al.* (1990), relevé 92 from Lousã *et al.* (1989); *Genisto hirsutae-Cistetum ladaniferi* relevés 93-97 from Rivas Goday (1964), relevés 98-100 from Rivas-Martínez *et al.* (1990), relevés 101-106 from Lousã *et al.* (1989); *Ulici eriocladi-Cistetum ladaniferi* relevés 107-118 from Rivas-Martínez (2005a), relevés 119-121 from Rivas-Martínez *et al.* (1990); *Lavandulo luisieri-Ulicetum jussiaei* relevés 122-131 from Costa *et al.* (1993); *Thymo villosi-Ulicetum airensis* relevés 132-141 from Costa *et al.* (1997); *Salvio sclareoidis-Ulicetum densi* relevés 142-165*; Thymo sylvestris-Ulicetum densi* relevés 166-175; *Teucrio capitati-Thymetum sylvestris* relevés 176-185 from Capelo *et al.* (1993); *and Sideritido lusitanicae-Genistetum algarbiensis* relevés 198-212 from Pinto-Gomes and Paiva-Ferreira (2005). These 212 relevés were submitted to cluster analysis (UPGMA) with the Bray-Curtis coefficient as the resemblance measure and principal coordinate analysis (PCoA) using *SYNTAX 2000* software (Gower, 1996; Ludwig & Reynolds, 1988; Podani, 2001). Principal coordinate analysis (PCoA) is a multidimensional scaling method that can be based on any similarity or dissimilarity index, making possible the use of ecologically meaningful indices (Chae & Warde, 2006).

III. RESULTS AND DISCUSSION

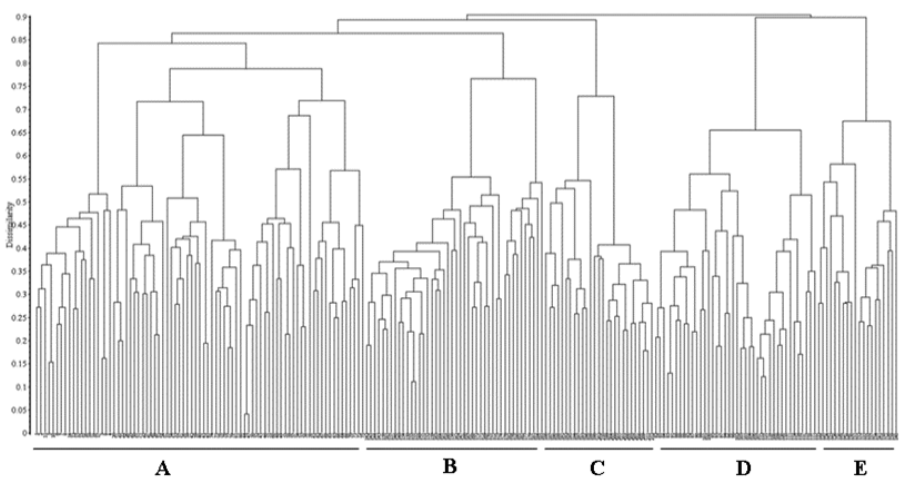
From the ordination obtained by the PCoA (fig. 1) and from the cluster analysis UPGMA (fig. 2) for all relevés, five different groups emerged, validating the segregation of the newly proposed suballiance: *Lavandulo luisieri-Cistenion albidi***.** The remaining four groups included the relevés from *Ulici argentei-Cistenion ladaniferi*, *Saturejo-Coridothymion capitati*, *Ulici densi-Thymion sylvestris and Ericion umbellatae*, which occurred in the same territories and frequently met the associations of the new suballiance.



Syntaxa: A – *Ulici argentei-Cistenion ladaniferi;* B – *Lavandulo luisieri-Cistenion albidi;* C – *Ericenion umbellatae;* D – *Ulici densi-Thymion sylvestris;* E – *Saturejo-Coridothymion capitatae.*

Fig. 1 – Principal coordinates analysis (PCoA) with the Bray-Curtis coefficient applied to the relevés composed by the *syntaxa*.

Fig. 1 – Análise de Coordenadas Principais (PCoA) com base no coeficiente de Bray-Curtis, aplicada aos inventários dos syntaxa.

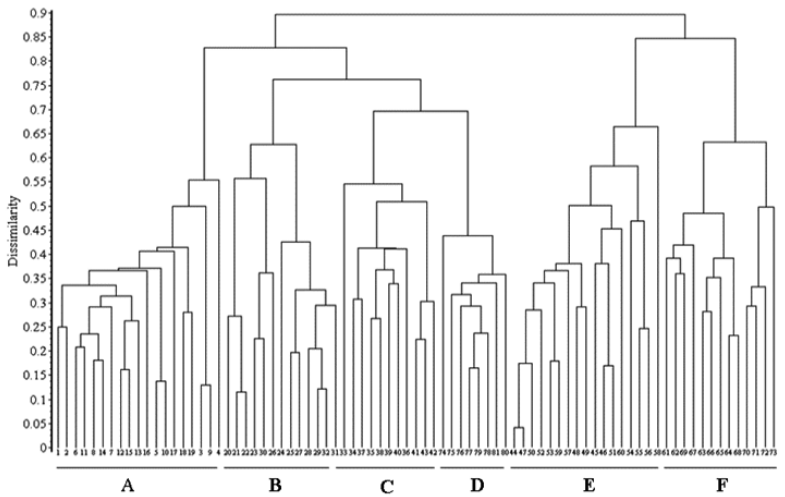


Syntaxa: A – *Lavandulo luisieri-Cistenion albidi* (relevés 1-81); B – *Ulici densi-Thymion sylvestris* (relevés 142-185); C – *Saturejo-Coridothymion capitatae* (relevés 186-212); D – *Ulici argentei-Cistenion ladaniferi* (relevés 82-121); E – *Ericenion umbellatae* (relevés 122-141).

Fig. 2 – UPGMA with the Bray-Curtis coefficient applied to the relevés composed by the *syntaxa.*

Fig. 2 – UPGMA com base no coeficiente de Bray-Curtis, aplicada aos inventários dos syntaxa.

The relevés analysis of the new suballiance, the *Lavandulo luisieri-Cistenion albidi* communities, made by cluster analysis UPGMA showed a good separation with high dissimilarity of the six associations, including three new associations (fig. 3), discriminated by their biogeography: in the Alentejanean and Pacensean districts the *Lavandulo sampaioanae-Cistetum albidi;* in the Algarvian, Aracenesean and Arrabidanean districts the *Phlomido purpureae-Cistetum albidi;* in the Coastal Vincentine district the *Thymetum congesti* and in the Dividing Portuguese sector the *Ulici airensis-Ericetum scopariae, Anthyllido maurae-Ulicetum jussiaei and Sedo albi-Cistetum crispi.*



A – *Lavandulo sampaioanae-Cistetum albidi* (relevés 1-19); B – *Phlomido purpureae-Cistetum albidi* (relevés 20-32); C – *Sedo albi-Cistetum crispi* (relevés 33-43); D – *Thymetum congesti* (relevés 74-81); E – *Ulici airensis-Ericetum scopariae* (relevés 44-60); F – *Anthyllido maurae-Ulicetum jussiaei* (relevés 61-73).

Fig. 3 – UPGMA with Bray-Curtis coefficient of the associations from *Lavandulo luisieri-Cistenion albidi alliance.*

Fig. 3 – UPGMA com base no coeficiente de Bray-Curtis, aplicada aos inventários das associações da subaliança Lavandulo luisieri-Cistenion albidi.

The floristic and ecological affinities between the chamaephytic *Cistus* scrublands and the nanophanerophytic heathlands from the Sadensean-Dividing Portuguese, Algarvian and Lusitan-Extremadurean regions, thermo to mesomediterranean, dry to humid, in skeletal soils derived from decarbonated limestone, red soil (leptosols, chromic luvisols and cambisols of the karstic Jurassic) support to propose a new syntaxon at the suballiance level: *Lavandulo luisieri-Cistenion albidi* J.C. Costa, Pinto-Gomes, C. Lopes, Neto, Monteiro-Henriques, Arsénio, V. Silva, Capelo, Lousã & Rivas-Martínez suball. nova hoc loco. This new syntaxon is affiliated into *Ulici argentei-Cistion ladaniferi* (*Lavanduletalia stoechadis, Cisto-Lavanduletea*). For the suballiance *holotypus* we elected: *Ulici airensis-Ericetum scopariae* Espírito-Santo, Capelo, Lousã & J.C. Costa in Espírito Santo, Lousã, J.C. Costa & Capelo (2000, p. 119-120).

The soils are neutral-basophilous, the pH in water varying between 6 and 7 being a lower unit in potassium chloride solution; they are decarbonated, originating from calcareous materials with a high percentage of organic matter, where the calcium from the limestone is dissolved in substantial amounts (Cabrita & Oliveira, 1964). Layers of these soils have a high percentage of organic matter normally higher than 10%, and it was also noted that there is a positive correlation between the calcium called "chemically active limestone" and the largest deviations between the sum of individually determined bases of exchange, for this reason in these soils the calcium ion is bound to organic forms (Cabrita & Oliveira, 1964).

We consider as characteristic species of this new suballiance *Ulex airensis*, *Thymus camphoratus* subsp. *congestus* and *Cistus* × *pulverulentus* (*Cistus crispus* × *C. albidus*), as their ecological optima occur in this sort of conditions. The silicicolous species *Cistus salviifolius, Cistus monspeliensis, Lavandula luisieri, Urginea maritima, Thymus mastichina* and *Astragalus lusitanicus,* as well as calcicolous plants such as *Cistus albidus, Rosmarinus officinalis, Anthyllis vulneraria* subsp. *maura, Salvia sclareoides, Thymus sylvestris, Teucrium capitatum* and *Avenula occidentalis* occur as differential; the acidophilous heathland species like *Erica scoparia, Genista triacanthos, Calluna vulgaris* and *Ulex jussiaei* are also common (table I in appendix 1).

The *Lavandulo luisieri-Cistenion albidi* suballiance occupies a middle position between the *Rosmarinetea officinalis* and *Cisto-Lavanduletea* classes, as shown by the PCoA results (fig. 1), even though it is closest to the *Cistaceae* dominated scrublands of the *Ulici argentei-Cistenion ladaniferi* associations. Despite the ecological and floristic affinities with the *Rosmarinetea officinalis,* typical of eroded limestone-derived soils, the constancy of the degree of coverage of *Cistus* species (*C. monspeliensis, C. salviifolius, C. crispus*) and *Lavandula luisieri* led us to integrate it in *Cisto-Lavanduletea*.

The following associations are included in this new syntaxa:

1. ***Lavandulo sampaioanae-Cistetum albidi*** M.T. Santos in Rivas-Martínez, Lousã, T.E. Díaz, Fernández-González & J.C. Costa 1990 (relevés 1-19; Rivas-Martínez *et al.*, 1990).
   A mesomediterranean association, dry to subhumid, with a Lusitan-Extremadurean distribution, on chromic luvisols and lime regosols originating from Cambric, Carboniferous, and Miocene limestones. It is dominated by *Cistus albidus*, and its differential species are *Lavandula sampaioana, Cistus ladanifer*, *Thymus zygis, Retama sphaerocarpa, Teucrium fruticans, Picris comosa* and *Ruta montana* (Belmonte, 1986; Santos & Ladero, 1988; table I in appendix 1) and subserial of *Rhamno fontqueri-Quercetum rotundifoliae* holm-oak forests.
2. ***Phlomido purpureae-Cistetum albidi*** Rivas-Martínez, Lousã, T.E. Díaz, Fernández-González & J.C. Costa 1990 (relevés 20-32; Rivas-Martínez *et al.*, 1990).
   A neutro-basophilous association, on dolomitic limestone (chromic luvisols) substrates of the thermomediterranean, dry to subhumid, original from the Algarve region, subserial of *Rhamno oleoidis-Quercetum rotundifoliae* holm-oak forests, characterized by *Cistus albidus, Phlomis purpurea, Lavandula luisieri* and *Cistus monspeliensis* (Pinto-Gomes & Paiva-Ferreira, 2005; Rivas-Martínez *et al.*, 1990;

table I). This association is also observed in the Guadiana lower basin (Capelo *et al.*, 1994; Lousã *et al.*, 1999) and was affiliate to the edapho-xerophilous series of the *Phlomido purpureae-Junipero turbinatae S.*, and in Serra da Arrábida it was integrated into the *Viburno tini-Querco rivasmartinezii* S. (Costa *et al.* 2005; Lousã *et al.*, 1999).

3. ***Ulici airensis-Ericetum scopariae*** Espírito-Santo, Capelo, Lousã & J.C. Costa in Espírito-Santo, Lousã, J.C. Costa & Capelo 2000 (relevés 44-60; Espírito-Santo *et al.*, 2000).
   An association in cambisols derived from karstic Jurassic limestone, humid to lower hyperhumid, mesomediterranean, occurring on Limestone Massif district, from Alvaiázere, Aire and Candeeiros mountain ranges, of Dividing Portuguese sector, and subserial of *Lonicero implexae-Quercetum rotundifoliae* holm-oak forests. It was characterized by the nanophanerophytes *Ulex airensis* and *Erica scoparia* (table I in appendix 1), with the following differential species, regarding the *Thymo villosae-Ulicetum airensis*, *Anthyllis vulneraria* subsp. *maura, Salvia sclareoides, Thymus sylvestris* and *Teucrium capitatum*.
4. ***Anthyllido maurae-Ulicetum jussiaei*** C. Lopes, J.C. Costa, P. Gomes, Lousã & Ladero in J.C. Costa *et al.* 2021 ass. nov. (relevés 61-73; Community of *Erica scoparia* and *Ulex jussiaei* C. Lopes, 2001; Lopes, 2001).
   (Holotypus: relevé no. 70, table II in appendix 1)
   Scrubland dominated by *Ulex jussiaei* and/or *Erica scoparia*, nanophanerophytic, mesomediterranean, upper subhumid to humid, in skeletal decarbonated soils derived from limestones (marl, marly limestone, and hard limestone) of the northern and western Dividing Portuguese sector (Sicó, Rabaçal, Boa Viagem and Montejunto mountain ranges). Its floristic combination includes: *Ulex jussiaei*, *Erica scoparia, Coronilla glauca*, *Cistus crispus, Lavandula luisieri, Cistus salviifolius, Cistus monspeliensis, Anthyllis vulneraria* subsp. *maura, Astragalus lusitanicus* and *Urginea maritima*; with the differential species, regarding the *Lavandulo luisieri-Ulicetum jussiaei, Anthyllis vulneraria* subsp. *maura, Thymus sylvestris, Cistus albidus, Staehelina dubia, Teucrium capitatum, Antirrhinum linkianum* and *Silene longicilia* (table II in appendix 1). It represents one of the most degraded seral stages from the *Arisaro-Querco broteroi S.* woodland series.
5. ***Sedo albi-Cistetum crispi*** J.C. Costa, Neto, P. Gomes, Lopes, Monteiro-Henriques, Arsénio, V. Silva, Capelo, Lousã & Rivas-Martínez in J.C. Costa *et al.* 2021 ass. nov. (relevés 33-43; Costa *et al.*, 2021).
   (Holotypus: relevé no. 43, table III in appendix 1)
   An early succession chamaephytic association, mesomediterranean, subhumid to humid, from the limestone mountain ranges of the Dividing Portuguese sector. It occurs on eroded soils (leptosols) derived from decarbonated red soils and hard karstic limestones from the Jurassic. It is constituted of several species of *Cistus* (*C. albidus, C. monspeliensis, C. crispus, C. salviifolius, C.* x *pulverulentus*), *Lavandula luisieri, Rosmarinus officinalis, Sedum album, Brachypodium phoenicoides, Narcissus obesus* and *Thymus mastichina* (table III in appendix 1). It is ascribed to

the calcicole series of *Lonicero implexae-Querco rotundifoliae S.* and *Arisaro-Querco broteroi S.*, where it represents one of the highest degradation stages, the first one to recover, being synvicarious with *Phlomido purpureae-Cistetum albidi* and *Lavandulo sampaioanae-Cistetum albidi*.

6. ***Thymetum congesti*** J.C. Costa, P. Arsénio, C. Neto, Loidi & P. Gomes in J.C. Costa *et al.* 2021 ass. nov. (relevés 74-81; Community of *Thymus camphoratus* subsp. *congestus* Neto *et al.*, 2009).
(Holotypus: relevé no. 76, table IV in appendix 1)
Pinto-Gomes *et al.* (2006) described *Thymus camphoratus* subsp. *congestus* for coastal alkaline soils areas of Coastal Vincentine district. We found this taxon forming a unique community on lithified calcareous dunes. *Thymus camphoratus* subsp. *congestus* is common in the characteristic combination, as well as *Rosmarinus officinalis, Cistus crispus, C. salviifolius, C. albidus, C. monspeliensis, Lavandula luisieri, Astragalus lusitanicus, Ulex australis* subsp. *welwitschianus, Ruta chalepensis, Urginea maritima,* and *Lithodora lusitanica* (table IV in appendix 1). The annual Lusitanian endemisms belonging to Annex II of the Council Directive 92/43/EEC (European Commission, 1992) and the Bern convention (Council of Europe, 1979) *Chaenorhinum serpyllifolium* subsp. *lusitanicum* and *Jonopsidium acaule* are also observed within this association. The occurrence of psammophilous plants such as *Halimium calycinum, Iberis welwitschii* and *Helichrysum picardii* is most certainly related to the fact that the substratum rock is barely consolidated, i.e., the limestone cement easily crumbles, producing sand-rich soils. It was mainly observed at *Querco cocciferae-Juniperetum turbinatae* clearings, with a thermomediterranean, dry bioclimatic belt.
The distribution of *Lavandulo luisieri-Cistenion albidi* communities in the Iberian Peninsula is presented in figure 4.

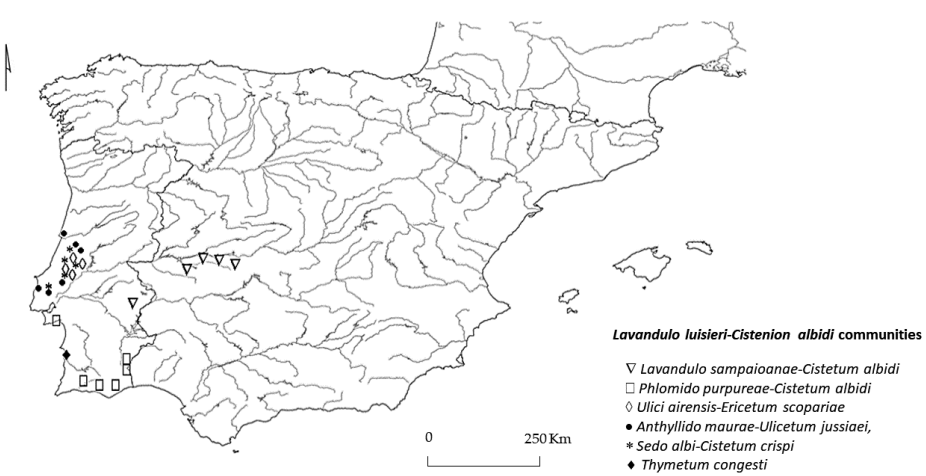


Fig. 4 – Distribution of the *Lavandulo luisieri-Cistenion albidi* communities.
Fig. 4 – Distribuição das comunidades de Lavandulo luisieri-Cistenion albidi.

IV. CONCLUSIONS

In this article we addressed the scrublands occurring in decarbonated, limestone-derived soils, from the west and southwest of the Iberian Peninsula. The analysis presented in this work, comparing these peculiar communities with other communities from *Cisto-Lavanduletea*, *Calluno-Ulicetea* and *Rosmarinetea officinalis*, allowed us not only to increase knowledge on these Iberian communities, but also to improve the syntaxonomical systematization of all these scrublands, paving the foundations for a better recognition in the field, management and conservation of such vegetation patches and the enclosed unique biodiversity.

SYNTAXONOMICAL SCHEME

CISTO-LAVANDULETEA Br.-Bl. in Br.-Bl., Molinier & Wagner 1940
♦ **Lavanduletalia stoechadis** Br.-Bl. 1940 em. Rivas-Martínez 1968
* ***Ulici argentei-Cistion ladaniferi*** Br.-Bl., P. Silva & Rozeira 1964
** **Ulici argentei-Cistenion ladaniferi**
1. *Cisto ladaniferi-Ulicetum argentei* Br.-Bl., P. Silva & Rozeira 1964
2. *Genisto hirsutae-Cistetum ladaniferi* Rivas Goday 1955
3. *Ulici eriocladi-Cistetum ladaniferi* Rivas-Martínez 1979
** **Lavandulo luisieri-Cistenion albidi** J.C. Costa, Pinto-Gomes, C. Lopes, Neto, Monteiro-Henriques, Arsénio, V. Silva, Capelo, Lousã & Rivas-Martínez 2021 [new in this study]
4. *Lavandulo sampaioanae-Cistetum albidi* M.T. Santos in Rivas-Martínez, Lousã, T.E. Díaz, Fernández-González & J.C. Costa 1990
5. *Phlomido purpureae-Cistetum albidi* Rivas-Martínez, Lousã, T.E. Díaz, Fernández-González & J.C. Costa 1990
6. *Ulici airensis-Ericetum scopariae* Espírito-Santo, Capelo, Lousã & J.C. Costa in Espírito Santo, Lousã, J.C. Costa & Capelo 2000
7. *Anthyllido maurae-Ulicetum jussiaei* C. Lopes, J.C. Costa, P. Gomes, Lousã & Ladero in J.C. Costa *et al.* 2021 [new in this study]
8. *Sedo albi-Cistetum crispi* J.C. Costa, Neto, P. Gomes, C. Lopes, Monteiro-Henriques, Arsénio, V. Silva, Capelo, Lousã & Rivas-Martínez in J.C. Costa *et al.* 2021 [new in this study]
9. *Thymetum congesti* J.C. Costa, P. Arsénio, C. Neto, Loidi & P. Gomes in J.C. Costa *et al.* 2021 [new in this study]
CALLUNO-ULICETEA Br.-Bl. & Tüxen ex Klika & Hadač 1944
♦ **Ulicetalia minoris** Quantin 1935
* ***Ericion umbellatae*** Br.-Bl., P. Silva, Rozeira & Fontes 1952 em. Rivas-Martínez 1979
** **Ericenion umbellatae** Rivas-Martínez 1979
10. *Lavandulo luisieri-Ulicetum jussiaei* J.C. Costa, Ladero, T.E. Díaz, M. Lousã, Espírito Santo, Vasconcelos, Monteiro & A. Amor 1993
11. *Thymo villosi-Ulicetum airensis* J.C. Costa, Capelo, Espírito Santo & Lousã in J.C. Costa, Capelo, Neto, Espírito Santo & Lousã 1997
ROSMARINETEA OFFICINALIS Rivas-Martínez, T.E. Días, F. Prieto, Loidi & Penas 2002
♦ **Rosmarinetalia officinalis** Br.-Bl. ex Molinier 1934
* ***Saturejo-Coridothymion capitati*** Rivas Goday & Rivas-Martínez 1969
** **Saturejo-Coridothymenion** (Rivas Goday & Rivas-Martínez 1969) Rivas-Martínez, Fernández-González & Loidi 1999
12. *Thymo lotocephali-Coridothymetum capitati* Rivas-Martínez, Lousã, T.E. Díaz, Fernández-González & J.C. Costa 1990

13. *Sideritido lusitanicae-Genistetum algarbiensis* P. Gomes *& P. Ferreira* 2005

✱ ***Ulici densi-Thymion sylvestris*** (Capelo, J.C. Costa, Espírito Santo & Lousã 1993) J.C. Costa, Capelo, Lousã, Neto & Rivas-Martínez 2009

14. *Salvio sclareoidis-Ulicetum densi* Rivas-Martínez, Lousã, T.E. Díaz, Fernández-González & J.C. Costa 1990 ex Capelo, J.C. Costa, Lousã & Neto 1992

15. *Teucrio capitati-Thymetum sylvestris* Espírito Santo & Capelo in Capelo, J.C. Costa, Espírito Santo & Lousã 1992

16. *Thymo sylvestris-Ulicetum densi* (Capelo, J.C. Costa, Lousã & Neto 1993) J.C. Costa, Capelo, Lousã, Neto & Rivas-Martínez 2009

APPENDIX 1

Table I – Synthetic table of the Lavandulo luisieri-Cistenion albidi.

Quadro I – Tabela sintética do Lavandulo luisieri-Cistenion albidi.

Synthetic table of the *Lavandulo luisieri-Cistenion albid*i													
Column number	1	2	3	4	5	6	7	8	9	10	11	12	13
Number of relevés	6	13	3	1	10	1	11	1	9	4	3	13	8
Differential associations													
Lavandula sampaioana	V	V	.	.	.	.	.	.	.	.	.	.	.
Cistus ladanifer	II	III	.	1	.	.	.	.	.	.	.	.	.
Retama sphaerocarpa	II	III	.	.	.	.	.	.	.	.	.	.	.
Thymus zygis	I	II	.	.	.	.	.	.	.	.	.	.	.
Teucrium fruticans	I	II	.	.	.	.	.	.	.	.	.	.	.
Picris comosa	I	.	.	.	.	.	.	.	.	.	.	.	.
Ruta montana	I	.	.	.	.	.	.	.	.	.	.	.	.
Serratula neglecta	.	.	1	.	.	.	.	.	.	.	.	.	.
Phlomis purpurea	.	.	3	1	V	1	.	.	.	.	.	.	.
Cistus x pulverulentus	.	.	.	.	.	.	III	.	.	.	.	.	.
Narcissus obesus	.	.	.	.	.	.	IV	.	.	.	.	.	.
Sedum album	.	.	.	.	.	.	V	.	.	.	.	.	.
Ulex airensis	.	.	.	.	.	.	.	1	V	4	3	.	.
Ulex jussiaei	.	.	.	.	.	.	.	.	.	.	.	V	.
Coronilla glauca	.	.	.	.	.	.	.	.	.	.	.	IV	.
Thymus camphoratus subsp. congestus	.	.	.	.	.	.	.	.	.	.	.	.	V
Ulex australis subsp. welwitschianus	.	.	.	.	.	.	.	.	.	.	.	.	V
Characteristics and suballiance differential													
Cistus albidus	V	V	3	1	V	1	V	.	IV	.	1	II	III
Rosmarinus officinalis	I	II	.	1	IV	1	V	1	V	4	2	.	V
Lavandula luisieri	.	.	3	1	V	1	V	1	V	.	3	IV	V
Cistus monspeliensis	.	.	3	1	V	1	V	.	II	2	1	III	IV
Ruta chalepensis	.	.	.	.	II	1	+	.	.	.	.	II	IV
Anthyllis maura	.	.	.	.	.	.	III	.	III	.	.	III	.
Salvia sclareoides	.	.	.	.	.	.	III	.	I	.	1	II	.
Thymus sylvestris	.	.	.	.	.	.	III	1	V	.	1	II	.
Erica scoparia	.	.	.	.	.	.	I	1	V	4	2	IV	.
Teucrium capitatum	.	.	.	.	.	.	I	1	III	2	.	I	.
Avenula occidentalis	.	.	.	.	.	.	+	1	IV	.	1	.	.
Siderites hirsuta var. *hirtula*	.	.	.	.	.	.	+	.	II	.	.	.	.

Characteristics of the superior units													
Urginea maritima	IV	III	3	.	III	1	IV	1	IV	3	2	III	V
Cistus salviifolius	IV	IV	.	.	.	1	V	1	V	3	2	V	V
Cistus crispus	.	.	.	.	.	.	V	1	V	1	2	V	V
Astragalus lusitanicus	I	II	1	1	I	1	II	.	.	.	.	II	V
Thymus mastichina	V	IV	1	.	III	1	III	.	.	.	.	.	.
Asphodelus aestivus	III	III	1	.	IV	1	.	.	.	.	2	.	.
Helichrysum italicum subsp. *serotinum*	III	II	.	.	II	1	II	.	II	.	.	.	.
Genista hirsuta	II	.	1	.	.	.	.	.	.	.	.	.	.
Lithodora lusitanica	.	.	1	.	.	.	.	.	.	1	1	.	IV
Cytinus macrantherus	.	.	1	.	+	.	I	.	.	.	.	.	.
Halimium viscosum	.	.	.	1	.	.	.	.	.	.	.	.	.
Tulipa australis	.	.	.	.	+	.	.	.	.	.	.	.	.
Helichrysum picardii	.	.	.	.	.	.	.	.	.	.	.	.	II
Iberis welwitschii	.	.	.	.	.	.	.	.	.	.	.	.	II
Halimium calycinum	.	.	.	.	.	.	.	.	.	.	.	.	II
Cistus ladanifer x *palhinhae*	.	.	.	.	.	.	.	.	.	.	.	.	II
Main companions													
Orchis italica	II	+	.	.	.	.	.	.	.	.	.	.	.
Ophrys tenthredinifera	I	II	.	.	.	.	.	.	.	.	.	.	.
Origanum virens	I	.	.	.	.	1	III	.	.	.	1	I	.
Biarum arundanum	I	+	.	.	.	.	.	1	I	.	.	.	.
Salvia argentea	I	.	.	.	.	.	.	.	.	.	.	.	.
Jasminum fruticans	I	.	.	.	III	.	+	.	.	.	.	.	.
Olea sylvestris	I	.	.	.	II	.	+	.	.	3	.	II	I
Rhamnus oleoides	I	I	.	.	III	.	.	.	.	.	.	.	.
Thapsia villosa	I	+	3	.	IV	1	IV	.	III	.	1	+	IV
Carex hallerana	I	+	.	.	+	1	IV	1	II	.	1	.	II
Dactylis hispanica	.	II	1	.	+	1	IV	1	IV	.	2	II	II
Quercus rotundifolia	.	III	.	.	+	.	.	1	III	4	.	.	.
Daphne gnidium	.	II	.	.	+	.	III	1	III	.	2	IV	II
Phlomis lychnitidis	.	II	.	.	+	.	+	.	.	.	.	.	.
Osyris alba	.	+	.	.	+	.	+	.	.	.	1	.	.
Orchis morio	.	III	.	.	.	.	.	.	.	.	.	.	.
Cytisus scoparius	.	II	.	.	.	.	.	.	.	.	.	.	.
Pimpinella villosa	.	II	.	.	.	.	.	.	.	.	.	.	.
Carlina hispanica	.	II	.	.	.	.	.	.	.	.	.	.	.
Orchis conica	.	II	.	.	.	.	.	.	.	.	.	.	.
Ajuga iva	.	II	.	.	.	.	II	1	II	.	.	.	.
Arisarum simorrhinum	.	.	1	.	III	.	IV	1	III	.	.	+	.
Elaeoselinum tenuifolium	.	.	1	.	I	.	.	.	.	.	.	.	.
Phagnalon rupestre	.	.	.	1	.	.	.	.	.	.	.	.	.
Hyparrhenia sinaica	.	.	.	1	.	.	.	.	.	.	.	.	II
Staehelina dubia	.	.	.	.	III	.	.	.	.	.	.	II	.
Teucrium haenseleri	.	.	.	.	III	.	.	.	.	.	.	.	.
Juniperus turbinata	.	.	.	.	III	.	.	.	.	.	.	.	IV
Pistacia terebinthus	.	.	.	.	III	.	.	.	.	.	.	.	.
Sedum sediforme	.	.	.	.	III	1	III	.	.	.	.	.	V
Arrhenatherum album	.	.	.	.	III	.	+	.	.	.	.	.	I
Quercus coccifera	.	.	.	.	I	.	+	.	IV	3	1	IV	III

Phagnalon saxatile	.	.	.	.	+	.	III	.	.	.	.	.	.
Phillyrea latifolia	.	.	.	.	+	.	.	.		1	.	.	.
Leuzea conifera	.	.	.	.	+	.	.	.	.	1	.	.	.
Brachypodium phoenicoides	.	.	.	.	.	1	V	1	V	3	1	V	.
Asparagus aphyllus	.	.	.	.	.	1	I	.	III	.	2	III	III
Anemone palmata	.	.	.	.	.	.	IV	1	II	.	.	.	.
Aristolochia paucinervis	.	.	.	.	.	.	III	.	.	.	.	.	.
Leontodon tuberosus	.	.	.	.	.	.	II	.	.	.	.	.	.
Calamintha baetica	.	.	.	.	.	.	II	.	.	.	.	.	.
Pulicaria odora	.	.	.	.	.	.	III	.	IV	.	.	+	II
Bupleurum paniculatum	.	.	.	.	.	.	II	.	III	.	2	III	.
Clinopodium arundanum	.	.	.	.	.	.	II	.	.	.	.	II	.
Pteridium aquilinum	.	.	.	.	.	.	II	.	II	.	.	.	.
Geum sylvaticum	.	.	.	.	.	.	I	.	.	.	1	.	.
Sedum forsterianum	.	.	.	.	.	.	I	.	.	.	1	.	.
Biscutella lusitanica	.	.	.	.	.	.	I	.	II	.	.	.	.
Euphorbia portlandica	.	.	.	.	.	.	+	1	III	.	.	.	.
Fritillaria lusitanica	.	.	.	.	.	.	+	.	I	.	1	.	I
Fumana thymifolia	.	.	.	.	.	.	+	.	I	.	.	.	.
Asparagus acutifolius	.	.	.	.	.	.	+	1	I	.	.	.	.
Euphorbia characias	.	.	.	.	.	.	+	.	I	.	.	II	.
Scilla monophyllus	.	.	.	.	.	.	.	1	.	1	.	.	II
Genista tournefortii	.	.	.	.	.	.	.	1	IV	.	1	II	.
Quercus x *airensis*	.	.	.	.	.	.	.	1	II	1	1	.	.
Rhamnus alaternus	.	.	.	.	.	.	.	.	II	2	1	.	.
Genista triacanthos	.	.	.	.	.	.	.	.	III	1	1	.	.
Calluna vulgaris	.	.	.	.	.	.	.	.	II	3	1	.	.
Erica umbellata	.	.	.	.	.	.	.	.	I	.	.	.	.
Ulex latebracteatus	.	.	.	.	.	.	.	.	I	.	.	.	.
Agrostis castellana	.	.	.	.	.	.	.	.	II	.	.	.	.
Pistacia lentiscus	.	.	.	.	.	.	.	.	.	3	.	III	III
Agrostis curtisii	.	.	.	.	.	.	.	.	.	.	1	.	.
Tuberaria lignosa	.	.	.	.	.	.	.	.	.	.	1	.	.
Serratula estremadurensis	.	.	.	.	.	.	.	.	.	.	1	.	.
Stipa gigantea	.	.	.	.	.	.	.	.	.	.	1	.	III
Crataegus monogyna	.	.	.	.	.	.	.	.	.	.	.	III	.
Quercus broteroi	.	.	.	.	.	.	.	.	.	.	.	II	.
Carex distachya	.	.	.	.	.	.	.	.	.	.	.	II	I
Lonicera etrusca	.	.	.	.	.	.	.	.	.	.	.	II	.
Sanguisorba spachiana	.	.	.	.	.	.	.	.	.	.	.	II	.
Antirrhinum linkianum	.	.	.	.	.	.	.	.	.	.	.	II	.
Carlina hispanica	.	.	.	.	.	.	.	.	.	.	.	II	II
Calendula algarbiensis	.	.	.	.	.	.	.	.	.	.	.	.	V
Chaenorhinum lusitanicum	.	.	.	.	.	.	.	.	.	.	.	.	III
Lobularia maritima	.	.	.	.	.	.	.	.	.	.	.	.	II
Osyris lanceolata	.	.	.	.	.	.	.	.	.	.	.	.	II

Lavandulo sampaioanae-Cistetum albidi: 1 Santos *et al.* 1988 (quadro 29), 2 Belmonte (1986), (Quadro 125); *Phlomido purpureae--Cistetum albidi*: 3 Rivas-Martínez *et al.* 1990 (quadro 11), 4 Capelo *et al.* (1994), 5 Pinto-Gomes & Ferreira 2005 (quadro III/LXI), 6 Lousã *et al.* 1999; *Sedo albi-Cistetum crispi*: 7; *Ulici airensis-Ericetum scopariae*: 8 Espírito Santo *et al.* 2000; 9 Costa *et al.* 2002 (quadro 3); 10 Lopes 2001 (quadro 4-47); 11 Gaspar 2003 (quadro 38); *Anthyllido maurae-Ulicetum jussiaei*: 12; *Thymetum congesti*: 13

Table II – Table of the *Anthyllido maurae-Ulicetum jussiaei.*

Quadro II – Tabela do Anthyllido maurae-Ulicetum jussiaei.

	Anthyllido maurae-Ulicetum jussiaei												
Relevé no.	61	62	63	64	65	66	67	68	69	**70**	71	72	73
Altitude (m)	350	150	240	210	150	210	240	190	80	**140**	220	175	195
Aspect	E	N	E	Pl	E	Pl	NW	E	W	**Pl**	SE	NW	NW
Surface (m^2)	100	70	100	80	80	90	100	90	100	90	100	200	100
Species no.	18	10	14	15	16	18	19	22	21	**18**	20	15	23
Characteristics													
Ulex jussiaei	4	2	2	2	3	2	2	2	3	**2**	4	2	3
Cistus crispus	1	1	+	2	1	1	.	+	2	**2**	1	2	2
Cistus salviifolius	.	1	1	+	1	+	+	+	2	+	1	2	2
Erica scoparia	2	1	1	1	2	2	1	1	+	**2**	.	.	.
Coronilla glauca	+	2	1	1	+	1	1	2	.	**.**	+	+	.
Lavandula luisieri	.	.	+	1	1	+	+	+	+	+	1	.	.
Urginea maritima	+	.	.	+	1	.	.	.	+	+	+	.	+
Anthyllis maura	.	.	.	.	.	.	.	1	1	+	2	3	3
Cistus monspeliensis	1	.	.	.	+	.	.	.	1	+	1	2	.
Cistus albidus	.	.	.	.	.	.	+	.	+	+	1	1	.
Astragalus lusitanicus	.	.	.	.	.	.	.	.	2	**.**	2	2	.
Salvia sclareoides	.	.	.	.	.	.	.	.	.	**.**	+	+	1
Ruta chalepensis	.	.	.	+	.	+	.	.	.	**.**	+	.	.
Companions													
Brachypodium phoenicoides	1	.	1	.	+	+	+	1	1	+	1	1	2
Daphne gnidium	+	1	.	+	1	+	1	.	+	+	+	.	.
Quercus coccifera	.	.	+	+	+	+	+	.	+	+	.	+	.
Pistacia lentiscus	.	1	+	1	.	1	.	1	+	**.**	.	.	1
Asparagus aphyllus	+	.	.	+	1	+	.	.	+	+	+	.	.
Bupleurum paniculatum	+	.	.	.	+	1	.	+	+	+	.	.	.
Crataegus monogyna	+	.	.	.	.	+	+	+	.	**.**	+	.	1
Lonicera etrusca	.	1	+	.	.	.	.	+	+	**.**	.	.	+
Genista tournefortii	+	.	.	.	1	.	.	.	+	**.**	.	.	3
Carex distachya	+	.	.	+	.	+	.	.	.	+	.	.	.
Quercus broteroi (frut.)	+	.	+	.	.	.	+	+	.	**.**	.	.	.
Sanguisorba spachiana	+		+	.	.	.	+	1	.	**.**	.	.	.
Thymus sylvestris (dif. ass.)	.	.	.	+	.	+	+	.	.	**1**	.	.	.
Euphorbia characias	+	.	.	.	+	.	+	.	.	**.**	+	.	.
Olea sylvestris	+	.	.	.	.	.	.	+	+	+	.	.	.
Clinopodium arundanum	.	1	.	.	+	.	.	.	.	**.**	+	.	.
Staehelina dubia (dif. ass.)	.	.	.	1	.	+	.	+	.	**.**	.	.	.
Viburnum tinus	.	+	.	.	.	.	+	+	.	**.**	.	.	.
Dactylis hispanica	.	.	.	.	.	.	.	.	.	**.**	+	1	+
Antirrhinum linkianum	.	.	.	.	.	.	+	+	.	**.**	+	.	.
Carlina hispanica	.	.	.	.	.	.	.	.	+	**.**	.	+	+
Teucrium capitatum (dif. ass.)	.	.	.	.	.	.	+	.	.	**1**	.	.	.
Origanum virens	.	.	.	.	.	.	.	.	+	**.**	.	.	+
Lathyrus sylvaticus	.	.	.	.	.	.	.	.	.	**.**	.	+	+

More: *+Silene longicilia*, *+Lavandula latifolia* in 61; *+Melica arrecta* in 63; *+Arisarum simorrhinum* in 67; *+Daucus carota* in 72; *+Pulicaria odora*, *+Thapsia villosa*, *+Smilax aspera*, *+Rubia peregrina*, *+Dittrichia viscosa*, *+Anacamptis pyramidalis*, *+Eryngium dilatatum*, *+Plantago lanceolata* in 73

Places: 61 Pousa Flores (Ansião); 62 Barreiros (Coimbra); 63 Podendes (Penela); 64, 66 Gateira; 65, 67 Traveira (Condeixa); 68 Portela do Gato (Coimbra); 69 Maceira (Lourinhã); 70 Fonte Coberta (Condeixa); 711 Serra de Montejunto (Alenquer); 72 Teira (Rio Maior); 73 Serra da Boa Viagem (Figueira da Foz)

Table III – Table of the *Sedo albi-Cistetum crispi*.

Quadro III – Tabela do Sedo albi-Cistetum crispi.

	Sedo albi-Cistetum crispi										
Relevé no.	33	34	**35**	36	37	38	39	40	41	42	43
Altitude (m)	300	500	**250**	520	400	310	480	350	370	270	320
Aspect	NW	E	**SE**	SW	SE	S	S	W	SE	N	SW
Surface (m²)	50	40	**60**	60	40	50	50	40	50	50	50
Species no.	22	22	**21**	27	24	25	25	24	17	19	24
Characteristics											
Cistus albidus	3	3	**2**	2	2	2	1	1	2	2	3
Cistus crispus	1	1	**1**	2	2	1	1	1	1	3	3
Cistus salviifolius	+	3	**2**	1	3	1	3	2	+	1	1
Cistus monspeliensis	1	1	**2**	3	2	3	3	3	2	1	.
Lavandula luisieri	.	1	**1**	+	+	1	2	2	1	1	1
Rosmarinus officinalis	.	1	**1**	1	1	3	+	2	3	3	2
Sedum album	+	+	**+**	+	1	.	+	.	1	+	+
Urginea maritima	+	+	**+**	1	+	.	.	.	+	.	+
Narcissus obesus	+	+	**.**	+	.	+	.	+	.	+	+
Cistus x pulverulentus	2	1	**2**	.	.	2	2	.	.	.	+
Thymus mastichina	.	.	**.**	.	+	.	+	+	+	+	.
Astragalus lusitanicus	+	.	**.**	.	1	.	.	.	.	+	.
Helichrysum serotinum	.	+	**.**	.	.	+	.	.	.	.	+
Cytinus macrantherus	+	.	**.**	.	.	+	.	.	.	.	.
Companions											
Brachypodium phoenicoides	1	1	**1**	1	1	1	.	+	1	.	1
Carex hallerana	+	+	**+**	+	+	.	.	.	+	.	+
Dactylis hispanica	.	+	**1**	.	1	+	+	.	.	1	+
Arisarum simorrhinum	.	+	**+**	+	.	+	.	+	+	.	+
Thapsia villosa	.	.	**+**	.	+	+	+	+	.	+	+
Anemone palmata	.	.	**+**	+	+	+	.	+	+	.	+
Daphne gnidium	.	.	**1**	+	+	.	+	+	+	.	.
Aristolochia paucinervis	+	.	**+**	+	.	+	.	+	.	+	.
Salvia sclareoides	.	+	**.**	+	+	.	+	+	.	+	.
Anthyllis maura	+	.	**+**	+	.	.	.	.	+	.	1
Sedum sediforme	+	+	**.**	.	+	+	.	.	.	+	.
Phagnalon saxatile	+	.	**.**	+	.	+	+	.	.	+	.
Thymus sylvestris	.	.	**.**	+	.	+	+	+	.	.	+
Pulicaria odora	.	.	**+**	.	+	.	+	+	+	.	.
Origanum virens	.	.	**.**	+	+	.	+	.	+	+	.
Bupleurum paniculatum	.	.	**.**	+	+	.	.	+	.	+	.
Leontodon tuberosus	+	+	**.**	.	.	1	.	+	.	.	.
Calamintha baetica	.	+	**+**	.	+	.	.	+	.	.	.
Clinopodium arundanum	.	+	**.**	.	.	.	+	.	.	.	+
Ajuga iva	.	.	**.**	.	.	.	+	+	.	.	+
Pteridium aquilinum	.	.	**.**	.	.	.	+	+	.	+	.
Biscutella lusitanica	+	.	**.**	.	.	.	.	.	.	.	+
Asparagus aphyllus	.	.	**+**	+	.	.	.	.	.	.	.
Sedum forsterianum	.	.	**.**	+	+	.	.	.	.	.	.
Erica scoparia	.	.	**.**	.	.	+	+	.	.	.	.
Geum sylvaticum	.	.	**.**	.	.	+	+	.	.	.	.
Teucrium capitatum	.	.	**.**	.	.	+	.	+	.	.	.

More: +*Euphorbia portlandica,* +*Fritillaria lusitanica*, +*Phlomis lychnitis*, +*Olea sylvestris* in 33; +*Agrimonia eupatoria* in 34; +*Arrhenatherum album*, +*Avenula occidentalis*, +*Jasminum fruticans,* +*Osyris alba* in 36; +*Stachys lusitanica* in 37; +*Sideritis hirsuta* var. *hirtula,* +*Quercus coccifera* in 38; +*Fumana thymifolia* in 39; +*Euphorbia characias,* +*Asparagus acutifolius* +*Brachypodion distachyon* in 40; +*Ruta chalepensis* in 42; +*Romulea bulbocodium*, +*Ornithogalum baeticum*, +*Anthyllis lusitanica* in 43;

Places: 33, 39 Serra de Candeeiros; 34, 35, 40 Serra de Alvaiázere; 36 Serra de Montejunto; 37, 38 Serra d'Aire; 41, 42 Between Fátima and Vila Nova de Ourém; 43 Serra de Stº António

Table IV – Table of the *Thymetum congesti*.

Quadro IV – Tabela do Thymetum congesti.

	***Thymetum congest*i**							
Relevé no.	74	75	**76**	77	78	79	80	81
Altitude (m)	50	50	**55**	40	40	40	50	50
Aspect	SE	S	**Pl**	SW	SW	W	W	N
Surface (m^2)	40	100	**40**	100	60	80	50	40
Species no.	20	23	**17**	25	21	22	28	25
Characteristics								
Thymus camphoratus subsp. *congestus*	3	2	**3**	4	3	3	2	3
Rosmarinus officinalis	2	1	**1**	2	2	3	3	1
Cistus crispus	1	1	**2**	3	2	2	3	3
Cistus salviifolius	2	2	**2**	1	2	2	2	1
Lavandula luisieri	1	+	**+**	1	1	2	2	+
Astragalus lusitanicus	2	2	**+**	+	1	1	+	1
Urginea maritima	.	+	**+**	1	+	1	+	1
Ulex welwitschianus	.	1	**1**	1	+	1	1	+
Cistus monspeliensis	1	.	**+**	.	+	+	+	1
Lithodora lusitanica	.	.	**+**	+	1	1	.	+
Ruta chalepensis	+	1	**+**	+	+	.	.	.
Cistus albidus	+	.	**1**	.	+	+	.	.
Helichrysum picardii	.	+	**.**	.	.	.	1	1
Halimium calycinum	.	1	**.**	.	+	.	+	.
Iberis welwitschii	.	+	**.**	.	.	.	1	.
Cistus ladanifer x *Cistus palhinhae*	.	.	**.**	+	.	.	+	.
Companions								
Sedum sediforme	2	2	**+**	2	1	1	1	1
Calendula algarbiensis	+	+	**+**	+	+	+	.	+
Thapsia villosa	+	.	**+**	+	1	+	.	.
Juniperus turbinata	+	.	**.**	+	.	+	+	1
Stipa gigantea	.	+	**.**	+	1	1	.	.
Chaenorhinum serpyllifolium subsp. *lusitanicum*	+	+	**+**	.	.	.	+	.
Asparagus aphyllus	+	.	**.**	.	+	+	.	+
Quercus coccifera	.	.	**.**	+	+	.	+	+
Pistacia lentiscus	.	.	**.**	+	.	+	+	+
Hyparrhenia sinaica	1	+	**.**	+	.	.	.	.
Osyris lanceolata	.	+	**.**	.	+	.	.	+
Daphne gnidium	.	.	**+**	+	.	+	.	.
Lobularia maritima	+	+	**.**	+	.	.	.	.
Gladiolus illyricus	+	+	**.**	.	.	.	+	.
Scilla monophyllus	.	+	**.**	.	+	.	+	.
Linum strictum	.	+	**.**	+	.	.	.	+
Carlina hispanica	.	.	**.**	.	+	+		+
Carex hallerana	.	.	**.**	.	.	.	+	1
Dactylis hispanica	.	.	**.**	.	.	.	1	+
Phillyrea angustifolia	.	.	**.**	+	.	.	+	.
Iberis sampaioana	.	.	**.**	.	.	+	+	.
Pulicaria odora	.	.	**.**	.	.	.	+	+

More: +*Olea sylvestris,* +*Briza maxima* in 74; +*Carex distachya* in 75; +*Rubia longifolia*, +*Rhamnus oleoides,* +*Phillyrea angustifolia* in 77; +*Fritillaria lusitanica* in 79; +*Arrhenatherum baeticum*, +*Biscutella vincentina*, +*Centaurium erythraea* subsp. *majus* in 80; +*Anagallis monelli* var. *microphylla*, +*Dittrichia revoluta* in 81

Places: 74, 75, 76 Ribeira da Azenha (Odemira), 77, 78 Malhão (Odemira), 79 Aivados (Odemira); 80, 81 Between Malhão and Vila Nova Milfontes (Odemira)

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