

Chorology and habitat characterization of *Fritillaria caballeroi* an endemic and threatened species in the Central System (Iberian Peninsula)

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Abstract: Amich, F. & Bernardos, S. *Chorology and habitat characterization of *Fritillaria caballeroi* an endemic and threatened species in the Central System (Iberian Peninsula)*. *Lazaroa* 34: 19-27 (2013).

Fritillaria caballeroi F.M. Vázquez is an endemic threatened plant whose distribution is restricted to the mountains of the western sector of the Central System (Tormantos, Béjar, Francia and Estrela) and the Montes de León. Here we give a detailed description of its distribution in these territories and analyze the different phytocoenoses in which it has become integrated.

Keywords: *Fritillaria caballeroi*, habitat, Central System mountains, plant communities.

Resumen: Amich, F. & Bernardos, S. *Corología y caracterización del hábitat de la liliácea endémica y amenazada *Fritillaria caballeroi* en las montañas del Sistema Central (Península Ibérica)*. *Lazaroa* 34: 19-27 (2013).

Fritillaria caballeroi F.M. Vázquez es una planta endémica y amenazada, cuya distribución está restringida a las montañas del occidente del Sistema Central (Tormantos, Béjar, Francia y Estrela) y Montes de León. Exponemos de manera detallada su distribución en estos territorios, y analizamos las diferentes fitocenosis en las que se integra.

Palabras clave: *Fritillaria caballeroi*, hábitat, montañas del Sistema Central, comunidades vegetales.

INTRODUCTION

The genus *Fritillaria* L. (*Liliaceae*) is distributed across the Northern Hemisphere and, in particular, in temperate zones of Asia, Europe, North Africa and the West of North America (Grove, 1931). The centre of diversification of the taxon could be considered to be in Iran, in the middle of Asia or in the Caucasus (GÜEMES, in press). The number of recognized species in the genus varies, depending on the author, ranging from 50 (KRAUSE, 1930) to almost 100 (MELCHIOR, 1964). In Spain, traditionally five taxa have been addressed (FERNÁNDEZ-ARIAS & DEVESA, 1991a; GÜEMES, in press), although with different taxonomic ranges. One such taxon is the Spanish endemism (*F. legionensis* Llamas & J. Andrés); two species are Iberian endemisms (*F. caballeroi* F.M. Vázquez and *F. stenophylla* Boiss. & Reuter), one en-

demism is Ibero-N. African (*F. lusitanica* Wikstr.) and the remaining species is Franco-Iberian (*F. pyrenaica* L.).

CABALLERO (1948) described *Fritillaria falcata* in the Sierra de Francia (Salamanca), pointing out that it was a very different species from other known species of the genus on the basis of its small size, its falcate leaves and the presence of a single flower. Later RICO (1985) proposed that it would be a form of *F. lusitanica*, indicating that the diagnostic characters are not always present within the same population. In their monographic work of the genus on the Iberian Peninsula FERNÁNDEZ-ARIAS & DEVESA (1991a) subordinate it to a subspecies of *F. nervosa* Willd., above all on the basis of its falcate, longitudinally folded leaves. More recently, VÁZQUEZ (2009) designated it a new name, *F. caballeroi*, owing to the existence of a previous heterotypic

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synonym for a Californian species (BEETLE, 1944). Finally, in Flora Iberica GÜEMES (in press) maintains that denomination of *F. caballeroi*, together with the specific rank for the plant.

Fritillaria caballeroi is considered to be a vulnerable plant (VU), both in the Red Lists of the Flora Vascular Española (VV.AA., 2000; MORENO, 2008), and in the Atlas and Red Book (AMICH & BERNARDOS, 2010), as a result of its reduced geographic distribution and of the continuing decrease in its number of mature plants. This taxon has not yet been assessed by the IUCN Red List (IUCN, 2012). Similarly, the species is catalogued as “Preferential Attention” in the catalogue of Flora Protegida de Castilla y León (ANONYMOUS, 2007). An index record of the plant has been made for Castilla y León and a proposal for a micro-reserve for the plant has been put forwards (AMICH & BERNARDOS, unpub. data), in concordance with the provisions of the Protection Decree for this Community (ANONYMOUS, 2007).

The aims of the present work were: (1) to address in detail the distribution of this endemism in the Sistema Central, and (2) to characterize the habitats of the populations of *F. caballeroi* in the areas where it grows in the Sistema Central and compare the habitats of the different sierras.

MATERIAL AND METHODS

GENERAL INFORMATION ON THE SPECIES INVESTIGATED AND PLANT MATERIAL

Fritillaria caballeroi flowers towards the end of spring (May-June) and fruits in summer (July-August); insect pollinated; seeds dispersed by wind. Its chromosome number is $2n = 24$ (FERNÁNDEZ-ARIAS & DEVESA, 1991b). In the central western part of the Iberian Peninsula, the species grows on siliceous rocks, either granites (Sierras de Béjar, Tormantos and la Estrella) or Armorican quartzes from the Silurian and Devonian (Sierra de Francia).

During the period 2008-2011 we visited most of the localities in the Iberian Peninsula in which *Fritillaria caballeroi* has been reported (Table 1) and we also surveyed other areas thought suitable

for this taxon along the sierras of the Sistema Central, including the Portuguese territories of the Serra da Estrella.

HABITAT CHARACTERIZATION OF *FRITILLARIA CABALLEROI*

This study involved 57 species and 8 relevés, and was performed following the method of BRAUN-BLANQUET (1979). The syntaxonomic nomenclature followed was that suggested by RIVAS-MARTÍNEZ & *al.* (2002) and RIVAS-MARTÍNEZ (2011) and COSTA & *al.* (2012). In the syntaxonomic synopsis of the syntaxa mentioned we also followed the ordering proposals of RIVAS-MARTÍNEZ & *al.* (2002) and RIVAS-MARTÍNEZ (2011), except for the association *Minuartio juresii-Festucetum summilusitanae* (in COSTA & *al.* 2012), described after works of RIVAS-MARTÍNEZ.

The nomenclature used for the taxa of syntaxonomic interest was that of Flora Europaea (TUTIN & *al.*, 1964-1980) and Flora Iberica (CASTROVIEJO, 1986-2012), except for *Festuca summilusitana* subsp. *gredensis* (Fuente & Ortúñez) Rivas-Mart., Fuente & Ortúñez in Itinera Geobotanica 18: 485 (2011), *Jasionis crispata* subsp. *centralis* (Rivas-Mart.) Rivas-Mart. in Anales Inst. Bot. Cavanilles 27:154 (1970), *Minuartia recurva* subsp. *juresii* (Willd. ex Schldtl.) Mattf. in Bot. Jahrb. Syst. 57, Beibl. 126: 31 (1921), and *Silene ciliata* subsp. *elegans* Link ex Brot. in Fl Lusit. 2: 185 (1804).

RESULTS AND DISCUSSION

DISTRIBUTION OF *FRITILLARIA CABALLEROI* IN THE CENTRAL WESTERN IBERIAN PENINSULA

We first reviewed the published data on the distribution of this species and additionally revised some of the main herbaria pertaining to central western Iberia (HVR, COI and SALA). The total number of known localities are shown in Figure 1 and Table 1. In the explorations carried out in these territories we did not note new population nuclei. However, their presence in them cannot be ruled out, owing their extraordinary geomor-

Table 1
Known localities of *Fritillaria caballeroi* in the Central System

Country	Province	Locality	Site	Altitude	UTM coordinates	Geographical coordinates	Voucher	Cited by
Portugal	Beira Alta	Manteigas	Covao d' Ametade	1575	29TQE2065	40° 19.735' N 07° 35.199' W	MA 784248	GÜEMES (in press)
Spain	Ávila	Navalguijo	Sierra de Tormantos	2120	30TTK8155	40° 13.009' N 05° 34.418' W	MAF 135686	SÁNCHEZ-MATA & al. (1991) AMICH & BERNARDOS (2010)
Spain	Ávila	Nava del Barco	Sierra de Tormantos, entre los circos de La Nava y los Caballeros	2180	30TTK8155	40° 13.011' N 05° 34.420' W	MAF 135687	SÁNCHEZ-MATA & al. (1991) AMICH & BERNARDOS (2010)
Spain	Cáceres	Tornavacas	Sierra de Tormantos, Garganta La Serrá	1600	30TTK76	40° 15.533' N 05° 42.273' W	HSS 25160	VÁZQUEZ (2009)
Spain	Cáceres	La Garganta	Sierra de Béjar, Hoya de Moros	2000	30TTK66	40° 15.364' N 05° 49.321' W	HSS 9909/9290B	VÁZQUEZ (2009)
Spain	Salamanca	Candelario	Sierra de Béjar, El Calvitero	2250	30TTK6967	40° 19.296' N 05° 43.130' W	MAF 131481	FERNÁNDEZ-ARIAS & DEVESA (1991a)
Spain	Salamanca	El Cabaco	Sierra de Francia, Peña de Francia	1675	29TQE4088	40° 30.481' N 06° 10.047' W	MA 21354, SALA 79649	MORENO (2002) CABALLERO (1947)
Spain	Salamanca	El Cabaco	Sierra de Francia, Paso de los Lobos	1500	29TQE3988	40° 30.498' N 06° 10.754' W	SALA 77857	FERNÁNDEZ-ARIAS & DEVESA (1991a) FERNÁNDEZ-ARIAS & DEVESA (1991a)
Spain	Salamanca	El Cabaco	Sierra de Francia, cercanías del Collado de Peña Cabra	1575	29TQE3989	40° 31.039' N 06° 10.733' W	---	AMICH & BERNARDOS (2010)
Spain	Salamanca	El Maiflo	Sierra de Francia, Peñas del Corzo	1500	29TQE3890	40° 31.595' N 06° 11.416' W	SALA 13628, 13645, 13646, 13650	RICO (1985)
Spain	Salamanca	Monsagro	Sierra de Francia, cercanías del Collado de Peña Cabra	1575	29TQE3989	40° 31.038' N 06° 10.732' W	---	AMICH & BERNARDOS (2010)

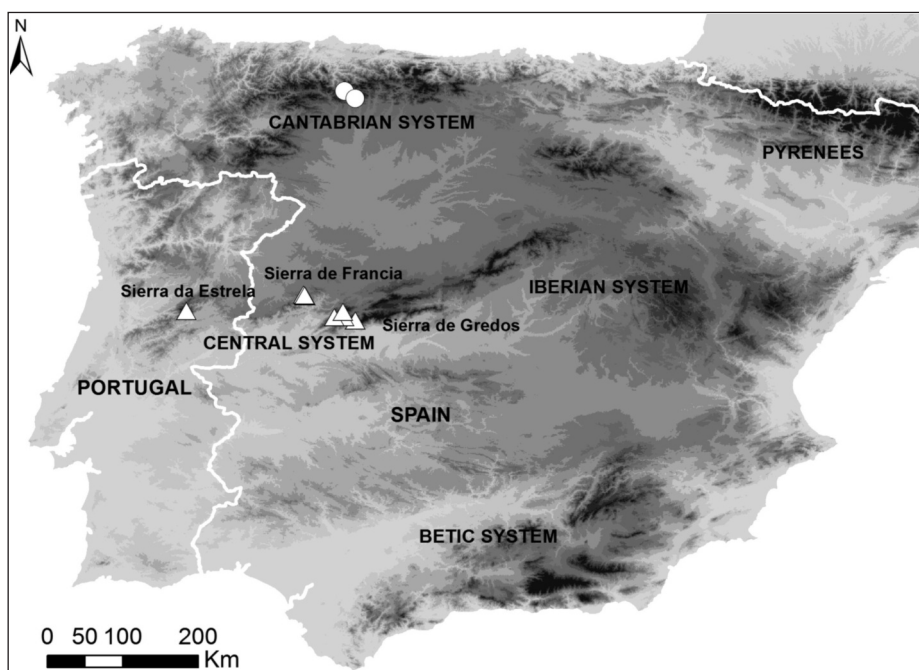


Figure 1. – *Fritillaria caballeroi* in the Iberian Peninsula: circles, Cantabrian mountains; triangles, Central System.

phological complexity, the early phenology of the plant and the existence of favorable ecological conditions for growth.

The citation of *Fritillaria caballeroi* for the Montes de León (PAZ & *al.*, 2011) was later confirmed by GÜEMES (in press).

Thus, *Fritillaria caballeroi* was found to be a narrow endemic of the Orocantabric and Carpetan Leonese subprovinces (Atlantic European and Mediterranean West Iberian provinces, respectively, according to RIVAS-MARTÍNEZ & *al.*, 2002; RIVAS-MARTÍNEZ, 2005, DEL EGIDO & PUENTE, 2011). In the Central System (Carpetan Leonese subprovince) we detected it in the following phytogeographic units: the Tormantino and Bejarano districts (Bejaran Gredensean biogeographical sector), the Altosalmantino district (Salmanticense sector), and the Altoestrelensean district (Estrelensean sector). In the Sistema Central it has two small populations in the sierra de Tormantos; another two small populations in the sierra de Béjar; a single population with small subpopulations scarcely separated by a few tens of metres in the Sierra de Francia, and a single population in the Portuguese Serra da Estrela.

Despite the different toponimies used in the citations referring to the Sierra de Francia, all of them correspond to only three municipalities and 3 squares of 10 x 10 km, which are contiguous (Figure 1, Table 1). The species' altitude range was from 1500 m for the populations in the Sierra de Francia up to 2250 m for the populations of the Sierra de Béjar. The southern and eastern limits of the populations are at 40° 13.009' and 05° 34.418' respectively (Sierra de Tormantos, Ávila), while the northern and western limits are respectively in the Sierra de Francia (40° 31.595') and the Serra da Estrela (07° 35.199').

HABITAT CHARACTERIZATION OF *FRITILLARIA CABALLEROI*

We elaborated a series of 8 relevés (Table 2) in all locales in which *Fritillaria caballeroi* has been cited and at which we had the possibility of confirming its presence.

In the Sierras de Béjar and Tormantos (Table 2, rels. 1-4) *Fritillaria caballeroi* is found in vigorous silicolous, psychrophilous and cryoromediterranean meadows, which prosper on the summit

Table 2

Agrostis rupestris-*Armerietum bigerrensis* (1-4)
(*Minuartio-Festucion curvifoliae*, *Festucetalia indigestae*, *Festucetea indigestae*)

Arenario querioidis-Festucetum gredensis (5-7)

Minuartio juresii-Festucetum summilusitanae (8)

(*Hieracio -Plantaginion radicatae*, *Jasiono sessiliflorae-Koelerietalia crassipedis*, *Festucetea indigestae*)

Altitude (m)	2100	2110	2150	2175	1575	1580	1585	1575
Area (m ²)	40	50	45	45	100	50	75	50
Coverage (%)	50	50	60	55	70	60	50	50
Exposure	N	N	NE	NE	E	E	NE	NE
Inclination (%)	25	20	15	20	10	10	15	10
Relevé number	1	2	3	4	5	6	7	8
Characteristics								
<i>Jasione crispa</i> subsp. <i>centralis</i>	2	3	2	1	.	.	.	.
<i>Armeria caespitosa</i>	1	1	1	2	.	.	.	.
<i>Silene ciliata</i> subsp. <i>elegans</i>	1	+	2	1	.	.	.	.
<i>Leucanthemopsis alpina</i>	1	1	1	+	.	.	.	.
<i>Plantago alpina</i>	1	1	.	+	.	.	.	.
<i>Luzula hispanica</i>	.	+	.	+	.	.	.	.
<i>Agrostis rupestris</i>	.	.	+	.	.	.	.	.
<i>Fritillaria caballeri</i>	+	+	+	+	1	2	1	1
<i>Agrostis delicatula</i>	1	1	+	1	2	1	1	+
<i>Sedum brevifolium</i>	1	1	.	+	1	1	.	1
<i>Festuca rivas-martinezii</i>	.	.	.	.	1	+	1	.
<i>Festuca summilusitana</i> subsp. <i>gredensis</i>	.	.	.	.	.	.	.	1
<i>Arenaria querioides</i>	.	.	.	.	1	2	1	1
<i>Jasione sessiliflora</i>	.	.	.	.	1	2	1	1
<i>Hieracium castellanum</i>	.	.	.	.	2	1	1	+
<i>Leucanthemopsis flaveola</i>	.	.	.	.	2	1	1	.
<i>Armeria salmantica</i>	.	.	.	.	1	1	2	.
<i>Armeria transmontana</i>	.	.	.	.	.	.	.	1
<i>Plantago holosteum</i>	.	.	.	.	1	1	1	.
<i>Koeleria crassipes</i>	.	.	.	.	1	1	.	1
<i>Corynephorus canescens</i>	.	.	.	.	+	1	1	.
<i>Scleranthus perennis</i>	.	.	.	.	1	1	.	.
Companions of <i>Salicetea</i> and <i>Nardetea</i>								
<i>Mucizonia sedoides</i>	1	+	.	+	.	.	.	.
<i>Nardus stricta</i>	+	+	.	+	.	.	.	.
<i>Dianthus gredensis</i>	1	1	.	.	.	.	.	.
Companions of <i>Helianthemetea</i>								
<i>Rumex angiocarpus</i>	.	.	.	.	1	1	1	1
<i>Logfia minima</i>	.	.	.	.	1	1	1	.
<i>Micropyrum tenellum</i>	.	.	.	.	+	1	+	.
<i>Spergula arvensis</i>	.	.	.	.	+	+	1	.
<i>Linaria elegans</i>	.	.	.	.	1	1	.	.
<i>Arnoseris minima</i>	.	.	.	.	1	.	+	.
<i>Cerastium ramosissimum</i>	.	.	.	.	.	1	+	.
Other companions								
<i>Senecio carpetanus</i>	+	+	+	.	.	.	.	.
<i>Dianthus lusitanus</i>	.	.	.	.	1	1	1	1
<i>Arrhenatherum carpetanum</i>	.	.	.	.	1	2	1	.
<i>Luzula lactea</i>	.	.	.	.	1	2	2	.
<i>Avenula pratensis</i>	.	.	.	.	1	2	1	.
<i>Linaria nivea</i>	.	.	.	.	1	2	1	.

Relevé number	1	2	3	4	5	6	7	8
<i>Poa bulbosa</i>	1	1	1	.
<i>Ornithogalum concinnum</i>	2	1	2	.
<i>Gagea lutea</i>	+	1	1	.
<i>Teedalia nudicaulis</i>	+	.	1	1
<i>Sedum hirsutum</i>	1	1	.	.
<i>Jasione montana</i>	1	+	.	.
<i>Cytisus oromediterraneus</i>	+	+	.	.	3	.	.	+
<i>Hyacinthoides non-scripta</i>	1	2	.	.
<i>Arenaria montana</i>	1	1	.
<i>Conopodium majus</i>	+	.	+	.	.	1	1	.
<i>Tulipa sylvestris</i>	1	1	.

Other species: *Pterospartum tridentatum* 3 in 5; *Echinopartum ibericum* and *Halimium alysoides* 2 in 5; *Erica arborea* and *E. australis* 1 in 5; *Orchis champagneuxii* 1 in 6; *Narcissus rupicola* + in 8.

Localities: SPAIN: 1: Ávila, Navalguijo, Sierra de Tormantos, 30TTK8155, 06.06.2008, Amich & Bernardos; 2: *ibidem*, 06.06.2008, Amich & Bernardos; 3: Ávila, Nava del Barco, Sierra de Tormantos, near Circo de La Nava, 30TTK8155, 06.06.2008, Amich & Bernardos; 4: *ibidem*, 06.06.2008, Amich & Bernardos; 5: Salamanca, El Cabaco, Sierra de Francia, near Collado de Peña Cabra, 29TQE3989, 15.05.2008, Amich & Bernardos; 6: *ibidem*, 15.05.2008, Amich & Bernardos; 7: Salamanca, Monsagro, Sierra de Francia, near Collado de Peña Cabra, 29TQE3989, 15.05.2008, Amich & Bernardos. PORTUGAL: 8: Beira Alta, Manteigas, Serra d'Estrella, Covao d'Ametade, 29TPE2065, 25.05.2010, Amich & Bernardos.

zones of high mountains of the Sistema Central (“altioreina” communities) on crests, spurs and rock ledges that receive little snow. These are phytocoenoses with a predominance of caespitoses chamaephytes and are rich in Central Iberian palaeoendemisms, such as *Armeria bigerrensis* subsp. *bigerrensis*, *Jasione crispa* subsp. *crispa*, *Minuartia recurva* subsp. *juresii*, and *Silene ciliata* subsp. *elegans*.

These grasslands belong to the association *Agrostio rupestris-Armerietum bigerrensis*, endemic to the Bejarano-Gredensean, from the Picos de Los Galayos to the Sierra de Béjar (SARDINERO, 1994, 2004; RIVAS-MARTÍNEZ, 2011), which is integrated within the optimum Carpetan alliance *Minuartio-Festucion curvifoliae*. This vegetation is representative of a mature stage of a series of climatophilous vegetation or of a permanent community of a xerophyte site.

By contrast, in the Sierra de Francia (Table 2, rels. 5-7,) *Fritillaria caballeri* is integrated in open pioneer-like grasslands that prosper on shallow, developed siliceous soils, subjected to strong phenomena of cryoturbation, on the Oromediterranean (“oreina” communities), generally on topographic scenarios of crests, steep slopes, or rocky spurs where the accumulation of snow is of little magnitude. This chyonophobic nature means that *F. caballeri* often shows a typically

subrupicolous behaviour. In these grasslands there is a greater predominance of short, and caespitoses hemicryptophytes although the grasslands are also rich in chamaephytes and therophytes. They also have different Iberian or Central Iberian endemisms such as *Arenaria querioides*, *Armeria salmantica*, *Festuca summilusitana* subsp. *summilusitana*, *F. summilusitana* subsp. *gredensis*, and *Jasione sessiliflora*.

These communities lie within the association *Arenario querioidis-Festucetum gredensis*, endemic to the Bejarano-Gredense (SÁNCHEZ-MATA, 1989; SARDINERO, 1994, 2004; SARDINERO & RIVAS-MARTÍNEZ, 1999), although also reaching the Altosalmantino (AMICH & BERNARDOS, 2010), integrated within *Hieracio castellani-Plantaginion radicatae*, an optimum Carpetan phytocoenosis (although also present in the oroiberian and orocantabric areas) like *Minuartio-Festucion*.

In most cases, these grasslands appear in clear areas close to oromediterranean *Cytiso-Echinopartum pulviniformis* broom, forming a regressive replacement stage (herbaceous serial stage) of the sierra broom communities with pulviniform “cambriones”, which form the natural potential vegetation of the Oromediterranean belt of the whole studied territory (RIVAS-MARTÍNEZ & *al.*, 1987; GAVILÁN & *al.*, 2011).

For the Serra da Estrella, MEIRELES (2010) cites *Fritillaria nervosa* subsp. *nervosa* (= *F. pyrenaica* L.), in agreement with the citation of FRANCO & ROCHA AFONSO (in FRANCO 1994), but the Lynnean taxon is not present in Portugal (GÜEMES, in press). *F. caballeroi* (GÜEMES, in press) is found, however, in the Beira Alta (Serra da Estrella). MEIRELES (2010) indicates that *Fritillaria* lives in communities of *Hieracio castellani-Plantaginion radicatae*.

In the Serra da Estrella (Table 2, rel. 8) we have found *F. caballeroi* in communities referable to the recently described association *Minuartio juresii-Festucetum summilusitanae* (COSTA & al., 2012), which replaces the association *Arenario querioidis-Festucetum gredensis* at the western end of the Central System, communities also belonging to the alliance *Hieracio castellani-Plantaginion radicatae*.

In the Montes de León, PAZ & al. (2011) also report it flourishing in silicolous grasslands of *Hieracio-Plantaginion*, and in clearings of heather clumps and groups of *Cytision oromediterranei*.

The habitats of *Fritillaria caballeroi* are clearly different from those occupied by other species of the genus on the Iberian Peninsula. Thus,

F. legionensis preferentially lives in hay meadows, semi-flooded meadows and intensely grazed acidophilous grasslands (“nardetas”) in the Supra- and Orotemperate belts, above all in the alliances *Arrhenatherion* and *Nardion* (LLAMAS & ANDRÉS, 1983; RODRÍGUEZ-ROJO & al., 2012; PAZ & al., 2011). *Fritillaria pyrenaica* is a taxon that is indifferent to the substrate, has a broad ecological distribution, and lives in areas ranging from grasslands and meadows to forest clearings, above all in the supra- and orotemperate storeys (FERNÁNDEZ-ARIAS & DEVESA, 1991a; PAZ & al., 2011). Finally, *F. lusitanica* lives in scrub communities of *Cytisetea* (GAVILÁN & al., 2011), shrubland and forest clearings, ranging from the thermo- to the supramediterranean storey, whereas *F. stenophylla* occurs on palaeodunes and sandy soils in thermomediterranean shrub patches of the alliance *Coremation albi* (FERNÁNDEZ-ARIAS & DEVESA, 1991a).

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SYNTAXONOMIC SCHEME

Communities cited in the text:

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Festucetalia curvifoliae Rivas Goday & Rivas-Martínez ex Rivas-Martínez 1964 corr. Izco & Pulgar 2009

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Agrostio rupestris-Armerietum bigerrensis Rivas-Martínez in Rivas-Martínez, Fernández-González & Sánchez-Mata 1986

Jasiono sessiliflorae-Koelerietalia crassipedis Rivas-Martínez & Cantó 1987

Hieracio castellani-Plantaginion radicatae Rivas-Martínez & Cantó 1987

Arenario querioidis-Festucetum gredensis Rivas-Martínez, Sánchez-Mata & Source in Rivas-Martínez, Fernández-González & Sánchez-Mata 1986 corr. Rivas-Martínez & Sánchez-Mata 2002

MOLINIO CAERULEAE-ARRHENATHERETEA ELATORIS Tüxen 1937

Arrhenatheretalia elatoris Tüxen 1931

Arrhenatherion elatoris Koch 1926

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