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New Contributions to the *Ericion umbellatae* Alliance in the Central Iberian Peninsula

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Abstract: The study of heathlands dominated by *Erica australis*, *E. umbellata* and *Cistus populifolius* in the centre and west of the Iberian Peninsula allows us to separate the eight shrubland communities. The taxonomic analysis of *E. australis* distinguishes two subspecies: *E. australis* subsp. *australis* and *E. australis* subsp. *aragonensis*. The statistical treatment confirms the differences between the suballiances *Ericenion aragonensis* and *Ericenion umbellatae*. This ecological, bioclimatic, biogeographical and floristic study has allowed us to differentiate three new associations from the remaining five: TCp = *Teucrio oxylepis-Cistetum populifolii* nova. HEau = *Halimio ocymoidis-Ericetum australis* nova. DEu = *Drosophyllo lusitanicae-Ericetum umbellatae* nova. ECp = *Erico australis-Cistetum* populifolii Rivas Goday 1964. PCp = *Polygalo microphyllae-Cistetum populifolii* Rivas Goday 1964. HEa = *Halimio ocymoidis-Ericetum aragonensis* Rivas-Martínez 1979. HEu = *Halimio ocymoidis-Ericetum umbellatae* Rivas Goday 1964. UEu = *Ulici eriocladi-Ericetum umbellatae.*

Keywords: association; taxonomy; heathlands; habitats; shrubs

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1. Introduction

Humid and subhumid areas contain woodlands of *Quercus broteroi* (Cout.) Rivas-Martínez & C.Sáenz (Portuguese oak), *Quercus canariensis* and *Quercus marianica* Vicioso, *Quercus suber* L. (cork oak) and *Quercus pyrenaica* Willd. (Pyrenean oak.) [1–3], all originating within the vegetation community dynamic of the *Ericaceae* family: *Arbutus unedo* L., *Erica australis* subsp. *australis* L., *Erica umbellata* Loefl. ex L., *Erica scoparia* L., and some communities of the *Cistaceae* family, *Cistus populifolius* L. Until now these communities in the central-western Iberian Peninsula have been included in the associations *Halimio ocymoidis-Ericetum aragonensis*, *Halimio ocymoidis-Ericetum umbellatae*, *Ulici eriocladi-Ericetum umbellatae*, and *Polygalo microphyllae-Cistetum populifolii* [4–13].

Heathlands are one of the most extensive and important habitats on the planet [14,15], and are among the most representative plant communities on the European continent with an Atlantic bioclimate and influence [5,16]. These formations are linked to oceanic environments, with abundant rainfall and short periods of summer drought in the case of the southern Iberian Peninsula [14,17–20], and in acidic, oligotrophic soils subject to erosion and fire [21].

From a conservation point of view, these communities have received a different treatment on the Iberian Peninsula [15] and were considered as mere replacement stages [5,21], whereas in the rest of Europe these plant formations—which harbour less diversity—are more highly regarded [15] in conservation terms. In the Habitats Directive, *Erica umbellata*-dominated heaths correspond to code 4030 "European dry heaths".

The associations dominated by *Erica* spp., *Ulex* spp. and *Cistus populifolius* are typical of subhumid and humid ombro-types and are consequently fragile in the face of climate change, since they are affected by the increase in temperature and rainfall irregularity, as are the endemic taxa in these associations, and consequently the endemic taxa present in mountain areas [22–24]. These thickets dominated by the genus *Erica* are typical of rainy environments and are at their optimum in temperate Europe, although they extend to the sub-Mediterranean mountains, and connect catenally towards dry-subhumid ombro-types, with micro-forests of *Juniperus oxycedrus* subsp. *badia* (H. Gay) according to Debeaux [25,26].

On the Iberian Peninsula, this type of habitat has encountered problems in its interpretation, largely due to its extension and its bioclimatic and biogeographical diversity. The classifications proposed have disregarded the typical Mediterranean heaths, with Atlantic nuances, of the southwest Iberian Peninsula, which are of enormous floristic and biogeographical interest [15]. It should be noted that, of the three heathland subtypes considered, these Mediterranean dry heaths are the richest in endemisms.

The associations studied should be considered habitats of interest for conservation, since they dominate the middle and high mountains and include rocky habitats and wetlands with a predominance of endemic, rare and in some cases threatened species such as *Coincya longirostra* (Boiss.) Greuter & Burdet, *Digitalis mariana* Boiss., *Jasione crispa* subsp. *tomentosa*, *Jasione crispa* subsp. *mariana* (A.DC.) Rivas Mart., *Dianthus lusitanus* Brot., *Adenocarpus hispanicus* subsp. *argyrophyllus* (Rivas Goday), *Drosophyllun lusitanicum* (L.) *Solenopsis laurentia* (L.) C. Presl, *Pinguicula lusitanica* L.

According to [22], *Erica australis* L. is highly variable; the species *Erica aragonensis* Willk. and *Erica australis* subsp. *aragonensis* (Willk.) Cout. Are not recognized and claimed to be a montane ecotype, although any convincing arguments to synonymise these taxa to *E. australis* are not provided; however, [23] the subsp. *Aragonensis* is accepted. In our opinion the character of extrorse anthers in the subsp. *aragonensis* compared to non-extrorse anthers in the subsp. *australis* is clear. We, therefore, maintain the subsp. *aragonensis*, which has a more northerly distribution than the subsp. *australis.*

The main objective of the present work is to highlight the plant diversity of scrubs dominated by different species of the genus *Erica* in the centre-south of the Iberian Peninsula within the Mediterranean climate domain. On the other hand, from the point of view of the sustainability of forests and accompanying shrublands, it is important to know how these heathlands provide the environmental conditions necessary for the establishment of plant stages of greater biomass. It is, therefore, necessary to know the diversity and structure of Mediterranean dry heaths for their conservation and sustainability over time.

2. Materials and Methods

2.1. Study Area

The territory in the study is located in the central-western Iberian Peninsula (Figure 1) and is dominated by siliceous materials, Palaeozoic slates, metamorphic quartzites and plutonic rocks (granite); it has a Mediterranean bioclimate with a thermo-type that ranges between the thermo- and the supra-Mediterranean, and an ombro-type between dry and humid.

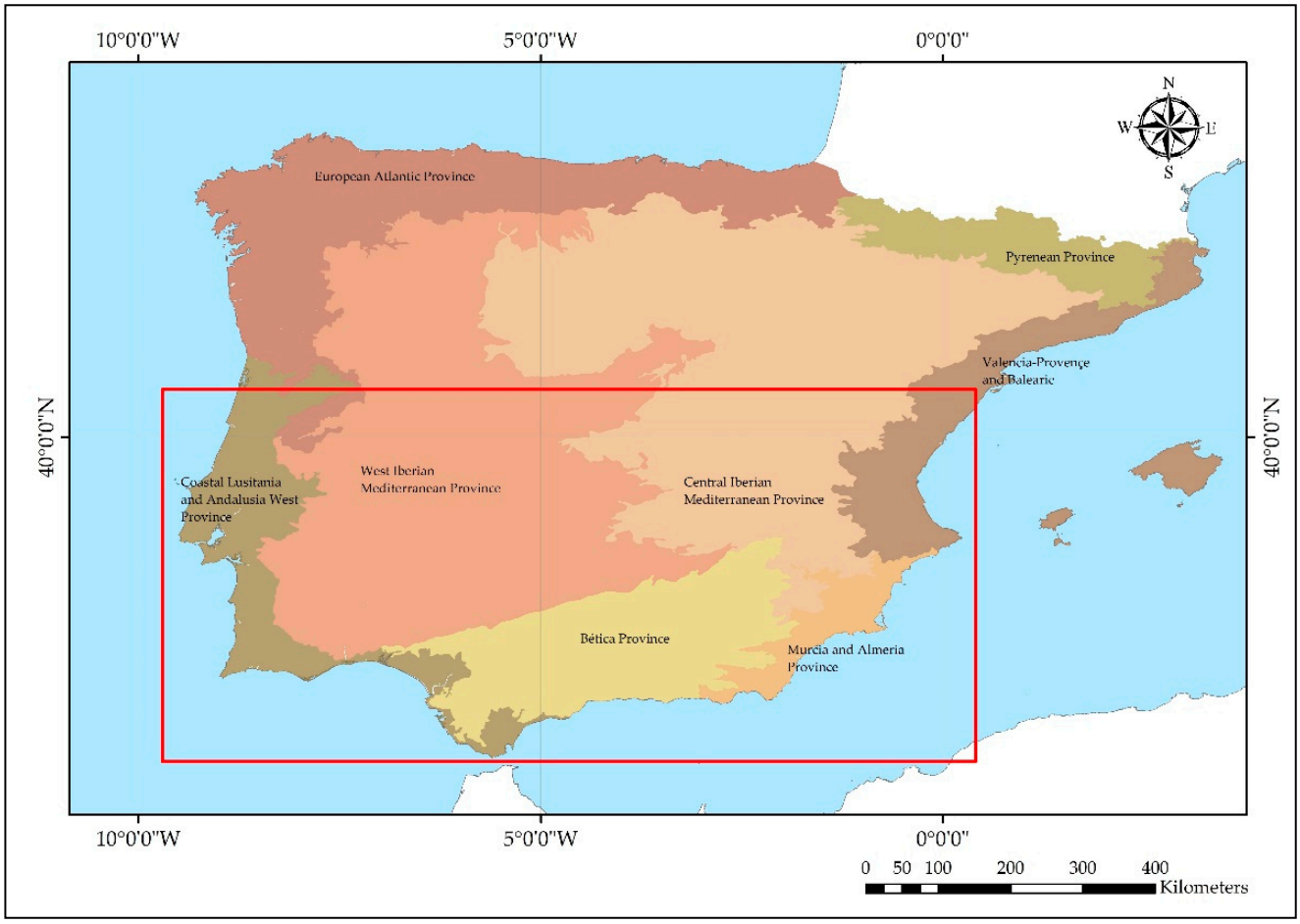

Figure 1. Location of the study area including the biogeographical provinces.

2.2. Sampling

An analysis was made of 232 heathland relevés dominated by *Erica umbellata*, *E. australis* and *Cistus populifolius* in the centre and west of the Iberian Peninsula, obtained from our own field research (56 samples) and various publications (176 samples) (Table 1). These relevés belong to ten associations: SDl = *Saturejo salzmannii-Drosophylletum lusitanicii;* TCl = *Teucrio mariani-Cistetum laurifolii;* TCp = *Teucrio oxylepis-Cistetum populifoli* (Figure 2); HEau = *Halimio ocymoidis-Ericetum australis*; ECp = *Erico australis-Cistetum populifolii;* PCp = *Polygalo microphyllae-Cistetum populifolii*; HEa = *Halimio ocymoidis-Ericetum aragonensis*; DEu = *Drosophyllo lusitanicae-Ericetum umbellatae*; HEu = *Halimio ocymoidis-Ericetum umbellatae;* UEu = *Ulici eriocladi-Ericetum umbellatae.* For the authorship of the taxa, we have followed Flora Ibérica, Flora Western Andalusia and Eastern Andalusia Flora. For the authorship of syntaxa, we have followed [12].

Our own samplings were taken following the Braun-Blanquet method, modified by Van der Maarel [24].

Table 1. Origin of the vegetation samples used in this work.

Plant Community	Bibliography	N° of Relevés
SDl	Galán de Mera, A. (1993)	5
	Junta de Andalucía	2
	Quezel P. et. al. (1988)	5
TCp	Own relevés	18
	Rodríguez Marzal (2006)	3
TCl	Junta de Andalucía	1
	Velasco Negueruela, A. (1981)	6
	Own relevés	4
HEa	Own relevés	12
ECp	Rivas Goday, S. (1964)	5
	Belmonte M.D. (2008)	13
	Muñoz, A.F.; Santa-Bárbara, C. & Vicent, C. (2008)	24
	Rufo Nieto (2009)	13
PCp	Melendo Luque, M. (1998)	7
	Rivas Goday, S. (1964)	8
	Belmonte M.D. (2008)	13
HEu	Rivas Goday, S. (1964)	5
	Belmonte M.D. (2008)	16
	Melendo Luque, M. (1998)	4
	Muñoz, A.F.; Santa-Bárbara, C. & Vicent, C. (2008)	9
Ueu	Muñoz, A.F.; Santa-Bárbara, C. & Vicent, C. (2008)	4
	Rivas-Martínez, S. (1979)	8
	Rufo Nieto (2009)	4
	Junta de Andalucía	21
DEu	Own relevés	22

SDl = Saturejo salzmannii-Drosophylletum lusitanici. TCl = Teucrio mariani-Cistetum laurifolii. TCp = Teucrio mariani-Cistetum populifolii. HEau = Halimio ocymoidis-Ericetum australis. ECp = Erico australis-Cistetum populifolii. PCp = Polygalo microphyllae-Cistetum populifolii. HEa = Halimio ocymoidis-Ericetum aragonensis. DEu = Drosophyllo lusitanicae-Ericetum umbellatae. HEu = Halimio ocymoidis-Ericetum umbellatae. UEu = Ulici eriocladi-Ericetum umbellatae.

2.3. Data Analyses

Subsequently, and based on the geographic and topographic information contained in these relevés, each sampling was geo-referenced and implemented in a geographic information system (GIS) using the corresponding maps (Appendix A). They were then matched with the place names and the rest of the data from the samplings in the bibliography in order to obtain the different climatic and bioclimatic variables for each sampling. The figures for altitude, orientation and slope were determined by plotting the previously geo-referenced points on a digital terrain map (DTM) with a pixel resolution of 30 × 30 metres for the points in Portugal and Morocco, and on a digital terrain model with a resolution of 10 × 10 metres for the points in Spain. The numerical values for altitude, orientation and slope were obtained from the DTM for each sampling point by means of numerical classification methods. An ascending hierarchical classification was applied for the ordination and comparison of the different samples using Ward's distance. For a better understanding of the results, a multivariate ordination analysis was carried out by means of detrended correspondence analysis.

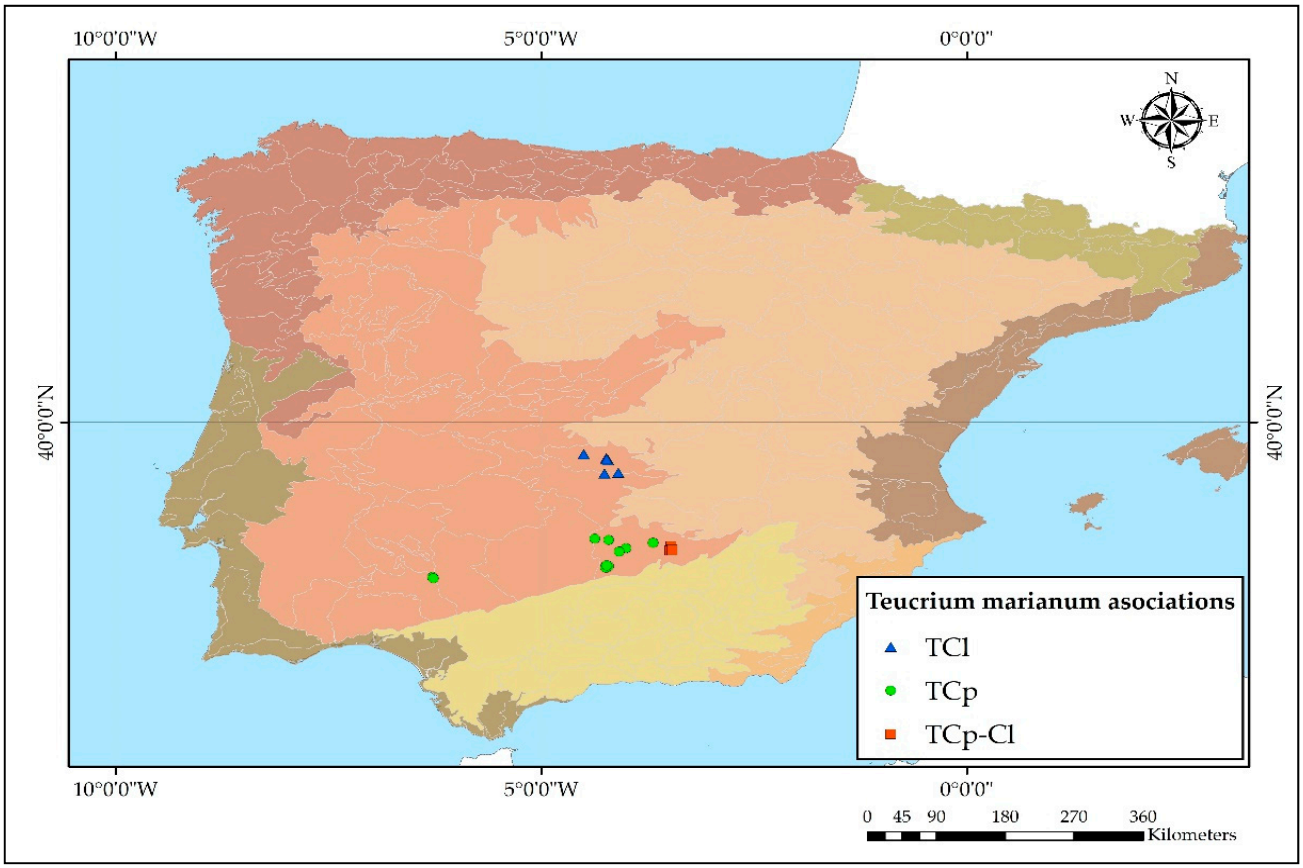

Figure 2. Distribution of plant communities dominated by *Teucrium oxylepis* subsp. *marianum*. TCl = *Teucrio mariani-Cistetum laurifolii* is located in the most inland areas of the Iberian Peninsula with a major continental influence. TCp = *Teucrio mariani-Cistetum populifolii* is located in more peripheral zones with a greater Atlantic influence. TCp-Cl = *Teucrio mariani-Cistetum populifolii* is a colder and more continental variant with *Cistus laurifolius*.

3. Results

We studied the communities of *Erica umbellata* Loefl. ex L., *Erica australis* L. subsp. *australis*, *Erica australis* L. subsp. *aragonensis* (Willk.) Cout. and *Cistus populifolius* L. in the central Iberian Peninsula. The statistical analysis of the communities dominated by these taxa (Figures 2–5) reveals the existence of two groups, G1 and G2, corresponding to the suballiances *Ericenion aragonensis* Rivas Martínez 1979 and *Ericenion umbellatae* Rivas Martínez 1979. The association *Polygalo microphyllae-Cistetum populifolii* (PCp1-PCp8) was described by [1] for shady Silurian sites in Extremadura, whose relevés PCp1-PCp8 are far removed from our group of relevés and [7] for the eastern Sierra Morena, and from the relevés of [1] from which he describes the association *Erico australis-Cistetum populifolii* (ECp1-ECp5), and which have a more thermophilous character than the former (Figure 4).

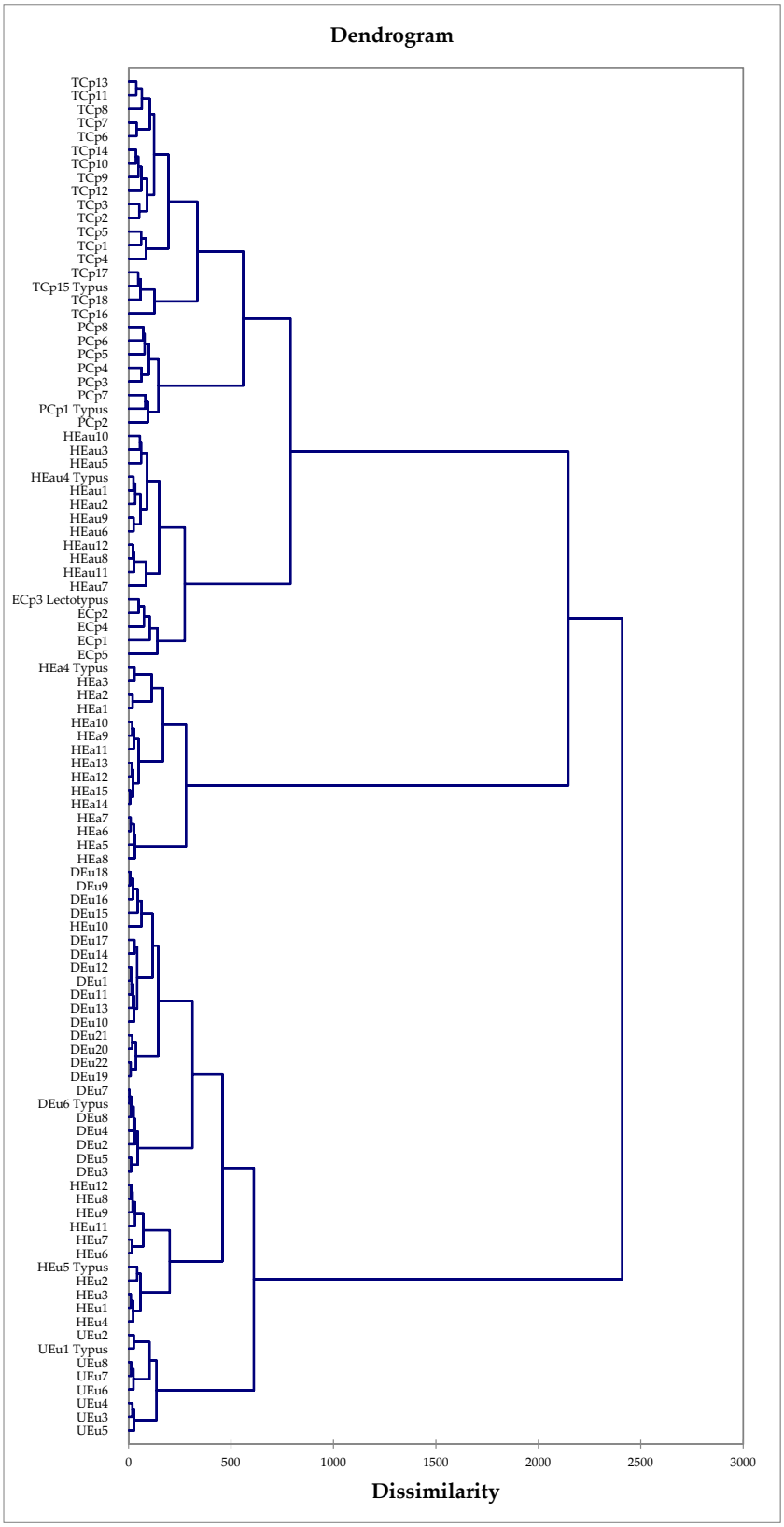

Figure 3. Cluster of heathland associations in the central-western Iberian Peninsula. The hierarchical classification used is based on Euclidean distance, using Ward's agglomerative method.

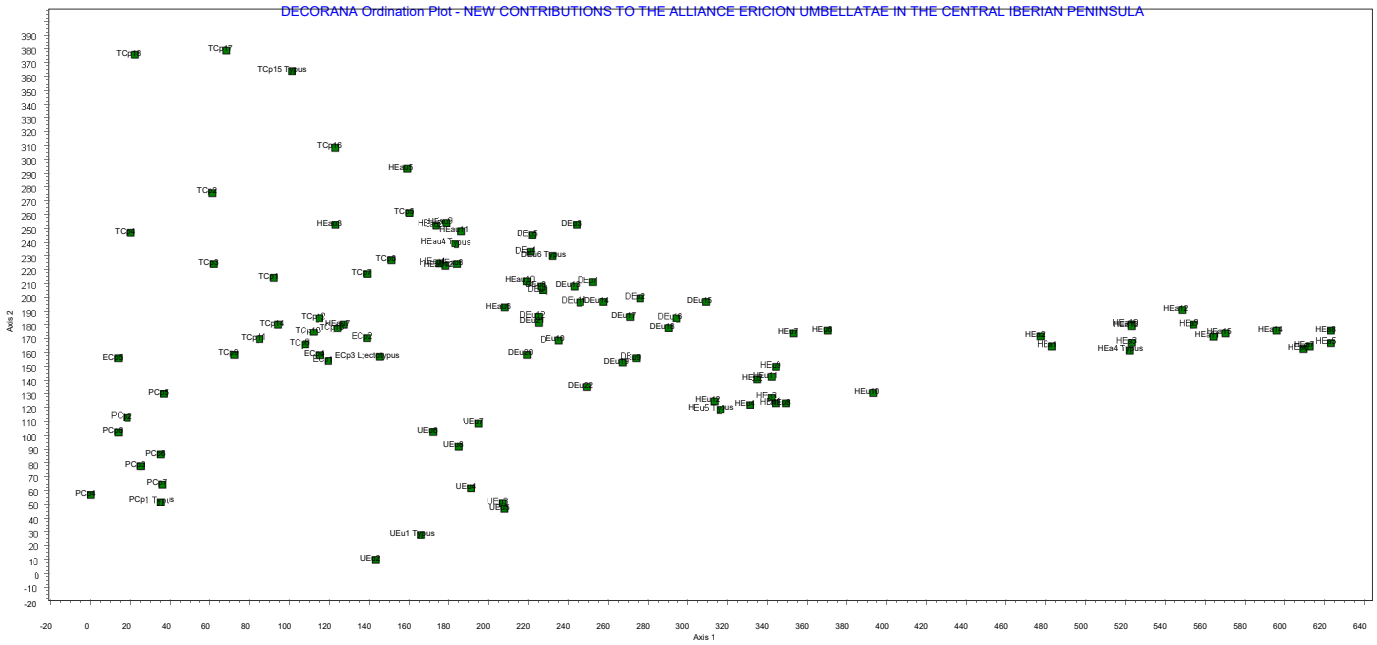

Figure 4. DECORANA (Detrended analyse of variance) ordination of heathland communities in the central-western Iberian Peninsula.

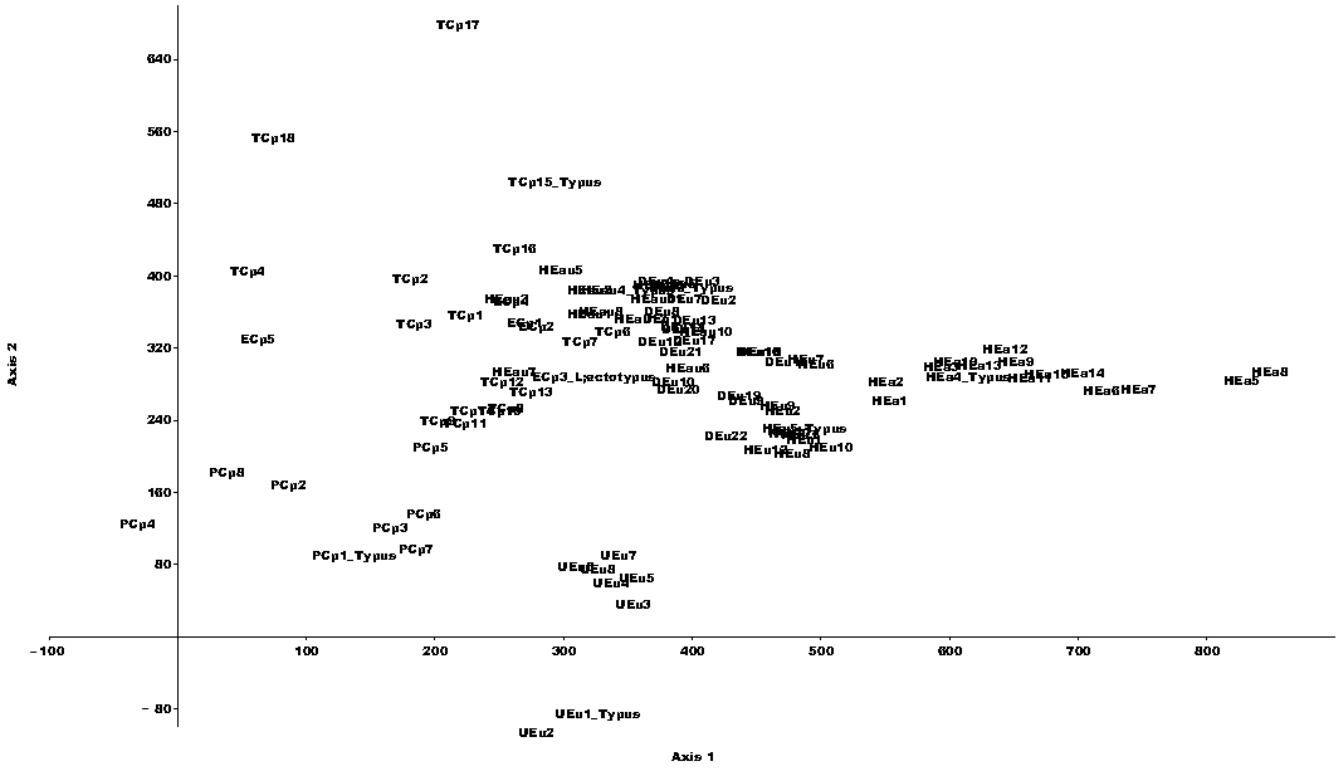

Figure 5. DCA ordination of heathland communities in the central-western Iberian Peninsula.

The relevés dominated by *C. populifolius* in eastern Sierra Morena differ floristically from the communities described by [4] in Extremadura, as they quite frequently include *Teucrium oxylepis* (endemic) and *Cistus laurifolius*, which grow in shady sites and foothills more influenced by the cold winds from the Manchegan plateau. We therefore propose the association *Teucrio mariani-Cistetum populifolii nova* (Table 2 rel. TCp1-TCp18 typus rel. TCp15*).

The relevés corresponding to the association described by [5], *Ulici eriocladi-Ericetum umbellatae* (UEu1-UEu8), are clearly separated and floristically, ecologically, dynamically and biogeographically differentiated from the other communities of *E. australis.* The association *Halimio ocymoidis-Ericetum aragonensis* (HEa1-HEa15), described by [5] for the territories of Guadalajara and Segovia, shows significant differences from the heathlands of *E. australis* in the Marianica range due to the absence in Marianican territories of *E. australis* subsp. *aragonensis*, *Luzula lactea* (Link) E.Mey., *Genista pilosa* L., *Deschampsia flexuosa* subsp. *iberica* Rivas Mart. and *Helianthemum pulverulentum* Pers. We therefore propose the association *Halimio ocymoidis-Ericetum australis nova* (Table 3 rel. HEau1-HEau11, typus rel. HEau4*), which has a more southerly character than the previous association, for supra-Mediterranean environments in the eastern Mariánico-Monchiquensean sector; this heathland represents a dynamic stage of the woodlands of *Sorbo torminalis-Quercetum pyrenaicae*. This association is statistically close to *Erico australis-Cistetum populifolii*; however, the latter has a more eastern and thermophilous character ([4], Table 67, page 446).

In the group of communities of *E. umbellata*, the relevés given by [4,5] in the Sierra de San Pedro (Cáceres) and Herrera del Duque (Badajoz), León and Zamora are gathered in a single compact group (HEu12-HEu21) corresponding to *Halimio ocymoidis-Ericetum umbellatae*; this association was described by [4] in highly oligotrophic and nutrient-poor soils. It has floristic, dynamic and biogeographical differences with the communities of *Erica umbellata* in the eastern Sierra Morena; the Leonese and Zamoran territories include the species *Halimium alysoides, E. australis* subsp. *aragonensis*, *Ulex minor, Genista micrantha,* and *Agrostis setacea*, which have a more oceanic character and are not present in the eastern Sierra Morena. The relevés of [7,10] are grouped with those taken recently by us in the province of Ciudad Real, where they include *E. umbellata, Halimium ocymoides, Tuberaria lignosa, Pterospartum tridentatum, Drophyllum lusitanicum, Lavandula pedunculata* and occasionally *Festuca elegans, Coincya longirrostra* and *Juniperus oxycedrus* subsp. *badia.* We therefore propose the association *Drosophyllo lusitanicae-Ericetum umbellatae nova* (Table 4 rel. DEu1-DEu22 typus rel. DEu6 *) growing on highly washed soils (distric lithosols) with a total absence of organic matter. This association is distributed throughout the eastern Mariánico-Monchiquensean sector.

Table 2. Teucrio mariani-Cistetum populifolii nova.

Altitude	889	472	817	867	877	800	800	650	740	680	660	730	580	660	948	976	969	876	890	930	985
Area m^2	200	200	100	200	200	100	150	150	200	200	150	100	100	150	100	100	100	100			
Coverage %	90	85	80	80	90	75	90	80	90	85	75	70	75	80	60	55	65	60	55	75	50
Inclination %	8	25		20	8	20	20	10	15	20	20	25	10	20	10	10	10	15	30	20	0
Orientation	N	N		NW	NE	N	NW	N	W	NW	NE	W	NE	NW	SW	SW	NE	N	NW	N	-
Medium height veg. in m.	1.80	0.90	1.70	1.40	0.80										0.70	0.70	0.70	0.35			
	Tm Cp	Tm Cp	Tm Cp	Tm Cp	Tm Cp	Tm Cp	Tm Cp	Tm Cp	Tm Cp	Tm Cp	Tm Cp	Tm Cp	Tm Cp	Tm Cp	Tm Cp	Tm Cp	Tm Cp	Tm Cp	Tm Cp	Tm Cp	Tm Cp
	01	02	03	04	05	06	07	08	09	10	11	12	13	14	15 *	16	17	18	19	20	21
Characteristic association species																					
Teucrium oxylepis subsp. marianum															5	2	5	5	2	2	3
Cistus populifolius subsp. populifolius	4	5	5	5	4	5	5	4	4	4	5	4	5	4	4	2	5	2	3	+	3
Characteristic species of Ericion umbellatae																					
Erica australis subsp. australis						1	1		+	1		1	2	1	2	+		+		+	+
Halimium ocymoides	+								+		+		2			5					
Polygala microphylla							2	1	+		+		1	+							
Erica umbellata						2					+	1		+							
Characteristic species of Calluno-Ulicetea																					
Pterospartum tridentatum subsp. lasianthum							+			+			+								
Calluna vulgaris						1	1	+					+								
Erica scoparia subsp. scoparia								+		1			+	+							
Tuberaria lignosa							+	+		+		+									
Characteristic species of Ulici-Cistion ladaniferi																					
Lavandula stoechas subsp. luisieri		1			2	2	1								+	1	1	+			
Lavandula pedunculata subsp. sampaiana								1			1		1	+							
Erophaca baetica				+					+	+				+							
Lavandula stoechas subsp. stoechas																				+	
Characteristic species of Lavanduletalia stoechadis and Cisto-Lavanduletea																					
Cistus ladanifer subsp. ladanifer	1	1	2	2	2		2	1	1	1	2	+	1	1	2		2	1		+	+
Cistus crispus			+																	3	2
Narcissus triandrus subsp. pallidulus															1	1	+		+		
Cistus monspeliensis				1																	
Iberis linifolia				+																	

Table 2. *Cont.*

Cistus salviifolius		1						+	2	1		+		1								+
Halimium umbellatum subsp. viscosum					5										1		+			3		
Cistus laurifolius	5			2	2											+						
Characteristic species of Querceta ilicis class and lower units																						
Erica arborea			+			1	1	1	1	+	1	+	+	+		1		+				
Arbutus unedo	1				+	+	1	+	2	+	1	+	1	+								
Phillyrea angustifolia	+			1	+	+	1	1		+	+		+			+	+	+	+			+
Daphne gnidium					+			1	1	1			+				+	+	+	+	+	+
Quercus broteroi	+				+	1	1		+				+	+		+		+				
Quercus suber						1	1	+	+		+							+	+			+
Doronicum plantagineum															2		2	1				
Paeonia broteri	+	+		+											+			+	+			
Teucrium fruticans																+		1				
Jasminum fruticans				1																		
Lonicera implexa					+													+	+			
Quercus rotundifolia					+														+			+
Rubia peregrina subsp. peregrina				+															+	+		
Viburnum tinus									+		+								+			
Juniperus oxycedrus subsp. badia			+															+				
Lonicera periclymenum subsp. hispanica				+											+							
Pistacia terebinthus									+			+										
Sanguisorba hybrida																						+
Characteristic species of Cytisetea scopario-striati class and lower units																						
Cytisus scoparius subsp. bourgaei	1	+	1	1	1				1	+			1	1		+						
Adenocarpus telonensis											1	+	1	+								
Pteridium aquilinum																			2			
Cytisus grandiflorus subsp. grandiflorus			+																			
Cytisus striatus subsp. striatus																						+
Characteristic species of Querco roboris-Fagetea sylvestris class and lower units																						
Cephalanthera longifolia		1			+													1				
Geum sylvaticum																	1	1		+		

Table 2. *Cont.*

Quercus faginea subsp. faginea																	2		+
Arenaria montana subsp. montana																1			
Tamus communis				+												+			
Epipactis helleborine subsp. helleborine																+			
Epipactis helleborine subsp. tremolsii																			+
Quercus pyrenaica																+			
Sorbus torminalis																+			
Companion species																			
Pinus pinaster																	5	4	5
Rosmarinus officinalis	1			2	+		1		1		+								
Thapsia villosa	+			+	+			1			1						2	+	+
Thymus mastichina		1		1										1		+			+
Carlina corymbosa subsp. corymbosa																	+	2	2
Agrostis capillaris x castellana																		3	+
Cistus albidus		+		2								+							
Halimium halimifolium																	+	2	+
Castanea sativa																	2	+	
Dactylis lusitanica		+	+	1															
Holcus lanatus																		2	+
Rubus ulmifolius																+	2		
Asphodelus albus subsp. albus				+											1				
Briza maxima																		2	
Helichrysum stoechas				+													+	+	+
Sanguisorba verrucosa							1		+										
Sedum forsterianum												1	+						
Centaurea melitensis				1															
Festuca rothmaleri															1				
Leucanthemum sylvaticum				1															
Magydaris panacifolia				1															
Origanum virens																+	+	+	
Avenula marginata subsp. sulcata																		+	+
Celtica gigantea																		+	+
Dactylis glomerata subsp. hispanica																	+		+
Ranunculus gramineus												+	+						

Table 2. *Cont.*

Rosa pouzinii				+						+		
Sanguisorba minor											+	+
Andryala integrifolia												+
Aristolochia pistolochia		+										
Arrhenatherum elatius subsp. bulbosum				+								
Campanula rapunculus			+									
Cardamine hirsuta								+				
Clinopodium vulgare subsp. arundanum											+	
Conopodium marianum			+									
Dorycnium penthaphyllum	+											
Eryngium tenue												+
Iris planifolia			+									
Linum suffruticosum subsp. suffruticosum			+									
Picris comosa		+										
Piptatherum miliaceum		+										
Srophularia scorodonia										+		
Thapsia garganica		+										
Tulipa sylvestris										+		

Typus *.

Table 3. Halimio ocymoidis-Ericetum australis nova.

	HEau1	**HEau2**	**HEau3**	**HEau ***	**HEau5**	**HEau6**	**HEau7**	**HEau8**	**HEau9**	**HEau10**	**HEau11**	**HEau12**
Altitude m.	820	1022	1061	1249	1229	742	752	800	760	1160	800	750
Area m^2	300	200	200	200	200	100	200	200	200	400	100	200
Coverage %	80	95	80	90	80	90	100	75	90	85	95	95
Slope %	15	8	8.5	8	10	8.5	4	20	20	25	20	20
Orientation	E	NE		NW	N		E-SE	N	N	S	N	S
Medium height veg. in m.	1	1.5	1.5	1.5	1.20	0.70	1.8	1.0	1.0	1.0	1.0	1.0
Characteristic association species and higher syn-taxonomic units												
Erica australis	4	5	4	5	4	5	5	5	5	4	5	5
Halimium ocymoides	1	1	1	2	1	1	1	1	+	2	1	1
Cistus poulifolius	+	+	1	1	1	1	4		1	1	1	2

Table 3. *Cont.*

	HEau1	HEau2	HEau3	HEau *	HEau5	HEau6	HEau7	HEau8	HEau9	HEau10	HEau11	HEau12
Erica umbellata	2	1		2		4	1	1	1			1
Lavandula luisieri	+		1				+	1		1	1	2
Calluna vulgaris						2			1	1	1	1
Polygala microphylla		+			+		+					+
Tuberaria lignosa		+		+						1		
Erica scopara						2	2					
Pterospartum tridentatum										1		
Companion species												
Cistus ladanifer	2	2	2	2	1	2	+	1	2	2	2	2
Arbutus unedo	+	+	1			+	1		+	+		+
Rosmarinus officinalis	+					+	1	2	+		2	2
Erica arborea	1		2	+					+	+		+
Phillyrea angustifolia	+		1			+	+		+		2	
Quercus broteroi							+		+	+		+
Festuca elegans		+	1	+	2							
Daphne gnidium		+					1					1
Quercus suber								+		+		+
Cistus salvifolius			+	+	+							
Avenula sulcata subsp. occidentalis		1	1									
Juniperus oxycedrus subsp. *badia*	+	+										
Quercus pyrenaica		+			+							
Thymus mastichina						+			1			
Asphodelus albus				1	1							
Quercus rotundifolia				+							+	
Saxifraga granulata		+										
Hypochaeris radicata		+										
Thapsia villosa		+										
Rumex angiocarpus		+										
Cytisus scoparius subsp. bourgaei			+									
Cistus crispus						+						
Ranunculus sardous subsp. aleae			+									
Klasea abulensis			+									

Table 3. *Cont.*

	HEau1	HEau2	HEau3	HEau *	HEau5	HEau6	HEau7	HEau8	HEau9	HEau10	HEau11	HEau12
Arrhenatherum elatius subsp. bulbosum				+								
Narcissus triandrus					+							
Arrhenatherum album					+							
Cardamine hirsuta							2					
Scirpus holoschoenus						+						
Salix atrocinerea						+						
Osyris alba							1					
Teucrium haenseleri							+					
Cytisus multiflorus							+					
Pistacia terebinthus								+				
Juniperus oxycedrus										+		

Typus *.

Table 4. Drosophyllo lusitanicae-Ericetum umbellatae nova.

	DEu1	DEu2	DEu3	DEu4	DEu5	DEu6 *	DEu7	DEu8	DEu9	DEu10	DEu11	DEu12	DEu13	DEu14	DEu15	DEu16	DEu17	DEu18	DEu19	DEu20	DEu21	DEu22
Altitude m.	795	1233	982	1042	1051	1061	1074	1095	742	599	830	1010	800	730	800	800	700	750	720	750	760	740
Area m^2	300	400	100	50	10	40	20	40	100	100	200	100	200	200	200	200	300	200	150	200	150	100
Coverage %	40	60	80	50	80	70	70	90	80	80	90	95	85	80	80	75	75	80	80	75	85	90
Slope %	12	20	4	6	8	8	6	4	10	8	30	5	15	15	15	30	35	30	25	10	10	15
Orientation	SW	N	S	NE	NE	NE	NE	NW	W	W	W	N-NE	N	N	N	S	S	W	SW	N	NE	NW
Medium height veg. in m.	0.80	1.5	0.70	0.40	0.60	0.50	0.40	0.50	0.25	0.35		0.60										
Characteristic association species and higher syntaxonomic units																						
Erica umbellata	4	5	4	4	5	5	5	5	4	4	5	5	4	4	5	5	4	5	4	4	4	4
Halimium ocymoides	4	4	4	4	4	4	1	4	1	4	1	4	1	4	4	5	4	4	5	4	1	5
Erica australis	1	+	4	1	1	1	1	1	1	1	1	1	1	1	1	1	+	1				
Drosophyllum lusitanicum		4	5	4	5	4	4	4														
Cistus populifolius				1	1	+		1													+	
Tuberaria lignosa		+						+											1		+	1
Lavandula luisieri										+			+		1							
Pterospartum tridentatum subsp. lasianthum		1																	+	+		1
Calluna vulgaris									1				+		5	1		1	1	+	+	1
Erica lusitanica									+													
Erica scoparia									+			+										
Companion species																						
Cistus ladanifer	1	+	4		4	+	+	+	+	+	1	1	1	+	+	+	+	+	1	1	4	1

Table 4. *Cont.*

	DEu1	DEu2	DEu3	DEu4	DEu5	DEu6 *	DEu7	DEu8	DEu9	DEu10	DEu11	DEu12	DEu13	DEu14	DEu15	DEu16	DEu17	DEu18	DEu19	DEu20	DEu21	DEu22
Rosmarinus officinalis	+											1	1	1		+	1	+	1	4	4	4
Lavandula stoechas subsp. sampaioana																			+	1		4
Briza máxima															1	+	1	+				
Tolpis barbata											+		1	+		1						
Petrorhagia prolifera															1	+	+					
Cistus salvifolius									+											+	+	+
Asphodelus albus		+			+	+														+		
Arrhenatherum bulbosum subsp. elatius		+																				
Jasione montana			+		+																	
Ranunculus gramineus				+																		
Xolanta guttata				+																		
Jasione crispa subsp. tomentosa					+																	
Lavandula pedunculata						+																
Cytinus hypocistis								+														
Scirpus holoschoenus									+													
Salix atrocinerea																						
Genista hirsuta										+												
Asphodelus microcarpus										+												
Osyris alba										+												
Gladiolus illyricus										+												
Thymelaea villosa																				+		+
Adenocarpus telonensis																			+			+
Dactylis hispanica														1	1							
Daphne gnidium												+							+		+	
Arbutus unedo					+			+														
Erica arborea	+																					
Phillyrea angustifolia						+																

Typus*.

4. Discussion

The study of heathlands dominated by *Erica australis* subsp. *australis*, subsp. *aragonensis*, *E. umbellata* and *Cistus populifolius* contributes eight different vegetation communities. Until now the heathlands in Luso-Extremaduran territories have been included in the known associations [4,5]. However, our recent studies in the province of Ciudad Real reveal floristic differences to the associations described previously. In the taxonomic study, [22,25] do not recognise *E. australis* L. subsp. *aragonensis* (Willk.) Cout., although [5,23] recognise the *aragonensis* variety.

Species in the genus *Erica* are always found in sub-humid–humid environments and appear in the dynamics of various types of *Quercus* from temperate and Mediterranean European areas [27–29], but always in acid-neutral pH substrates, never in *Quercus* forests on basic substrates [30]. In the degradation of these scrubs, either by human action or climate change [31–34]. They are replaced by species of the genus *Cistus* [24]; *Cistus ladanifer* is the species that replaces *Erica australis* and *Erica umbellata* in the studied territory.

The association TCp is a shrubland dominated by *C. populifolius* and is a cold vicariant community of PCp described by [4] for the more oceanic Extremaduran territories. The new association occupies the easternmost areas of the Mariánica mountain range, which receives the influence of the climate of the Manchegan plateau and comprises differential species such as *C. laurifolius* and the endemism *Teucrium oxylepis* subsp. *marianum*. These communities cannot therefore be included in the association PCp. [5] Lecto typifies the association HEu described by Rivas Goday in the province of Cáceres. The floristic and ecological differences make it inadvisable to include the communities dominated by *E. umbellata* from the eastern Maríanica range in this association, HEu, as they grow on extremely nitrogen-poor distric lithosols that allow the presence of *Drosophyllum lusitanicum*; the new association is therefore a soil vicariant of HEu. This same author describes the association HEa for the provinces of Segovia and Guadalajara, and gives the typus in the locality of Puerto de San Benito (Guadalajara) at an altitude of 1840 m. The floristic, bioclimatic and biogeographical differences lead us to propose the association HEau for the Luso-Extremaduran territories (Table 5).

Table 5. Synoptic table: TCp = Teucrio oxylepis-Cistetum populifolii; HEau = Halimio ocymoidis-Ericetum australis; ECp = Erico australis-Cistetum populifolii; PCp = Polygalo microphyllae-Cistetum populifolii; HEa = Halimio ocymoidis-Ericetum aragonensis; DEu = Drosophyllo lusitanicae-Ericetum umbellatae; HEu = Halimio ocymoidis-Ericetum umbellatae.

	TCp	**HEau**	**ECp**	**PCp**	**HEa**	**DEu**	**HEu**	**UEu**
Halimium ocymoides	I	V	III	II	II	V	V	V
Erica australis	II	V	V			IV		II
Cistus ladanifer	IV	V	IV			V	II	II
Erica umbellata	I	II				V	V	V
Tuberaria lignosa	I	II				I	III	II
Cistus crispus	I	I	II					V
Lavandula luisieri	II	III	III			I		V
Erica scoparia	I	I		I		I	I	I
Cistus salvifolius	II	I				I		IV
Quercus rotundifolia	I	I	II	II			II	I
Calluna vulgaris	I	II		II	V	II	IV	
Genista tridentata	I	I	III	II	I	II	V	
Polygala microphylla	I	I		IV			I	
Halimium umbellatum subsp *viscosum*	I		II		IV		I	
Quercus pyrenaica	I	II			I		I	
Erica arborea	III	II		IV	I	I		
Cistus populifolius	V	V	V	V		I		
Arbutus unedo	III	II	III	IV		I		
Phillyrea angustifolia	III	III	IV	III		I		
Daphne gnidium	II	I		II		I		
Rosmarinus officinalis	II	III	I			II		

Table 5. *Cont.*

	TCp	HEau	ECp	PCp	HEa	DEu	HEu	UEu
Asphodelus albus	I	I				I		
Arrhenatherum elatius subsp *bulbosum*	I					I		
Ranunculus gramineus	I					I		
Adenocarpus telonensis	I			III		I		
Lavandula stoechas subsp *sampaioana*	I			III		I		
Cistus laurifolius	I			II	I			
Quercus suber	II	I	IV	III				
Pistacia terebinthus	I	I	I	IV				
Viburnum tinus	I		I	III				
Dactylis lusitanica	I		II	I				
Lonicera peryclimenum	I		I	III				
Paeonia broteroi	I		I	I				
Rubia peregrina	I		I	II				
Lonicera implexa	I			II				
Doronicum plantagineum	I			II				
Cytisus grandiflorus	I			I				
Cephalanthera longifolia	I			II				
Arenaria montana	I			I				
Tamus communis	I			III				
Teucrium fruticans	I			II				
Magydaris panacifolia	I			II				
Astragalus lusitanicus	I			III				
Conopodium marianum	I			II				
Jasminum fruticans	I			I				
Thapsia villosa	I							
Cytisus scoparius subsp *bourgaei*	II	I	IV					
Cardamine hirsuta	I	I	IV					
Helichrysum stoechas	I		I					
Srophularia scorodonia	I		I					
Origanum vulgare subsp *virens*	I		I					
Cistus albidus	I		I					
Quercus broteroi	III	II						
Thymus mastichina	I	I						
Juniperus oxycedrus subsp *badia*	I							
Teucrium oxylepis subsp *marianum*	I							
Sedum forsterianum	I							
Narcissus pallidulus	I							
Cistus laurifolius	I							
Geum sylvaticum	I							
Festuca rothmaleri	I							
Rubus ulmifolius	I							
Rosa pouzinii	I							
Epipactis helleborine	I							
Sorbus torminalis	I							
Tulipa sylvestris	I							
Dorycnium penthaphyllum	I							
Aristolochia pistolochia	I							
Piptatherum miliaceum	I							
Helminthotheca comosa	I							
Thapsia garganica	I							
Leucanthemum sylvaticum	I							
Iberis linifolia	I							
Centaurea melitensis	I							
Campanula rapunculus	I							
Iris planifolia	I							
Linum suffruticosum	I							
Cistus monspeliensis	I							
Sanguisorba verrucosa	I							

Table 5. *Cont.*

	TCp	HEau	ECp	PCp	HEa	DEu	HEu	UEu
Teucrium haenseleri		I		I			I	
Osyris alba		I		I		I		
Narcissus triandrus		I				I		
Scirpus holoschoenus		I				I		
Cytisus multiflorus		I		I				
Festuca elegans		I						
Ranunculus sardous		I						
Klasea integrifolia		I						
Arrhenatherum album		I						
Helictochloa marginata		I						
Salix atrocinerea		I						
Halimium lasianthum			III					I
Xolantha guttata			IV			I	I	
Pteridium aquilinum			I	III				I
Urginea maritima			IV	IV			I	
Sanguisorba hybrida			I					I
Phillyrea latifolia			I	III				
Asparagus acutifolius			III	I				
Senecio minutus			I	II				
Phlomis purpurea			I					
Genista polyanthos			III					
Smilax mauritanica			III					
Euphorbia nicaeensis			II					
Myrtus communis			II					
Pistacia lentiscus			I					
Bupleurum fruticosum			I					
Genista falcata			I					
Ruscus aculeatus			I					
Quercus canariensis			I					
Digitalis purpurea subsp tomentosa			I					
Saxifraga granulata subsp glaucescens			I					
Asplenium adiantum-nigrum			I					
Selaginella denticulata			I					
Lunularia cruciata			I					
Genista triacanthos				I				V
Thymelaea villosa				V		I		II
Drosophyllum lusitanicum						I		
Quercus lusitanica				III				
Teucrium scorodonia				IV				
Anthericum baeticum				III				
Ornithogalum pyrenaicum				IV				
Silene psammitis				IV				
Thapsia nitida				IV				
Cistus psilosepalus				II				
Genista tournefortii				II				
Smilax aspera				II				
Pterocephalus papposus				II				
Halimium halimifolium				I				
Halimium atriplicifolium				I				
Quercus coccifera				I				
Blechnun spicant				I				
Agrostis castellana					I		II	II
Erica australis subsp aragonensis					V		I	
Polytrichum piliferum					II		II	
Avenula sulcata					III		I	
Cladonia furcata					I		I	
Jasione montana					I	I		

Table 5. *Cont.*

	TCp	HEau	ECp	PCp	HEa	DEu	HEu	UEu
Luzula lactea					V			
Deschampsia flexuosa subsp iberica					V			
Genista pilosa					III			
Artostaphylos uva-ursi subsp crassifolia					II			
Sedum brevifolium					II			
Helianthemum apenninum					II			
Lotus corniculatus subsp carpetanus					II			
Vaccinium myrtillus					I			
Jasione laevis subsp carpetana					I			
Erica cinerea					I			
Cetraria islandica					I			
Fagus sylvatica					I			
Nardus stricta					I			
Hieracium pilosella					I			
Plantago radicata					I			
Festuca durandii					I			
Juniperus nana					I			
Thymus bracteatus					I			
Genista hirsuta						I		I
Cytinus hypocistis						I	I	
Jasione crispa subsp tomentosa						I		
Lavandula pedunculata						I		
Erica lusitanica						I		
Asphodelus microcarpus						I		
Gladiolus illyricus						I		
Briza máxima						I		
Tolpis barbata						I		
Petrorhagia prolifera						I		
Dactylis hispanica						I		
Halimium alyssoides							III	
Cladonia verticillata							II	
Cladonia mediterranea							I	
Agrostis setacea							I	
Ulex minor							I	
Genista micrantha							I	
Agrostis truncatula							I	
Ulex parviflorus subsp *eriocladus*								V
Pterospartum tridentatum								V
Festuca ampla								I

Syntaxonomical Checklist

CALLUNO-ULICETEA Br.-Bl. & Tüxen ex Klika & Hadac 1944
ULICETALIA MINORIS Quantin 1935

Ericion umbellatae Br.-Bl., P. Silva, Rozeira & Fontes 1952
Ericenion umbellatae Rivas-Martínez 1979

Halimio ocymoidis-Ericetum umbellatae Rivas Goday 1964
Ulici eriocladi-Ericetum umbellatae Rivas-Martínez 1979
Drosophyllo lusitanicae-Ericetum umbellatae nova

Ericenion aragonensis Rivas-Martínez 1979

Polygalo microphyllae-Cistetum populifolii Rivas Goday 1964
Erico australis-Cistetum populifolii Rivas Goday 1964
Halimio ocymoidis-Ericetum aragonensis Rivas-Martínez 1979
Teucrio mariani-Cistetum populifolii nova
Halimio ocymoidis-Ericetum australis nova

5. Conclusions

This study reveals a set of new associations for scrub dominated by species of the genera *Erica* and *Cistus*. All these communities act as dynamic states of cork oak forests *Quercus suber, Q. broteroi, Q. pyrenaica, Q. marianica* and *Q. canariensis*, of which the forests of *Q. pyrenaica* and *Q. canariensis* are the most fragile, both because they are at the edge of the range and are threatened by climate change. It is therefore essential to protect these forest formations and their dynamic stages, constituted firstly by scrub of *Arbutus unedo* and secondly by heaths of *Erica* sp. and *C. populifolius*. Since all these plant communities are located in sub-humid or humid mountain environments, where a high rate of endemic, rare or threatened species thrive, protection measures must be put in place against fire and excessive livestock pressure. The territory dominated by these shrubs contains a high rate of endemisms, which is why their protection is necessary by subjecting these areas to sustainable development, with control of livestock.

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Conflicts of Interest: The authors declare no conflict of interest.

Appendix A

Table A1. Geographical and bibliographical data of the Teucrio mariani-Cistetum populifolii association.

Inventories	Localities	Coord. X	Coord. Y	References
TCP1	Sierra de San Andrés.	30S0440046	4259889	
TCp2	Prox. Río Robledillo	30S0412374	4252579	
TCp3	Umbría sierra de Niefla	30S0380443	4266304	
TCp4	Umbría de Juán Rodríguez	30S0458460	4254905	
TCp5	Prox. Barranco de las Palomas	30S0440174	4259923	
TCp6	Monte Rosalejo			Cano 1988
TCp7	Hontanar de Flores a Quintana			Cano 1988
TCp8	Barranco de Valdecañas (30SUH9227)			Melendo 1998
TCp9	Brezorrubios (30SUH9226)			Melendo 1998
TCp10	Barranco del Valle de En medio (30SUH9128)			Melendo 1998
TCp11	Barranco del Valle de En medio (30SUH9128)			Melendo 1998
TCp12	Prox. Cortijos de Fimia (30SUH9126)			Melendo 1998
TCp13	Barranco de Valdeinfierno (30SUH9428)			Melendo 1998
TCp14	Barranco del Cuervo (30SUH9229)			Melendo 1998
TCp15	Barranco de los Gabilanes	30S0459282	4250323	
TCp16	Umbría de los Gabilanes	30S0459360	4250242	
TCp17	Puerta del Telmo	30S0459676	4250349	
TCp18	Collado de los Jardines	30S0457259	4249203	

Table A2. Geographical and bibliographical data of the *Halimio ocymoidis-Ericetum australis* association.

Inventories	Localities	Coord. X	Coord. Y	References
HEau1	Sierra Madrona	30S0405702	4250017	
HEau2	Valle de Valmayor	30S0394329	4250907	
HEau3	Cumbres sierra Niefla	30S0377945	4266753	
HEau4	Abulagoso	30S0387149	4257635	
HEau5	Sierra Navalmanzano	30S0392537	4254795	
HEau6	Sierra Canalizos	30S0362282	4297986	
HEau7	V. Pilones. Sierra de los Canalizos	30S0364121	4306199	
HEaU8	Hontanar de Flores			Cano 1988
HEau9	Prox. Risquillo			Cano 1988
HEau10	Burcio del Pino. Sierra Quintana			Cano 1988
HEau11	Monte Rosalejo			Cano 1988
HEau12	Monte Rosalejo			Cano 1988

Table A3. Geographical and bibliographical data of the Drosophyllo lusitanicae-Ericetum umbellatae association.

Inventories	Localities	Coord. X	Coord. Y	References
DEu1	Sierra Madrona	30S0405425	4249829	
DEu2	Abulagoso	30S0385725	4258301	
DEu3	Puerto de Madrona	30S0406569	4251696	
DEu4	Subida desde Puerto Madrona a Cumbres de Madrona	30S0406107	4251824	
DEu5	Subida desde Puerto Madrona a Cumbres de Madrona	30S0406072	4251798	
DEu6	Subida desde Puerto Madrona a Cumbres de Madrona	30S0405918	4251663	
DEu7	Subida desde Puerto Madrona a Cumbres de Madrona	30S0405731	4251616	
DEu8	Prox. Cumbres de Madrona	30S044993	4251508	
DEu9	Sierra Canalizos	30S0362282	4297986	
DEu10	Finca la Tapiada. Sierra Canalizos	30S0344784	4305623	
DEu11	Ladera oeste de Sierra Quintana			Cano 1988
DEu12	Majada del Reloj. Monte Limones	30S0439899	4255085	
DEu13	Hontanar de Flores (Jaén)			Cano 1988
DEu14	Hontanar de Flores (Jaén)			Cano 1988
DEu15	Hontanar de Flores a Risquillo			Cano 1988
DEu15	Subida a Burcio del Pino. Sierra Quintana			Cano 1988
DEu17	Subida a Burcio del Pino. Sierra Quintana			Cano 1988
DEu18	Ladera oeste de Sierra Quintana			Cano 1988
DEu19	Brezorrubios. 30SUH9226			Melendo 1998
DEu20	Brezorrubios. 30SUH9226			Melendo 1998
DEu21	Brezorrubios. 30SUH9226			Melendo 1998
DEu22	Brezorrubios. 30SUH9226			Melendo 1998
HEau1	Sierra Madrona	30S0405702	4250017	
HEau2	Valle de Valmayor	30S0394329	4250907	
HEau3	Cumbres sierra Niefla	30S0377945	4266753	
HEau4	Abulagoso	30S0387149	4257635	
HEau5	Sierra Navalmanzano	30S0392537	4254795	
HEau6	Sierra Canalizos	30S0362282	4297986	
HEau7	V. Pilones. Sierra de los Canalizos	30S0364121	4306199	
HEaU8	Hontanar de Flores			Cano 1988
HEau9	Prox. Risquillo			Cano 1988
HEau10	Burcio del Pino. Sierra Quintana			Cano 1988
HEau11	Monte Rosalejo			Cano 1988
HEau12	Monte Rosalejo			Cano 1988
TCP1	Sierra de San Andrés.	30S0440046	4259889	
TCp2	Prox. Río Robledillo	30S0412374	4252579	
TCp3	Umbría sierra de Niefla	30S0380443	4266304	
TCp4	Umbría de Juán Rodríguez	30S0458460	4254905	

Table A3. *Cont*

Inventories	Localities	Coord. X	Coord. Y	References
TCp5	Prox. Barranco de las Palomas	30S0440174	4259923	
TCp6	Monte Rosalejo			Cano 1988
TCp7	Hontanar de Flores a Quintana			Cano 1988
TCp8	Barranco de Valdecañas (30SUH9227)			Melendo 1998
TCp9	Brezorrubios (30SUH9226)			Melendo 1998
TCp10	Barranco del Valle de En medio (30SUH9128)			Melendo 1998
TCp11	Barranco del Valle de En medio (30SUH9128)			Melendo 1998
TCp12	Prox. Cortijos de Fimia (30SUH9126)			Melendo 1998
TCp13	Barranco de Valdeinfierno (30SUH9428)			Melendo 1998
TCp14	Barranco del Cuervo (30SUH9229)			Melendo 1998
TCp15	Barranco de los Gabilanes	30S0459282	4250323	
TCp16	Umbría de los Gabilanes	30S0459360	4250242	
TCp17	Puerta del Telmo	30S0459676	4250349	
TCp18	Collado de los Jardines	30S0457259	4249203	

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