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A phytosociological review of siliceous sedges in C-W Spain and their state of conservation based on diversity indices

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Abstract

A study was made of waterlogged areas in C-W Spain, and revealed the presence of the alliance *Genistion micrantho-anglicae*, and a series of associations belonging to *Isoeto-Nanojuncetea* included in habitat 3170*. This work describes the new association *Ericetum scopario-lusitanicae* in *Genistion micrantho-anglicae*, and assigns it to habitat 4020*. Due to the importance of these areas, we study their state of conservation and analyse their diversity by applying Shannon's index and establishing a relationship between the characteristic and companion species abundance in the community. The analysis of the diversity and state of conservation of the sampled plots at a global scale over the whole territory shows a conservation level of VmCa-VmCo > 0. However the study of individual plots reveals a trend towards the transformation of heathland into plant communities of *Molinia caeruelea*, *Junxcus acutiflorus*, *Pteridium aquilinum* and *Rubus ulmifolius*.

Key words: conservation, diversity, habitat, vegetation.

Introduction

We analyse environments undergoing temporary and permanent waterlogging in central-western Spain. Their high phytocenotic diversity is conditioned by the moisture gradient. In small areas with temporary waterlogging of an ephemeral nature there is a predominance of Habitat 3170* (temporary Mediterranean lakes and pools), represented by the following associations: *Pulicario uliginosae-Agrostietum salmanticae*; *Junco pygmaei-Isoetetum velati*; *Hyperico humifusi-Cicendietum filiformis*; *Periballio laevis-Illecebretum verticillati*; *Sibthorpio-Pinguiculetum lusitanicae*. If the waterlogging persists for longer periods, and only the upper soil horizon dries out, the dominant communities belong to Habitat 6410 (meadows with *Molinia caerulea* on moist soils most of the year). This is a non-priority habitat for the EU, which we propose should be made priority due to its transitional character between 3170* and 4020*. These communities belong to the associations *Hyperico undulati-Juncetum acutiflori* and *Lobelio urentis-Lotetum pedunculati*.

A study is made of wetland vegetation in Sites of Community Interest (SCI): Sierra Morena, Almadén-Chillón-Guadalmez, Sierra de Canalizos and Guadiana-Laderas Vertientes in central-western Spain. Numerous authors have conducted research in these areas; Rivas Goday *et al*. (1954) spoke of these permanently and temporarily flooded areas in his work on the Sierra Madrona (Finca de Aulagas), in which he studied the siliceous sedges of *Erica tetralix* and *Genista anglica*. Subsequently this same author again discussed these waterlogged sites in his work on the vegetation and flora of the province of Badajoz (Rivas Goday, 1964). Velasco Negueruela (1980) described the communities of *Erica tetralix* in the eastern areas of the Portuguese-Extremaduran biogeographic unit, *Erico tetralicis-Myricetum galeae* Ladero & A. Velasco in A. Velasco 1980, an association that Cano (1988) located sporadically in the Sierra Morena in Jaén, and which was later investigated by Cano *et al*. (1996) in the Finca de Aulagas (Sierra Madrona, C. Real). Rivas-Martínez (1979) conducted a review of western European heathlands and sedges and proposed the association *Cisto psilosepali-Ericetum lusitanicae* Ladero ex Rivas-Martínez 1979, which includes the alliance *Ericion umbellatae* Br.-Bl., P. Silva, Rozeira & Fontes 1952, based on the relevé taken in the location of Granadilla (Cáceres), and created for the first time the alliance *Genistion micrantho-anglicae* Rivas-Martínez 1979. Studies on the Guadiamar basin (Seville) by Pérez Latorre *et al*. (2002) revealed the presence of this association. Val-

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des Francis (1984) gave a table of seven relevés in the Sierra de Cabo Gata (Cáceres) and included them in *Cisto psilosepali-Ericetum lusitanicae*, while Castro (2005) cited this association in westernmost Portuguese territories in the Sierra de Gata (Sierra de San Mamede, Portugal). Belmonte (1998) published four relevés in *Cistus psilosepalus* and *Erica lusitanica* in the Monfrague National Park. Other researchers such as Quesada (2010) have cited this association in Sierra Morena in Jaén, but without the presence of *Cistus psilosepalus*. Siliceous sedges are characterised by growing in permanently waterlogged environments, and consequently on gley soils, where the moisture gradient and the gleyic character are the factors that condition the presence of a particular type of sedge. The permanently waterlogged areas with *Sphagnum* are essentially located towards the interior of the area, and this is where the association *Erico tetralicis-Myricetum galeae* grows, whereas communities of *Erica lusitanica* are found in the outer zones. These types of permanently waterlogged sites contain habitats of community interest 3170* and 4020*. That are also present in Italy (Gigante *et al*., 2013) and we have interpreted them according to the European Directive (Biondi *et al*., 2012); furthermore, they are covered by Act 9/1999 of the Castile-La Mancha regional legislation. For this reason, these communities are of great importance, both from the standpoint of phytosociological knowledge and to determine their current state of conservation. Due to the degradation of some of these wetlands, we took phytosociological relevés and mapped different sites of community interest to study their diversity and state of conservation.

Material and methods

Several SCIs were mapped in the province of Ciudad Real (Spain) and phytosociological relevés were taken of the different associations in two types of habitats: 3170* and 6410. A total of 64 relevés were analysed, of which 19 correspond to *Cicendion* (Rivas Goday in Rivas Goday & Borja 1961) Br.-Bl. 1967 (C), 13 to *Hyperico-Juncetum acutiflori* Teles 1970 (HJ), 19 to a community of *Molinia caeruleae* (CoMc), 6 to *Preslion cervinae* Br.-Bl. ex Moor 1937 (Pc), and 7 to *Verbenion supinae* Slavnic 1951 (Vs). Siliceous sedges belong to habitat 4020*, with 12 samplings corresponding to the association *Erico tetralicis-Myricetum galeae* (EM), 20 to the new association we describe in this work, *Ericetum scopario-lusitanicae* (Esl) – of which 10 samplings were made by ourselves and the other 10 were taken from Quesada (2010) and Pérez Latorre *et al*. (2002) –, and 16 included by several authors in *Cisto psilosepali-Ericetum lusitanicae* (C-E). Finally, we studied 9 relevés belonging to the association *Lavandulo-Ericetum scopariae* Rivas-Martínez & Cano 2011, recently published by Rivas-Martínez (2011), making a total of 57 sedge relevés (Tab. 1). Data from 58 meteorological stations were used for the bioclimatic analysis, and the bioclimatic indices were determined at www.globalbioclimatics.org by Professor Rivas-Martínez (Tab. 2). An ordination analysis was performed using Ward's agglomerative cluster analysis, Euclidean distance, and a DECORANA and RA with the CAP3 community analysis package. The first cluster analysis includes 4 associations – EM, Esl, C-E, L-E – to separate the associations in the alliance *Genisthion micrantho-anglicae* (EM, Esl, C-E); successive ordination analyses were done between them, as association L-E is located at the outer edge of *Genisthion micrantho-anglicae* and is not included in the alliance (Rivas-Martínez, 2011). A phytosociological study was made of the different communities by preparing phytosociological tables and a synthetic table of sedges. The table of syntaxa was compiled with 4 associations – EM, Esl, C-E, L-E – following the studies of Biondi (2011) and Ernandes & Marchiori (2012), which give an ecology of *Marsilea strigosa* Willd. in Italy that is equal to the ecology for this species in Spain and similar to the ecology of *Marsilea batardae* Launert in Sierra Morena, and includes both species in habitat 3170*.

The floristic diversity was determined by applying Shannon's index to the total species present in the association, the characteristic species of the association and higher syntaxonomic units, and the companion species belonging to other neighbouring associations. The diversity of both species groups shows the trend towards a greater or lesser conservation rate. The degree of conservation was determined by finding the average values for the abundance indices of the characteristic species in the association and higher syntaxonomic units (Vmca) and the companion species (Vmco); the difference between Vmca-Vmco indicates the state of conservation of the association *in situ*. An association can be assumed to present its highest degree of conservation when all the species present are characteristic of the association and higher syntaxonomic units. All plant associations are formed by two groups of species: those that give the association its character, and companion species belonging to other neighbouring associations. This situation is stable on a spatial-temporal scale while the environmental parameters that generated it persist. If the environmental conditions change, the companion species behave opportunistically and displace the community's characteristic species, leading to an imbalance between the two species groups (characteristic and companion) in a community, and thus a change in species abundance values. The new method we propose indicates the trend and state of conservation of the plant association.

Tab. 1 - Source of the relevés used.

Source of the relevés	nº rel.	References
Cisto psilosepali-Ericetum lusitanicae	16	Rivas-Martínez (1979)
Ericetum scopario-lusitanicae	5	Pérez Latorre et al. (2002)
Ericetum scopario-lusitanicae	5	Quesada (2010)
Ericetum scopario-lusitanicae	10	Rels. Own
Erico tetralicis-Myricetum galeae	12	Rels. Own
Lavandulo-Ericetum scopariae	1	Rivas-Martínez (2011)
Lavandulo-Ericetum scopariae	8	Rels. Own

Tab. 2 - Bioclimatic data for the study area.

Weather Station	Altitude	UTM	Tªm	P	It/Itc	Io	Ic
ALÁJAR	577	29 S 706711 4193625	15.1	1151	323	6.34	15
ALMADÉN DE LA PLATA	450	29 S 757600 4186952	14	831	259	4.94	18
ALMADEN MINAS	535	30 S 340722 4292480	16.2	625	316	3.22	20
ALMODOVAR DEL CAMPO	670	30 S 398550 4284132	14.9	489	279	2.74	20
ALMODOVAR DEL RIO	150	30 S 322312 4186846	17	598	345	2.93	18
ANDUJAR	212	30 S 407453 4210724	18.1	464	372	2.14	19
ARACENA	731	29 S 715460 4195700	14.5	1026	281	5.88	18
AROCHE EL VINCULO	426	29 S 681704 4196733	15.7	838	340	4.43	15
AZUEL	662	30 S 383775 4242782	15.5	636	298	3.42	19
BAILEN	343	30 S 432128 4216955	17.9	582	369	2.71	20
BERLANGA	573	30 S 253635 4241006	15.2	493	294	2.7	18
CABEZA DEL BUEY	550	30 S 307281 4287668	16.3	586	320	2.99	19
CABEZA LA VACA	759	29 S 726571 4218213	14.9	878	289	4.92	18
CABEZAS RUBIAS CUMBRES DE EN-	565	29 S 670133 4189084	14.8	993	309	5.61	15
CALZADA DE CALATRAVA	685	30 S 431852 4280078	14.5	445	268	2.57	21
CASTELLAR DE SANTISTEBAN LA	790	30 S 488662 4234248	14.8	740	299	4.16	19
COZAR	860	30 S 494199 4277940	13.6	478	241	2.93	21
EL CENTENILLO	824	30 S 436237 4243739	14.7	679	270	3.84	20
EL CENTENILLO T (51-63) P (51-88)	824	30 S 436237 4243739	14.7	679	272	3.86	19
ENCINASOLA	433	29 S 686972 4222759	16.5	778	338	3.94	19
FONTANOSAS	570	30 S 366757 4290151	14.9	672	285	3.76	19
FREGENAL DE LA SIERRA	580	29 S 705870 4226917	14.4	750	287	4.33	16
GRANJA DE TORREHERMOSA	593	30 S 274099 4242259	15	541	284	3.01	19
GUADALCANAL	907	30 S 256475 4215686	13.8	610	254	3.67	19
HINOJOSA DEL DUQUE	540	30 S 312592 4263615	14.8	477	284	2.68	18
HORNACHUELOS	184	30 S 302670 4189144	19.3	745	407	3.21	18
HORNACHUELOS (59-74, 51-87)	184	30 S 302670 4189144	19.5	701	406	2.99	19
JEREZ DE LOS CABALLEROS	492	29 S 695246 4243311	15.6	665	314	3.56	17
LAS NAVAS DE LA CONCEPCION	434	30 S 283540 4201349	14.3	720	284	4.19	16
MESTANZA PRIMERA CENTRAL	549	30 S 405578 4265548	15.2	426	298	2.33	18
MINAS DE RIOTINTO	421	29 S 711585 4175241	16.4	713	355	3.62	16
MONTEMOLÍN	640	29 S 751768 4207844	16.6	744	358	3.74	16
MONTIZÓN	700	30 S 493532 4246110	13.6	612	254	3.75	19
MONTORO	195	30 S 378543 4209562	17.5	572	361	2.72	18
PANTANO DE CALA	220	29 S 757143 4178612	16.8	744	352	3.69	17
PANTANO DE ENCINAREJO	280	30 S 411981 4223621	16.5	560	333	2.82	18
PANTANO DE GUADALÉN	310	30 S 457617 4223563	16.6	578	343	2.9	19
PANTANO DE GUADALMELLATO	200	30 S 353334 4211518	17	698	349	3.43	18
PANTANO DE PUENTE NUEVO	460	30 S 329498 4220462	16.3	604	328	3.09	18
PANTANO DEL JÁNDULA	360	30 S 414983 4231296	16.8	505	340	2.5	20
PANTANO DEL PINTADO	300	30 S 240759 4207913	16.2	647	330	3.33	17
PANTANO DEL RUMBLAR	300	30 S 429144 4223916	16.7	657	343	3.28	19
PEÑARROYA-PUEBLONUEVO	550	30 S 301395 4242075	17.6	524	358	2.49	20
POSADAS	88	30 S 314459 4185786	17.7	687	359	3.24	18
POZOBLANCO	649	30 S 337997 4249430	15.6	477	295	2.55	20
POZOBLANCO (54-91, 61-90)	649	30 S 337997 4249430	16.1	515	311	2.67	20
PUERTOLLANO	700	30 S 408652 4280310	14.5	448	280	2.57	19
SANTA CRUZ DE MUDELA	721	30 S 459383 4276192	15.2	370	286	2.03	21
SANTELMO	350	29 S 677547 4185541	17.8	727	378	3.4	17
TORRE DE JUAN ABAD LA GRANJA	790	30 S 482605 4281656	14.6	415	273	2.37	19
TORRECAMPO	572	30 S 352275 4260275	16.7	539	334	2.69	20
USAGRE	566	29 S 747596 4248450	15.3	602	295	3.28	19
VALDEZUFRE	611	29 S 721424 4192157	17.2	921	366	4.46	17
VILLANUEVA DE CORDOBA	725	30 S 357663 4242738	15.7	600	318	3.18	18
VILLANUEVA DE LOS INFANTES	875	30 S 500000 4287185	13.8	468	251	2.84	20
VILLANUEVA DE SAN CARLOS SE-	690	30 S 430338 4272693	15	401	288	2.23	20
ZAFRA	508	29 S 725486 4257057	15.4	574	296	3.11	18
ZUFRE	480	29 S 729066 4181261	16.3	904	348	4.62	16

The study area

These sites, dominated by Palaeozoic quartzite rocks and slates, are characterised by their high rainfall produced by the barrier effect of the mountains against Atlantic squalls, and have a continental influence due to their proximity to the La Mancha plateau. All these factors condition the presence of forests of *Quercus pyrenaica*, *Quercus canariensis* and *Quercus broteroi*. The territory is in the easternmost areas of the Portuguese-Extremaduran biogeographical unit (Mariánico-Monchiquense unit), with a predominantly subhumid-humid ombrotype.

Results and discussion

Phytosociological analysis

The analysis of siliceous sedges in the more continentalised areas of the Mariánico-Monchiquense biogeographic sector (Rivas-Martínez, 2011) reveals the presence of three types of associations: *Erico tetralicis-Myricetum galeae* (EM) and *Ericetum scopario-lusitanice* (Esl), which occupy more permanently waterlogged areas with highly gleyic soils, with high rainfall and a subhumid and humid ombroclimate. These are areas dominated by forests of *Arbuto-Quercetum pyrenaicae* (Rivas Goday in Rivas Goday, Esteve, Galiano, Rigual & Rivas-Martínez 1960) Rivas-Martínez 1987, *Doronico plantaginei-Quercetum canariensis* Rivas-Martínez & Cano 2011, and *Pistacio terebinthi-Quercetum broteroi* Rivas Goday in Rivas Goday, Esteve, Galiano, Rigual & Rivas-Martínez 1960, while the temporarily waterlogged areas dominated by forests of *Pyro bourgaeanae-Quercetum broteroi* Cano, García Fuentes, Torres, Pinto, Cano-Ortiz, Montilla, Muñoz, Ruiz & Rodríguez 2004 are home to the sedge *Lavandulo luisieri-Ericetum scopariae* (L-E), which represents the first dynamic stage of these forests. Forests developed in rainy environments with subhumid-humid ombrotype (see Tab. 2). These types of communities are usually located in the central part of the Mariánica range with values of $I_o > 4$. The association EM always occupies the part of the tesela where there is a high degree of permanent flooding, a lack of oxido-reduction phenomena and thus highly gleyic soils, with such emblematic species as *Erica tetralix*, *Myrica gale* and *Genista anglica*. the spaces left by this type of vegetation are occupied by species such as *Sibthorpia europea*, *Pinguicula lusitanica* and *Drosera rotundifolia*. The outer edge of EM is colonised by Esl, a community dominated by *Erica scoparia* and *Erica lusitanica*, with an absence of *Cistus psilosepalus* and *Erica australis* subsp. *aragonensis*. Permanently waterlogged areas are home to communities of *Genistion micrantho-anglicae* (Rivas-Martínez, 1979), with the presence of habitat 4020* in this alliance, and including the association *Erico tetralicis-Myricetum gale*,

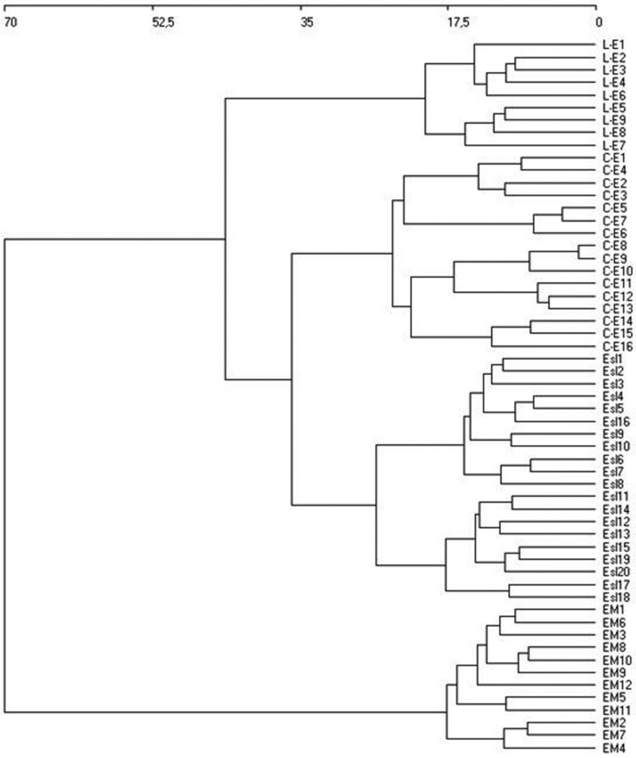

Fig. 1 - Cluster analysis for the four groups studied (L-E, C-E, Esl and EM).

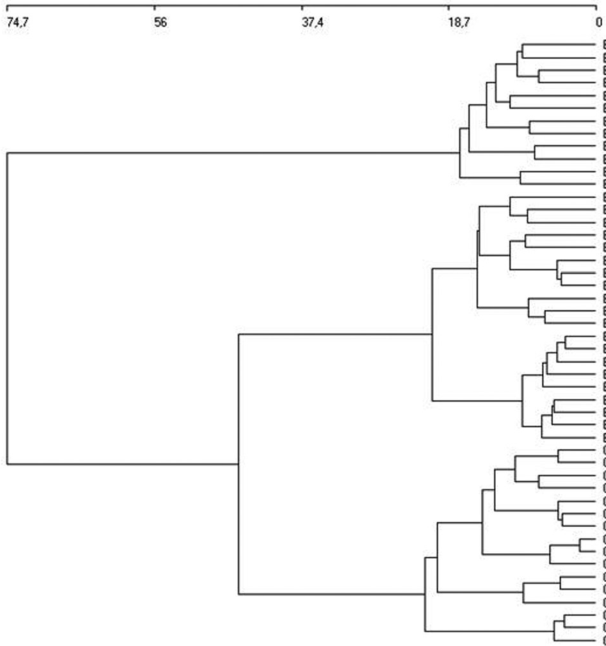

Fig. 2 - Cluster analysis for the three groups studied (EM, Esl and C-E).

and on its outer edges on less waterlogged soils, a community of *Erica lusitanica*, and outside this a community of *Erica scoparia*. The statistical study thus perfectly separates the four groups between the different sedge communities (EM, Esl, C-E, L-E) (Fig. 1). The communities Esl and C-E are close (Figs. 2, 3, 4) in the cluster analyses, DECORANA and RA. As the difference between both associations is the absence of *Cistus psilosepalus* and *Erica australis* subps. *aragonensis* in Esl, it is also located in more continental environments than C-E, which is more oceanic. In view of this, we propose *Ericetum scopario-lusitanicae* ass. nova (Tab. 3, relevés 1-20, *typus* inv. 6) as a vicarious association of C-E for the easternmost areas of the Mariánico-Monchiquense sector. This is corroborated in the synthetic table for the four previous associations (Tab. 3).

Analysis of the diversity and state of conservation

The association *Erico tetralicis-Myricaetum galeae* is always located in the most siliceous sites occupied by the alliance *Genistion micrantho-anglicae*. In this case, we studied 12 samplings from different locali-

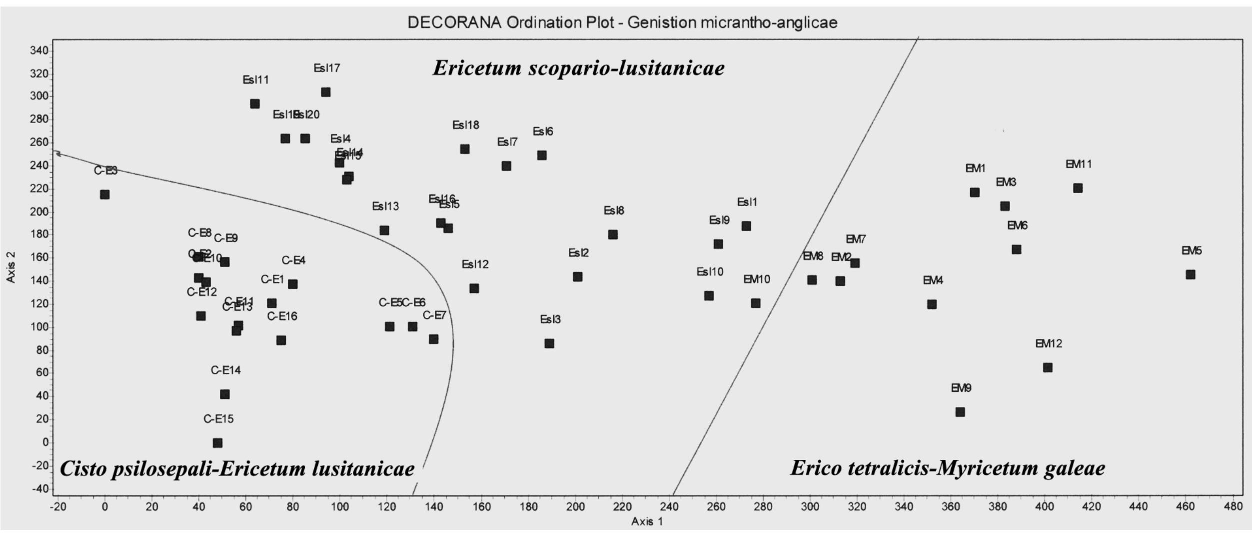

Fig. 3 - DECORANA ordination analysis of the communities EM, Esl and C-E in the alliance *Genistion micrantho-anglicae*.

Tab. 3 - *Ericetum scopario-lusitanicae* (Esl).

Area in m^2	2	-	-	100	50	200	100	200	200	200	100	50	100	20	25	20	60	30	20	50
Altitud in m.	844	-	-	615	947	562	545	537	794	816	340	350	300	170	450	674	559	556	665	759
Cover rate in %	8	-	-	80	60	95	70	70	80	85	60	60	70	100	80	80	40	40	100	50
Slope %	8	-	-	15	12	2	8	10	7	10	-	-	30	-	10	-	-	-	-	-
Orientation	N	-	-	N	NO	N	N	N	N	N	-	-	N	-	N	-	-	-	-	-
Average height of veg. (m)	2	-	-	1.5	0.9	2	2	1.9	2	2	3	2	3	3	3.5	2	1.5	2	2	1.5
Nº of cluster	Esl1	Esl2	Esl3	Esl4	Esl5	Esl6	Esl7	Esl8	Esl9	Esl10	Esl11	Esl12	Esl13	Esl14	Esl15	Esl16	Esl17	Esl18	Esl19	Esl20
Nº of order	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
Characteristic of the association and upper units																				
Erica scoparia subsp. scoparia L.	+	4	4	3	2	4	3	2	+	2	.	.	.	1	.	2	.	.	.	1
Erica lusitanica Rudolphi	4	1	+	1	3	4	3	3	4	4	+	1	1	+	3	3	3	2	3	4
Erica australis L.	.	.	+	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.
Erica erigena R. Ross	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Erica tetralix L.	2	+	+	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.
Erica umbellata Loefl. ex L.	.	2	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Calluna vulgaris (L.) Hull	.	1	+	.	1	.	.	.	+	1	.	.	.	.	.	+	.	.	.	.
Frangula alnus subsp. alnus Mill.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Halimium ocymoides (Lam.) Willk.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Lavandula stoechas L. subsp. luisieri Rozeira	.	.	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Companions																				
Rubus ulmifolius Schott	.	.	.	2	.	2	1	+	+	.	2	3	3	5	3	1	.	.	1	2
Carex elata All. subsp. tartessiana Luceño & Aedo	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	+	.	.
Carex elata subsp. reuteriana (Boiss.) Luceño & Aedo	.	.	.	.	.	1	2	2	+	+	.	.	.	.	.	.	.	.	.	.
Carex pendula Huds.	.	.	.	.	.	1	+	.	.	.	.	.	.	.	.	.	.	.	.	.
Carum verticillatum (L.) W. D. J. Koch	.	.	.	.	.	+	.	+	1	+	.	.	.	.	.	.	.	.	.	.
Cistus ladanifer L.	.	+	.	+	+	.	.	.	1	+	.	.	.	.	.	.	.	.	.	.
Cistus monspeliensis L.	.	.	.	1	1	+	.	+	.	.	.	.	.	.	.	.	.	.	.	.
Cistus populifolius L.	.	.	.	1	1	.	.	.	.	+	.	.	2	.	+	.	.	.	.	.
Aristolochia paucinervis Pomel	.	+	.	.	.	+	+	+	.	.	.	.	.	.	.	.	.	.	1	1
Agrostis castellana Boiss. & Reut.	.	.	1	.	.	.	.	.	.	.	.	2	.	.	.	.	.	.	.	.
Alnus glutinosa (L.) Gaertn.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	+
Anagallis tenella (L.) L.	.	.	.	.	.	.	+	+	1	+	.	.	.	.	.	.	.	.	.	.
Arbutus unedo L.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	1	1	.	.	.	.
Bellis perennis L.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	1	.	.
Blechnum spicant (L.) Roth subsp. Spicant	.	.	.	.	.	.	.	.	.	1	.	.	.	.	.	.	.	.	.	.
Briza minor L.	.	.	.	.	.	.	.	+	+	.	.	1	.	.	.	.	.	.	.	.
Callitriche brutia Petagna	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.
Cruciata glabra subsp. glabra (L.) Ehrend.	.	.	.	.	.	+	+	.	+	.	.	.	.	.	.	.	.	.	.	.
Digitalis purpurea L.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.
Dorycnium rectum (L.) Ser. in DC.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.
Epilobium obscurum Schreb.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.

Equisetum telmateia Ehrh.	.	.	.	.	.	.	.	.	.	.	2	.	.	.	.	.	.	.	.	.
Erica arborea L.	.	.	.	.	+	.	.	.	.	.	.	.	1	.	.	2	1	2	.	.
Fraxinus angustifolia Vahl	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	1	1	.	.
Genista triacanthos Brot.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.
Gladiolus illyricus Koch	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.
Holcus lanatus L.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.
Hypericum tomentosum L.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.
Hypericum undulatum Schousb. ex Willd.	.	.	+	.	.	.	.	1	.	+	.	.	.	.	.	.	.	.	.	.
Hypochaeris radicata L.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+
Juncus acutiflorus Ehrh. ex Hoffm.	.	.	1	.	.	.	.	1	1	1	.	.	.	.	.	.	.	.	.	.
Juncus subnodulosus Schrank	.	.	.	.	.	.	.	.	.	.	1	.	.	.	.	.	.	.	.	.
Lobelia urens L.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Lotus pedunculatus Cav.	.	.	.	.	.	.	+	1	+	+	.	.	.	.	.	.	.	.	.	.
Lythrum salicaria L.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.
Mentha pulegium L.	.	.	1	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.
Molinia caerulea (L.) Moench subsp. altissima (Link) Domin	3	1	1	.	.	1	.	.	1	1	.	.	.	.	.	+	.	+	.	.
Myosotis debilis Pomel	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.
Narcissus pseudonarcissus subsp. munozii-garmendiae (Fern. Casas) Fern. Casas	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Nerium oleander L.	.	.	.	.	.	.	.	.	.	.	3	.	.	1	.	.	.	2	.	.
Oenanthe crocata L.	.	.	.	.	.	.	.	.	.	.	.	.	1	.	+	.	.	.	2	1
Phillyrea angustifolia L.	.	.	.	.	.	+	.	.	.	.	.	.	+	.	.	.	.	.	.	.
Phragmites australis (Cav.) Trin. ex Steud.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.
Plantago lanceolata L.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Potentilla erecta (L.) Raeusch.	.	.	.	.	.	.	.	.	+	+	.	.	.	.	.	.	.	.	.	.
Potentilla reptans L.	.	+	.	.	.	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Pteridium aquilinum (L.) Kuhn var. aquilinum	2	2	.	.	.	.	.	.	.	1	.	2	1	.	.	.	.	.	.	.
Pulicaria paludosa Link	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Quercus broteroi (Cout.) Rivas Mart.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Quercus marianica C.Vicioso	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Quercus pyrenaica Willd.	.	.	.	.	.	.	.	.	.	1	.	.	.	.	.	.	.	.	.	.
Radiola linoides Roth	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Ranunculus bulbosus L. subsp. aleae (Willk.) Rouy & Fouc.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1
Ranunculus hederaceus L.	.	.	.	.	.	.	.	+	.	+	.	.	.	.	.	.	.	.	.	.
Rosa canina L.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	2	1
Rosa pouzinii Tratt.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.
Salix atrocinerea Brot.	.	1	.	.	.	.	.	.	.	.	.	.	.	.	.	1	.	.	.	.
Salix salviifolia Link ex Willd. subsp. australis Franco [sub]	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.
Sanguisorba hybrida (L.) Font Quer	.	.	.	.	.	.	.	.	.	.	.	+	2	.	.	.	.	.	.	.
Scirpoides holoschoenus (L.) Soják	.	+	.	.	+	+	1	1	.	.	1	.	1	.	1	1	1	.	2	.
Selaginella denticulata (L.) Spring	.	.	.	.	.	.	.	.	.	.	.	.	1	.	1	.	.	+	.	.
Sibthorpia europaea L.	2	.	.	.	.	+	.	.	.	1	.	.	.	.	.	.	.	.	.	.
Sphagnum sp.	+	.	.	.	.	.	.	.	1	+	.	.	.	.	.	.	.	.	.	.

Tab. 4 - EM: *Erico tetralix-Myricaetum galeae*. Esl: *Ericetum scopario-lusitanicae*. C-E: *Cisto psilosepali-Ericetum lusitanicae*. L-E: *Lavandulo luisieri-Ericetum scopariae*.

	EM	Esl	C-E	L-E	Presences
Characteristic					
Erica scoparia subsp. scoparia L.	II	III	III	V	4
Calluna vulgaris (L.) Hull	II	I	III	II	4
Erica lusitanica Rudolphi	II	V	III	.	3
Erica tetralix L.	V	I	.	I	3
Halimium ocymoides (Lam.) Willk.	I	I	.	I	3
Genista anglica L.	II	.	.	I	2
Erica erigena R. Ross	II	I	.	.	2
Myrica gale L.	I	.	.	.	1
Lavandula stoechas L. subsp. luisieri Rozeira	.	I	I	II	3
Erica australis subsp. australis	.	I	.	II	2
Frangula alnus subsp. alnus Mill.	.	I	.	.	1
Erica umbellata Loefl. ex L.	.	I	.	.	1
Cistus psilosepalus Sweet	.	.	V	.	1
Erica australis L. subsp. aragonensis	.	.	II	.	1
Halimium halimifolium subsp. halimifolium (L.) Willk.	.	.	.	I	1
Companions					
Molinia caerulea (L.) Moench subsp. altissima (Link) Domin	V	II	I	II	4
Rubus ulmifolius Schott	I	III	V	II	4
Juncus acutiflorus Ehrh. ex Hoffm.	II	I	I	I	4
Scirpoides holoschoenus (L.) Soják	I	II	III	I	4
Carum verticillatum (L.) W. D. J. Koch	II	I	.	II	3
Sphagnum sp.	III	I	.	I	3
Potentilla reptans L.	II	I	.	I	3
Potentilla erecta (L.) Raeusch.	I	I	.	I	3
Radiola linoides Roth	I	I	.	I	3
Salix atrocinerea Brot.	I	I	I	.	3
Lotus pedunculatus Cav.	I	I	I	.	3
Eleocharis multicaulis (Sm.) Desv.	II	.	.	I	2
Pinguicula lusitanica L.	I	.	.	I	2
Pteridium aquilinum (L.) Kuhn var. aquilinum	II	I	.	.	2
Anagallis tenella (L.) L.	II	I	.	.	2
Sibthorpia europaea L.	II	I	.	.	2
Carex elata subsp. reuteriana (Boiss.) Luceño & Aedo	I	I	.	.	2
Carex pendula Huds.	I	I	.	.	2
Holcus lanatus L.	I	I	.	.	2
Eleocharis palustris subsp. palustris (L.) Roem. & Schult.	I	I	.	.	2
Ranunculus bulbosus L. subsp. aleae (Willk.) Rouy & Fouc.	I	I	.	.	2
Lobelia urens L.	I	I	.	.	2
Mentha pulegium L.	I	I	.	.	2
Dactylorhiza elata (Poir.) Soó	I	.	.	.	1
Danthonia decumbens (L.) DC.	I	.	.	.	1
Carex demissa Hornem.	I	.	.	.	1
Carex echinata Murray	I	.	.	.	1
Cicendia filiformis (L.) Delarbre	I	.	.	.	1
Drosera rotundifolia L.	I	.	.	.	1
Hypericum elodes L.	I	.	.	.	1
Hypericum humifusum L.	I	.	.	.	1
Hypochaeris radicata L.	I	.	.	.	1
Isoetes velatum A. Braun subsp. velatum	I	.	.	.	1
Juncus tenageia Ehrh. ex L. fil.	I	.	.	.	1
Rosa canina L.	.	I	I	II	3
Hypericum undulatum Schousb. ex Willd.	.	I	.	I	2
Pteridium aquilinum (L.) Kuhn in Kerst.	.	I	III	.	2
Genista triacanthos Brot.	.	I	I	.	2
Lythrum salicaria L.	.	I	I	.	2
Alnus glutinosa (L.) Gaertn.	.	I	.	.	1
Blechnum spicant (L.) Roth subsp. Spicant	.	I	.	.	1
Callitriche brutia Petagna	.	I	.	.	1
Carex elata All. subsp. tartessiana Luceño & Aedo	.	I	.	.	1
Cruciata glabra subsp. glabra (L.) Ehrend.	.	I	.	.	1
Dorycnium rectum (L.) Ser. in DC.	.	I	.	.	1
Epilobium obscurum Schreb.	.	I	.	.	1
Equisetum telmateia Ehrh.	.	I	.	.	1
Hypericum tomentosum L.	.	I	.	.	1
Juncus subnodulosus Schrank	.	I	.	.	1
Myosotis debilis Pomel	.	I	.	.	1
Narcissus pseudonarcissus subsp. munozii-garmendiae (Fern. Casas) Fern. Casas	.	I	.	.	1
Narcissus triandrus subsp. pallidulus (Graells) Rivas Goday	.	I	.	.	1
Pulicaria paludosa Link	.	I	.	.	1
Ranunculus hederaceus L.	.	I	.	.	1
Rosa pouzinii Tratt.	.	I	.	.	1
Rosa corymbifera Borkh.	.	.	I	I	2
Carex flava L. subsp. oedocarpa (Andersson) O. Bolòs & Vigo [sub]	.	.	I	.	1
Galium broterianum Boiss. & Reut.	.	.	I	.	1
Genista falcata Brot.	.	.	II	.	1
Holcus annuus C.A. Mey subsp. setiglumis (Boiss. & Reut.) M. Seq. & Castrov. [sub]	.	.	I	.	1
Lithodora diffusa (Lag.) I. M. Johnston	.	.	I	.	1
Mentha suaveolens Ehrh.	.	.	I	.	1
Origanum virens Hoffmanns. & Link	.	.	I	.	1
Prunella vulgaris L.	.	.	I	.	1
Ulex minor Roth	.	.	I	.	1
Thymus mastichina L.	.	.	.	II	1
Rosmarinus officinalis L.	.	.	.	II	1
Celtica gigantea (Link) F. M. Vázquez & Barkworth	.	.	.	I	1
Fluggea tinctoria (L.) G. L. Webster	.	.	.	I	1
Glyceria declinata Bréb.	.	.	.	I	1
Juncus bufonius L.	.	.	.	I	1
Juncus pygmaeus Rich. ex Thuill.	.	.	.	I	1
Juniperus oxycedrus subsp. lagunae (Pau ex C. Vicioso) Rivas Mart.	.	.	.	I	1
Pulicaria odora (L.) Rchb.	.	.	.	I	1
Ranunculus ollissiponensis subsp. ollissiponensis Pers.	.	.	.	I	1

ties by applying Shannon's index to the total species (Shannon_H_T), and separately to the characteristic species (Shannon_H_Ca) and (Shannon_H_Co). In table the relevés EM4, EM5 and EM12 have a Shannon's index value of = 0, due to the fact that *Erica tetralix* is only present in these samplings as a characteristic species with an abundance-dominance value of 2 in EM4 and EM5, and 1 in EM12, with companion species exceeding the diversity of characteristic species. Within the companion species there is a dominance of *Pteridium aquilinum* and *Molinia caeruleae*; in this case the value of Shannon_H_Co = 1.92, 2.46 and 2.28, which is very similar to the total diversity of Shannon_H_T > 2.05. In the rest of the samplings, the diversity of companion species far exceeds that of characteristic species, and from the overall point of view the value of Shannon_H_Co = 1.96 > Shannon_H_Ca = 0.76, compared to a total diversity of 2.27. This reveals that the sedges of *Erico tretralicis-Myricaetum galeae*, present in the 12 localities studied, have a tendency to transform into other communities, fundamentally *Molinion caeruleae* and *Juncion acutiflori*. This phenomenon has been observed in the locality of Finca de Aulagas (Sierra Morena), where Rivas Goday (1953) and Cano *et al*. (1996) incorporated *Genista anglica*, *Erica tetralix*, *Erica scoparia*, *Carum verticillatum*, *Sibthorpia europea* and *Pinguicula lusitanica* in their samplings. However, these plant communities have disappeared in recent samplings in the same locality, and been replaced by a fragmented community of *Hyperico-Juncetum acutiflori*.

Based on the relationship between the abundance of characteristic and companion species in each sampling in EM4, EM5 and EM12 VmCa-VmCo can be observed to have negative values of -0.21, -0.55 and -0.52 respectively, indicating that these three areas in the sampling are at high risk of disappearing and becoming transformed into other plant communities, as VmCa < VmCo.

In the case of the sedge *Cisto psilosepali-Ericetum lusitanicae*, we include 16 samplings published by se-

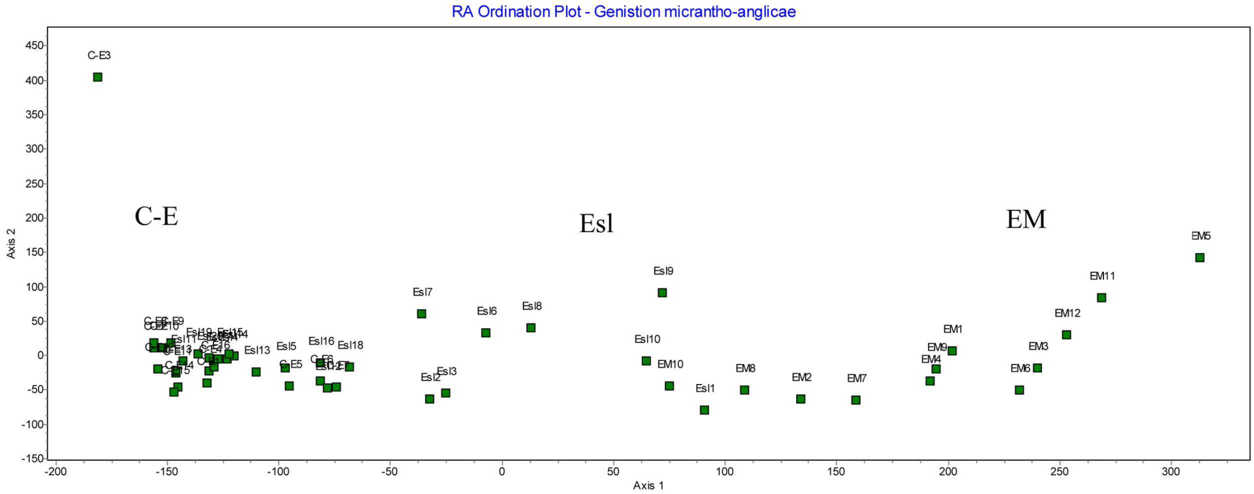

Fig. 4 - RA ordination analysis of the communities EM, Esl and C-E in the alliance *Genistion micrantho-anglicae*.

veral authors for Portugal and the westernmost areas of Spain. The total diversity ranges between 2.16 for C-E15 and 3.05 for C-E2. In all the areas sampled –C-E1 to C-E16, with the exception of C-E13– the value of Shannon_H_Ca < Shannon_H_Co. The diversity of characteristic species ranges from 0.99 for C-E4 to 1.54 for C-E11, while the diversity of companion species is between 1.77 for C-E11 and 2.86 for C-E3. In all cases indicating a dominance of the diversity of companion species compared to the characteristic species in the community, while C-E13 complies with Shannon_H_Ca > Shannon_H_Co, with values of 1.71 and 1.36 respectively. In general terms, it can be seen (Fig. 5) that the mean value of the diversity of companion species far exceeds the diversity of characteristic species.

Applying the mean species abundance values, VmCa can be seen to exceed Vmco in all areas due to a low diversity in characteristic species but high abundance values. *Erica lusitanica* presents abundance-dominance values of 4 and 5, except in C-E14, C-E15 and C-E16, in which this species does not exist, and *Cistus psilosepalus* is present in all these samplings. This fact, together with the high diversity in companion species and low abundance-dominance values, is the cause of the low VmCo values. All this indicates that despite a high diversity of companion species, the degree of conservation is good, as it is always the case that VmCa > VmCo.

The total maximum diversity for the new association proposed, *Ericetum scopario-lusitanicae*, corresponds to Esl10 with a value of 3.08 and a minimum value of

Tab. 5 - Values for Shannon's index and VmCa, VmCo and VmCa-VmCo by association.

Ass.	**Esl1**	**Esl2**	**Esl3**	**Esl4**	**Esl5**	**Esl6**	**Esl7**	**Esl8**	**Esl9**	**Esl10**	**Esl11**	**Esl12**	**Esl13**	**Esl14**	**Esl15**	**Esl16**	**Esl17**	**Esl18**	**Esl19**	**Esl20**	**Vm**
Shannon_H_T	2.31	2.5	2.89	2.03	2.25	2.75	2.42	2.84	2.89	3.08	2.24	2.25	2.79	1.98	2.33	2.26	2.86	2.36	2.25	2.58	2.49
Shannon_H_Ca	1.01	1.54	2.1	1.03	1.08	0.69	0.69	0.69	0.95	1.52	0	0	0	0.67	0	1.04	0	0	0	0.64	0.68
Shannon_H_Co	2	2.04	2.28	1.57	1.93	2.68	2.27	2.74	2.75	2.87	2.14	2.14	2.73	1.68	2.25	1.92	2.82	2.26	2.15	2.46	2.28
Vmca	1.2	1.8	2.3	1	1.2	1.2	1	0.9	1	1.7	0.2	0.3	0.3	0.5	0.5	1.2	0.5	0.4	0.5	0.9	0.93
Vmco	0.22	0.19	0.25	0.13	0.15	0.36	0.24	0.39	0.37	0.41	0.26	0.26	0.44	0.19	0.26	0.19	0.43	0.26	0.25	0.31	0.28
Vmca-Vmco	0.98	1.61	2.05	0.87	1.05	0.84	0.76	0.51	0.63	1.29	0	0.04	0	0.31	0.24	1.01	0.07	0.14	0.25	0.59	0.65

Ass.	**C-E1**	**C-E2**	**C-E3**	**C-E4**	**C-E5**	**C-E6**	**C-E7**	**C-E8**	**C-E9**	**C-E10**	**C-E11**	**C-E12**	**C-E13**	**C-E14**	**C-E15**	**C-E16**	**Vm**
Shannon_H_T	2,76	3,05	2,98	2,76	2,57	2,35	2,58	2,49	2,49	2,321	2,33	2,294	2,22	2,37	2,16	2,93	2,54
Shannon_H_Ca	1,07	1,37	1,03	0,99	1,37	1,37	1,38	1,28	1,28	1,318	1,55	1,268	1,71	1,34	0,68	1,37	1,27
Shannon_H_Co	2,57	2,86	2,83	2,59	2,26	1,9	2,261	2,04	2,15	1,882	1,77	1,934	1,37	1,89	1,92	2,69	2,18
Vmca	2	2	1.83	1.83	3	3	3	2.6	2.6	2.83	3.16	2.50	3	1.83	1.16	1.83	2.66
Vmco	0.83	1.04	0.95	0.79	0.55	0.44	0.59	0.53	0.57	0.44	0.30	0.30	0.18	0.40	0.34	0.91	0,57
Vmca-Vmco	1.17	0.96	0.88	1.04	2.45	2.56	2.41	2.07	2.03	2.39	2.86	2.20	2.82	1.43	0.82	0.92	2.09

Ass.	**EM1**	**EM2**	**EM3**	**EM4**	**EM5**	**EM6**	**EM7**	**EM8**	**EM9**	**EM10**	**EM11**	**EM12**	**Vm**
Shannon_H_T	2.1	2.38	2.18	2.06	2.55	2.32	2.33	2.21	2.43	2.01	2.36	2.38	2.28
Shannon_H_Ca	1.06	1.26	0.69	0	0	1.31	0.64	1.33	0.67	1.52	0.66	0	0.76
Shannon_H_Co	1.67	2	1.93	1.92	2.47	1.87	2.15	1.75	2.28	1.06	2.15	2.29	1.96
VmCa	1.25	2	1.12	0.5	0.5	1.62	1.12	2.25	1.15	2.12	1	0.37	1.12
VmCo	0.55	0.65	0.68	0.71	1.05	0.52	0.71	0.39	0.71	0.23	0.81	0.89	0.65
VmCa-VmCo	0.7	1.38	0.44	-0.21	-0.55	1.1	0.41	1.86	0.44	1.89	0.19	-0.52	0.47

1.98 in Esl14. In the 20 sampling plots Shannon_H_Co > Shannon_H_Ca and Shannon's diversity index is =0, specifically in plots Esl11, Esl12, Esl13, Esl15, Esl17, Esl18 and Esl19, due to the sole presence of *Erica lusitanica* with low abundance-dominance values (Tab. 5). The relation between the characteristic and companion species abundance highlights the low values for VmCa-VmCo for the areas previously mentioned, with negative values for Esl11 and Esl13, indicating that these seven sampled areas have a poor state of conservation (Tab. 5).

The causes of the transformation of some communities into others is due to improper management of the territory, such as the partial drainage of waterlogged areas and excessive grazing pressure.

Conclusions

The study of permanently and temporarily waterlogged areas in the central and western Iberian Peninsula reveals the presence of EU priority habitats 3170* and 4020* and the non-priority habitat 6410, which acts as a transition between the two previous ones. Habitat 3170* includes several plant associations such as *Pulicario uliginosae-Agrostietum salmanticae*, *Junco pygmaei-Isoetetum velati*, *Hyperico humifusi-Cicendietum filiformis*, *Periballio laevis-Illecebretum verticillati*, *Sibthorpio-Pinguiculetum lusitanicae*. Habitat 4020* is represented by three sedge associations included in the alliance *Genistion micrantho-anglicae*, within which we propose the new association *Ericetum scopario-lusitanicae* for less oceanic and more continentalised Portuguese-Extremaduran territories.

The analysis of the diversity and state of conservation of the sampled plots on a global scale for the whole territory shows a positive state of conservation with values of VmCa-VmCo > 0 Figure 5). However, the study of individual plots points to a tendency for sedge communities to become transformed into plant communities of *Molinia caeruelea*, *Juncus acutiflorus*, *Pteridium aquilinum* and *Rubus ulmifolius*.

The analysis of characteristic and companion species diversity reveals the trend in the state of conservation of the plant association, as the characteristic species diversity for some sampling plots is zero, and the diversity of companion species is the same as the total community diversity. This is similar to the assessment of the state of conservation obtained from the relation between VmCa-VmCo, which for these cases is also zero, close to zero, or takes negative values, as in the case of the samples Esl11, Esl13, Esl15, Esl17, Esl18, Esl19, EM4, EM5 and EM12, for example. However, the average Shannon and VmCa values are high, so the state of conservation of the three associations in the sampled territory is acceptable.

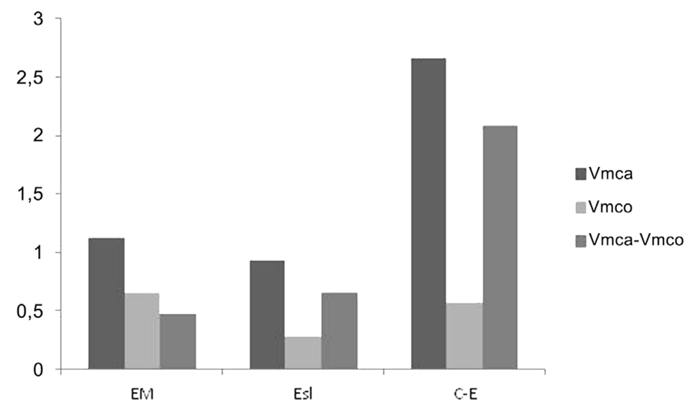

Fig. 5 - Mean values for the three associations studied (Vmca and Vmco).

Syntaxonomic scheme

CALLUNO-ULICETEA Br.-Bl. & Túxen ex Klika & Hadac 1944
ULICETALIA MINORIS Quantin 1935
Genistion micrantho-anglicae Rivas-Martínez 1979
Cisto psilosepali-Ericetum lusitanicae Ladero ex Rivas-Martínez 1979
Erico tetralicis-Myricetum galeae Ladero & A. Velasco in A. Velasco 1980
Ericetum scopario-lusitanicae ass. nova *hoc loco*
Ericion umbellatae Br.-Bl., P. Silva, Rozeira & Fontes 1952
Lavandulo-Ericetum scopariae Rivas-Martínez & Cano 2011

Other syntaxa quoted in the text

Arbuto unedonis-Quercetum pyrenaicae (Rivas Goday, in Rivas Goday, Esteve, Galiano, Rigual & Rivas-Martínez 1960) Rivas-Martínez 1987; *Cicendion* (Rivas Goday in Rivas Goday & Borja 1961) Br.-Bl. 1967; Community of *Molinia caeruleae*; *Doronico plantaginei-Quercetum canariensis* Rivas-Martínez & Cano 2011; *Hyperico humifusi-Cicendietum filiformis* Rivas Goday (1964) 1970; *Hyperico undulati-Juncetum acutiflori* Teles 1970; *Isoeto-Nanojuncetea* Br.-Bl. & Tüxen ex Westhoff, Dijk & Passchier 1946; *Juncion acutiflori* Br.-Bl. in Br.-Bl. & Tüxen 1952; *Junco pygmaei-Isoetetum velati* Rivas Goday 1956; *Lobelio urentis-Lotetum pedunculati* Rivas Goday 1964; *Molinion* *caeruleae* Koch 1926; *Periballio laevis-Illecebretum verticillati* Rivas Goday 1954; *Pistacio terebinthi-Quercetum broteroi* Rivas Goday, in Rivas Goday, Esteve, Galiano, Rigual & Rivas-Martínez 1960; *Preslion cervinae* Br.-Bl. ex Moor 1937; *Pulicario uliginosae-Agrostietum salmanticae* Rivas Goday 1956; *Pyro bourgaeanae-Quercetum broteroi* Cano, García Fuentes, Torres, Pinto, Cano-Ortiz, Montilla, Muñoz, Ruiz & Rodríguez 2004; *Sibthorpio europeae-Pinguiculetum lusitanicae* Ladero & A. Velasco in A. Velasco 1980; *Verbenion supinae* Slavnic 1951.

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Appendix I: Sites in the relevés

Tab. 3 - *Ericetum scopario-lusitanicae* (Esl). Esl1: Bonal de la Teresas, SCI Sierra Morena; Esl2, Esl3: SCI Guadiana and Laderas Vertientes; Esl4, Esl5, Esl6, Esl7, Esl8: SCI Sierra Morena; Esl9, Esl10: Cortijo Robledillo, SCI Sierra Morena. Esl11-Esl15 (Pérez la Torre *et al*., 2002, Tab. 2, relevés 1-5, in Acta Botánica Malacitana 27: 198); Esl16-Esl20 (Quesada, 2010, doctoral thesis “estudio y análisis de la flora, vegetación y paisaje vegetal de las riberas de la provincia de Jaén (S.España): Propuestas para su gestión”).