

Rupicolous vegetation of the betic ranges (south Spain)

J.F. Mota Poveda¹, F. Gómez Mercado² & F. Valle Tendero³

¹Dpto. Biología Vegetal, Facultad de Ciencias Experimentales, Univ. Granada, Almería-04120, Spain

²Dpto. Biología Vegetal, E.U. Politécnica, Univ. Granada, Almería-04120, Spain ³Dpto. Biología Vegetal, Facultad de Ciencias, Univ. Granada, Granada-18003, Spain

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Abstract

On rupicolous vegetation (cl. *Asplenietea trichomanis*) of the Betic ranges in south Spain. The endemic alliance *Saxifragion camposii* developed in the upper zones of this area is here thoroughly examined. Phytosociological tables with records of all the syntaxa and biogeographical, ecological and floristic data among others are shown. Finally, as a result of a profound syntaxonomical discussion and the last data available the synopsis of this alliance is completed with four new associations: *Hieracio texedensi-Moehringietum tejedensis*, *Athamanto hispanicae-Sideritetum stachydioidis*, *Sileno andryalifoliae-Saxifragetum camposii*, *Jasiono minutae-Saxifragetum rigoi*.

Resumen

Se estudia la vegetación rupícola (cl. *Asplenietea trichomanis*) de las Cordilleras Béticas, emplazadas en el sur de España. En los territorios más elevados de estas se desarrolla la alianza endémica *Saxifragion camposii*, cuya revisión completa se realiza en este trabajo. Se aportan tablas fitosociológicas de todos los sintáxones, así como datos de tipo biogeográfico, ecológico, florístico, etc. Como resultado de una profunda discusión sintaxonómica y con los nuevos datos disponibles, se completa el esquema de la mencionada alianza con cuatro asociaciones nuevas (ver resumen en inglés).

Nomenclature: The taxa names are given according Castroviejo *et al.* (1984, 1990), Greuter *et al.* (1984, 1986, 1989) or Tutin *et al.* (1964–1980), except: *Hieracium texedense* Pau, Mem. Mus. C. Nat. Barcelona (Bot.), 1(1): 54 (1922); *Centaurea mariana* Nyman, Suppl. Syll.: 6, n871 (1961).

If the subspecies are distinguished, the species name is omitted. This concerns the following taxa: *Asplenium trichomanes* subsp. *quadrialeans*, *Anthyllis montana* subsp. *hispanica*, *Crepis albida* subsp. *scorzoneroides*, *Sempervivum tectorum* subsp. *lainzii*, *Bunium alpinum* subsp. *macucae*, *Aquilegia pyrenaica* subsp. *cazorlensis*, *Sisymbrium austriacum* subsp. *hispanicum*, *Sarcocapnos betica* subsp. *integrifolia*, *Moehringia intricata* subsp. *giennensis* and *Jasione foliosa* subsp. *minuta*.

Introduction

An excellent representation of the chasmophytic and calcicole vegetation (*Asplenietea trichomanis*, *Potentilletalia caulescentis*) it to be found in the mountains lands of the south of the Hispanic Peninsula. These communities reach such diversification and floristic richness above 1,500 m. that they become a peculiar alliance by itself: *Saxifragion camposii* Cuatrecasas ex Quézel 1953.

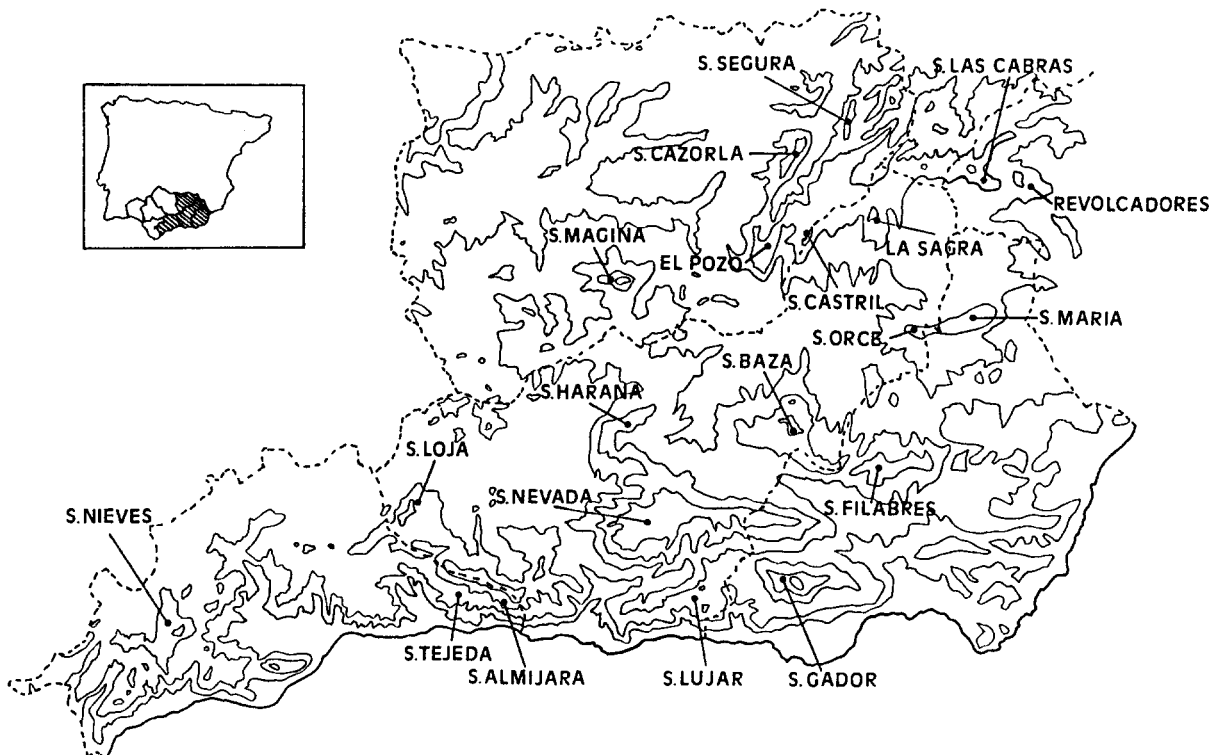
This alliance takes place in the Betic ranges, especially in east Andalucía, and coincides well with the biogeographical division known as the chorological Betic province (Rivas Martínez 1987). Its altitudinal location extends from 1,300–1,500 m., varying with the more or less continental character of the regions, to the highest peaks of a calcareous nature in the south of Spain. The present study is therefore concerned with mountain-living communities, many of the characteristic species of the order occurring in them: *Moehringia giennensis*, *rhamnus pumila*, *Festuca plicata*, *Asplenium ruta-muraria*, *Silene saxifraga*,

Erinus alpinus, *Hieracium elisaeum*, *Anthyllis ramburii*.

The alliance *Saxifragion camposii* was first suggested by Cuatrecasas (1929), but he failed to provide in his work an original and sufficient diagnosis of a type association. Nevertheless, Quézel (1953) published it validly when he described the as. *Kernerio-Teucrietum rotundifolii* and included it in the above mentioned alliance. However, numerous questions on nomenclature and syntaxonomy affecting the alliance and its communities still remain unsolved and demand and inescapable and full review.

Materials and methods

Between 1985 and 1989 phytosociological records were made using the Braun-Blanquet method. After preliminary exploration of the localities, and previous studies in the whole area, vegetation relevés, mapping and ecological analysis and measurements were carried out. The map shows



the territory investigated. By means of a synthetic table, we have compared eight associations included in the *Saxifragion camposii* alliance. The phytocenological and nomenclatural problems of individual communities are treated with reference to the most significant papers and controversial issues.

According to the biogeographical typology of Rivas Martínez (1987), the area studied belongs to the betic province. This territory comprises the sectors: malacitano-almijareense, alpujarreño-gadoreense, guadiciano-bacense, subbético, ron-deño, nevadense and hispalense.

Alliance's associations

Kerneria boissieri-Teucrietum rotundifolii Quézel 1953 nom. inv. (syn. *Saxifrago erioblastae-Teucrietum rotundifolii* Valle 1981) (Tables 1 and 2)

Association located in its optimum development in malacitano-almijareense (S^a Nevada, S^a de Tejada and Almirajara), reaching hardly recognizable the neighbouring S^a de Gádor. Two sub-associations have been described: *anthyllidetosum ramburii* (Valle 1981) Pérez Raya 1987 and *erodietosum daucoidis* (Losa Quintana & Pérez

Table 1. Ass. *Kerneria boissieri-Teucrietum rotundifolii* Quézel 1953 nom. inv.

Nr. order	1	2	3	4	5	6
Altitude (m × 10)	173	168	169	166	190	160
Exposure	N	E	E	NE	O	N
Area (m ²)	4	4	4	2	4	9
Characteristic of the association and alliance						
<i>Teucrium rotundifolium</i>	•	2-2	1-1	1-1	1-1	2-2
<i>Linaria verticillata</i>	1-1	1-1	1-1	•	+	•
<i>Jasione minuta</i>	+	•	•	+	•	•
<i>Potentilla petrophila</i>	+	1-1	1-1	•	•	+
<i>Kerneria boissieri</i>	•	•	•	•	1-1	1-2
<i>Saxifraga erioblasta</i>	+	1-1	•	1-1	•	•
<i>Asplenium quadrivalens</i>	+	•	•	1-2	•	•
Characteristics of order and class						
<i>Sedum dasyphyllum</i>	+	1-1	1-1	2-2	•	+
<i>Campanula velutina</i>	•	1-1	2-2	1-1	•	•
<i>Chaenorhinum villosum</i>	+	+	1-1	1-1	1-1	1-1
<i>Festuca plicata</i>	1-1	•	1-1	•	•	•
<i>Centranthus nevadensis</i>	•	•	+	2-2	•	•
<i>Cystopteris fragilis</i>	+	•	+	•	•	•
<i>Galium frutescens</i>	•	+	1-1	•	•	•
Accompanying						
<i>Brachypodium boissieri</i>	1-1	+	1-1	2-2	1-1•	•
<i>Bunium macuca</i>	+	•	1-1	•	•	•
<i>Crepis scorzoneroides</i>	•	•	1-1	+	•	•
<i>Cerastium boissieri</i>	1-1	•	•	+	•	•

Species in only one relevé present: *Poa ligulata* 1-1, en 1. *Mucizonia hispida* 1-1, *Anthyllis tejedensis* +, en 3. *Draba hispanica* +, *Arenaria grandiflora* +, en 5. *Anthyllis ramburii* 1-1, *Erinus alpinus* 1-1, *Sanguisorba rupicola* +, en 6.

Localities: 1-4. S^a Tejada: Bco. de los Presillejos-Salto del Caballo. 5. S^a Nevada: Dornajo. 6. S^a de Alfacar: Pto. de la Mora.

Table 2. Ass. *Kernerio boissieri-Teucrietum rotundifolii alyssetosum cadevalliani* subass. nova (Holotype: rel. 9).

Nr. de orden	1	2	3	4	5	6	7	8	9	10
Altitude (m × 10)	195	190	187	206	205	192	220	217	200	210
Exposure	NE	NE	N	NE	NE	N	N	N	NE	NE
Area (m ²)	16	8	15	16	9	20	12	15	16	20
Characteristics of association and alliance										
<i>Saxifraga erioblasta</i>	2-2	1-1	2-2	2-2	1-2	1-2	2-2	2-2	2-2	2-2
<i>Linaria verticillata</i>	•	2-2	1-1	1-1	•	•	•	•	2-2	•
<i>Jasione minuta</i>	•	•	•	•	•	•	•	2-2	1-1	•
<i>Teucrium rotundifolium</i>	•	•	•	+	•	1-1	•	•	•	•
Characteristics of order and class										
<i>Hieracium amplexicaule</i>	1-1	1-1	2-2	•	1-1	1-1	2-2	+	1-1	•
<i>Hieracium elisaeum</i>	+	•	1-1	1-1	2-2	1-1	2-3	1-1	1-2	•
<i>Rhamnus pumila</i>	+	2-3	•	2-2	1-1	2-2	2-2	2-2	2-2	•
<i>Festuca plicata</i>	1-1	•	•	2-2	•	1-1	2-2	•	•	1-1
<i>Asplenium quadrivalens</i>	•	+	+	•	•	+	1-1	•	•	•
<i>Asplenium ruta-muraria</i>	•	+	+	•	•	•	1-1	+	•	•
<i>Sedum dasyphyllum</i>	•	1-1	•	2-2	•	1-1	•	•	1-1	•
<i>Ceterach officinarum</i>	1-1	•	+	•	•	•	•	•	+	•
<i>Cystopteris fragilis</i>	•	•	+	•	•	•	1-2	•	•	•
Differ. subassociation <i>alyssetosum cadevalliani</i>										
<i>Alyssum cadevallianum</i>	+	1-1	2-2	1-1	1-1	1-1	2-2	1-1	1-1	1-1
<i>Anthyllis hispanica</i>	2-2	•	•	1-1	•	2-2	•	1-1	1-1	•
Accompanying										
<i>Crepis scorzonoides</i>	1-1	1-1	1-1	1-1	•	+	•	+	+	•
<i>Draba hispanica</i>	1-1	•	1-1	1-1	1-1	1-1	1-1	•	2-2	•
<i>Sempervivum lainzii</i>	1-1	•	1-1	1-2	+	1-1	1-1	+	+	•
<i>Campanula hispanica</i>	1-1	+	•	•	+	+	•	1-1	•	•
<i>Prunus prostrata</i>	+	•	1-1	+	•	•	•	•	•	•
<i>Andryala agardhii</i>	•	•	+	•	•	+	1-1	1-1	+	•
<i>Arenaria grandiflora</i>	•	•	1-1	1-1	1-1	•	•	1-1	1-1	•
<i>Ephedra nebrodensis</i>	•	•	•	+	•	+	•	•	+	•
<i>Bupleurum bourgaei</i>	•	•	•	•	•	•	1-1	•	1-1	1-1
<i>Silene boryi</i>	•	•	•	•	1-1	•	1-1	1-1	•	•

Species in only one relevé present: *Chaenorrhinum crassifolium* 1-1, *Amelanchier ovalis* +, en 2. *Phyteuma charmeli* 2-2, en 5. *Seseli granatense* 1-1, en 8.

Localities: All relevés are situated in the S^a de Baza. 1. Cabecera del Bco. del Relumbre. 2. Calar del Descabezo. 3-6. Calar de la Rapa. 7-9. Calar de Sta. Bárbara. 10. Picón de Gor.

Raya 1981) Pérez Raya 1987. The following must be added to them:

– *alyssetosum cadevalliani* subas. nova (table 2, holotype relevé 9), colonizing the limestone supra- and oromediterranean cliffs in the S^a de Baza (subsector serrano-bacense). It differs

from the typical by the presence of *Alyssum cadevallianum* and *Anthyllis montana*. Likewise it has some aspects in common with the serrano-mariense association *Athamanto-Sideritetum stachydioidis*.

Hieracio texedensi-Moehringietum tejedensis ass. nova (Table 3, holotype relevé 1)

Characteristic association on shady cliffs, always in north or almost north exposure. Replaced by the association *Kernerio-Teucrietum rotundifolii* on dolomitic walls with more pronounced, though not outstanding, sunny exposures. It presents certain ecological affinities with the rupicolous communities where species from the genus *Sarcocapnos* are dominant (both grow in shade).

Clearly defined by two endemic tejedenses species, *Hieracium texedense* and *Moehringia tejedensis*, it was probably more widespread in other climatic epochs of higher humidity. Due to its microclimatic requirements it is very sparse in the S^a de Tejada, where it may be considered a relict nowadays.

Athamanto hispanicae-Sideritetum stachydioidis Rigual, Esteve & Rivas Goday ass. nova (*Centaureo macrorrhizae-Sideritetum stachydioidis sensu Martínez Parras & Peinado 1987 non Rivas Goday & Mayor*) (Tables 4 and 5; holotype: Table 4, relevé 6)

In extremely dry limestone cliffs, especially on south-facing walls in very sunny exposures. Confined to the S^a María, Maimón and S^a de Orce (sector guadiciano-bacense, subsector serranomariense). Its variability is wide enough to contain two subassociations:

– *teucrietosum buxifolii* (typical, Table 4), characteristic of the easternmost part of the serranomariense subsector and the northeastern limits of the chorologic Betic province. Due to its distribution it is highly influenced by the alliance *Teucrion buxifolii* from the east of the Peninsula. Charac-

Table 3. *Hieracio texedensi-Moehringietum tejedensis* ass. nova (Holotype: rel. 1).

Nr. order	1	2	3	4	5	6
Altitude (m × 10)	173	176	166	180	175	176
Exposure	NO	N	N	N	N	N
Area (m ²)	16	8	4	4	16	2
Characteristic of the association and alliance						
<i>Moehringia tejedensis</i>	2–2	1–1	1–1	1–1	+	1–1
<i>Hieracium texedense</i>	+	1–1	1–1	1–1	+	•
<i>Potentilla petrophila</i>	2–2	2–2	2–2	2–2	2–2	2–2
<i>Jasione minuta</i>	1–1	+	1–2	2–2	+	•
<i>Saxifraga erioblasta</i>	+	•	•	•	•	1–1
<i>Linaria verticillata</i>	•	•	1–1	•	•	•
Characteristics of the order and class						
<i>Festuca plicata</i>	•	1–1	•	•	1–1	•
<i>Chaenorhinum villosum</i>	2–2	•	+	•	•	•
<i>Asplenium quadrivalens</i>	+	•	+	•	•	•
<i>Campanula velutina</i>	•	+	•	•	•	•
<i>Sedum dasyphyllum</i>	+	•	•	•	•	•
Accompanying						
<i>Brachypodium boissieri</i>	1–1	1–1	1–1	•	+	•
<i>Bunium macuca</i>	+	+	•	•	•	+
<i>Cerastium boissieri</i>	+	•	•	•	•	•
<i>Poa ligulata</i>	•	+	•	•	•	•

Localities: 1–6. S^a de Tejada: Bco. de los Presillejos-Salto del Caballo.

Table 4. *Athamantho hispanicae-Sideritetum stachydioidis* Rigual, Esteve & Rivas Goday ass. nova (Holotype: rel. 6).

Nr. orden	1	2	3	4	5	6	7
Altitude (m × 10)	140	150	150	151	153	155	155
Exposure	NO	O	N	NO	NO	NO	N
Area (m ²)	4	9	6	16	16	12	9
Characteristics of the association and alliance							
<i>Sideritis stachydioides</i>	1-1	1-1	2-2	1-1	1-1	2-2	1-1
<i>Teucrium buxifolium</i>	+	1-1	1-1	+	1-1	1-1	•
<i>Athamanta hispanica</i>	•	•	+	1-1	2-2	2-2	1-1
<i>Alyssum cadevallianum</i>	+	•	•	+	+	+	1-1
<i>Moehringia intricata</i>	+	•	•	•	+	1-1	•
Characteristics of the order and class							
<i>Silene saxifraga</i>	+	•	1-1	1-1	•	1-1	+
<i>Sedum dasyphyllum</i>	1-1	1-1	+	1-1	•	1-1	+
<i>Festuca plicata</i>	•	•	1-1	+	+	1-1	1-1
<i>Hieracium elisaeaeum</i>	•	•	•	+	+	•	•
<i>Sanguisorba rupicola</i>	+	+	•	•	•	•	•
<i>Ceterach officinarum</i>	+	•	•	•	+	•	•
<i>Rhamnus pumila</i>	•	•	•	+	•	+	•
Accompanying							
<i>Centaurea mariana</i>	+	+	11	•	•	1-1	+
<i>Hypericum ericoides</i>	+	+	•	1-1	1-1	+	•
<i>Crepis scorzonoides</i>	+	•	+	1-1	+	•	+
<i>Galium album</i>	•	+	+	+	•	+	•
<i>Globularia spinosa</i>	•	•	•	+	•	1-1	•

Species present in only one relevé: *Asplenium quadrivalens* 1-1, *Ephedra nebrodensis* +, en 3. *Cerastium boissieri* 1-1, en 4. *Chaenorhinum villosum* 1-1, en 6.

Localities: 1-7. S^a de Maria: Maimón, north slopes.

terized by *Teucrium buxifolium* and *Athamanta hispanica*.

– *teucrietosum rotundifolii* subass. nova (Table 5; holotype: relevé 5), representing the association in its maximum development, above 1,800 m.

Sileno andryaliifoliae-Saxifragetum camposii ass. nova (Table 6; holotype: inv. 2)

Association peculiar to the S^a Mágina (subsector subbético-maginense). Perhaps the most remarkable feature of this association is its floristic combination which comprises diverse subbetic taxa

(*Linaria lilacina*, *Saxifraga camposii*) in addition to others like *Saxifraga erioblasta*, *Silene andryaliifolia*, etc. which tend to occur in contiguous chorologic territories.

Jasiono minutae-Saxifragetum rigoi ass. nova (syn. *Linario lilacinae-Saxifragetum rigoi* Boucher 1982 nom. nud.) (Table 7; holotype: relevé 14)

Despite being restricted to the territories of the S^a de Cazorla, S^a de Segura, S^a de la Sagra, etc. (subsectors cazorlense), it shares with the preceding taxon the subbetic sector. The relationships between them are notable.

Table 5. *Athamanto hispanicae-Sideritetum stachydioidis* Rigual, Esteve & Rivas Goday ass. nova *teucrietosum rotundifolii* subass. nova (Holotype: rel. 5).

Nr. de orden	1	2	3	4	5	6	7	8	9	10
Altitude (m × 10)	188	185	185	186	190	191	195	194	195	196
Exposure	S	S	SE	SO	SE	SE	SO	E	E	E
Area (m ²)	9	25	9	15	12	15	12	16	9	9
Characteristics of the association and alliance										
<i>Sideritis stachydioides</i>	2-2	1-1	1-1	2-2	2-2	1-1	+	2-2	1-1	1-1
<i>Moehringia intricata</i>	1-1	1-1	•	+	+	1-1	•	+	2-2	1-1
<i>Chaenorrhinum villosum</i>	2-2	+	•	1-1	2-2	1-1	1-1	+	+	2-2
Characteristics of the order and class										
<i>Silene saxifraga</i>	1-1	1-1	•	+	+	1-1	•	+	2-2	1-1
<i>Festuca plicata</i>	•	1-1	•	•	1-1	1-1	1-1	1-1	1-1	1-1
<i>Rhamnus myrtifolius</i>	1-1	+	•	•	•	•	2-2	1-1	2-2	2-2
<i>Hieracium laniferum</i>	+	•	•	1-1	•	•	1-1	+	1-1	•
<i>Sedum dasyphyllum</i>	•	1-1	•	1-1	•	•	•	•	•	•
<i>Asplenium quadrivalens</i>	•	•	•	+	•	•	1-1	•	•	•
<i>Ceterach officinarum</i>	1-1	•	•	•	•	+	•	•	•	•
Differ. subassociation										
<i>Teucrium rotundifolium</i>	2-2	1-1	+	2-2	2-2	1-1	2-2	2-2	1-1	1-1
<i>Saxifraga camposii</i>	•	•	•	•	•	•	+	+	•	•
Accompanying										
<i>Centaurea mariana</i>	+	+	1-1	•	1-1	1-1	+	+	+	•
<i>Galium album</i>	•	+	•	•	•	•	1-1	+	1-1	•
<i>Globularia spinosa</i>	1-1	•	+	•	•	1-1	•	+	2-2	+
<i>Hypericum ericoides</i>	1-1	1-1	•	+	•	•	•	+	1-1	+
<i>Crepis scorzonerooides</i>	•	+	+	+	•	+	•	+	+	•
<i>Arenaria grandiflora</i>	•	•	•	•	•	+	1-1	+	•	•
<i>Alyssum spinosum</i>	•	•	•	•	+	1-1	•	+	•	•
<i>Prunus postrata</i>	•	1-1	•	+	+	2-2	•	•	•	•
<i>Seseli granatensis</i>	+	•	•	•	•	+	•	•	1-1	•
<i>Festuca scariosa</i>	•	+	•	•	+	+	•	•	•	•

Species present in only one relevé: *Jasione minuta* 1-1, en 1. *Antirrhinum majus* +, *Helianthemum rosmaessleri* 1-1, *Erodium cheilanthifolium* +, en 6. *Linaria cavanillesi* +, en 7. *Cerastium boissieri* 1-1, en 8.

Localities: 1-10. Cara Sur de la Sierra de Maria.

Rumici indurati-Aquilegium cazorensis Fernández Casas 1972 (Table 8)

Characteristic association of rupicolous rather confined and shady terrains where snow is likely to remain for a long period. For its topographical location this association is placed between the

genuine communities of *Asplenietea trichomanis* and those of *Thlaspietea rotundifolii*. This assumed ecological ambivalence results from its position at the foot of limestone walls where periodical ice occurrences produce boulder slopes through cryofractures, making this habitats easy to colonize by the plants of this association.

Table 6. *Sileno andryalifoliae-Saxifragetum camposii* ass. nova (Holotype: rel. 2).

Nr. order	1	2	3	4	5	6	7	8
Altitude (m × 10)	186	188	192	187	164	164	165	175
Exposure	NE	N	O	N	SE	N	N	NO
Area (m ²)	10	6	9	4	15	9	9	9
Characteristics of the association and alliance								
<i>Silene andryalifolia</i>	1-1	2-2	2-2	2-2	1-1	1-1	1-1	+
<i>Linaria tilacina</i>	+	1-1	•	•	+	1-1	2-2	•
<i>Potentilla petrophila</i>	1-1	2-2	2-2	2-2	+	+	+	1-1
<i>Saxifraga camposii</i>	1-1	1-1	2-2	2-2	•	1-1	•	+
<i>Teucrium rotundifolium</i>	1-1	1-1	+	•	2-2	2-2	•	2-2
<i>Linaria verticillata</i>	•	+	1-1	1-1	•	•	•	•
<i>Saxifraga erioblasta</i>	+	•	•	•	•	•	•	+
<i>Leucanthemum arundanum</i>	•	•	•	+	•	•	•	+
<i>Jasione minuta</i>	•	•	•	+	•	+	•	•
Characteristics of the order and class								
<i>Chaenorhinum villosum</i>	•	•	1-1	•	+	1-1	•	1-1
<i>Campanula velutina</i>	•	•	•	•	2-2	1-1	1-1	1-1
<i>Sedum dasyphyllum</i>	1-1	1-1	1-1	•	•	•	•	•
<i>Silene saxifraga</i>	+	+	•	1-1	•	•	•	+
<i>Festuca plicata</i>	•	•	1-1	•	+	1-1	+	1-1
<i>Hieracium amplexicaule</i>	•	•	•	+	•	1-1	•	1-1
<i>Asplenium quadrivalens</i>	•	+	•	•	•	•	+	+
<i>Cystopteris fragilis</i>	•	•	•	•	•	+	+	•
<i>Hieracium laniferum</i>	•	•	•	+	•	•	•	+
Compañeras								
<i>Galium album</i>	1-1	1-1	1-1	•	•	1-1	•	•
<i>Crepis scorzoneroideis</i>	+	•	+	+	•	1-1	•	•
<i>Bunium macuca</i>	•	•	•	+	•	1-1	+	+
<i>Arenaria grandiflora</i>	+	•	+	•	•	+	•	+
<i>Arenaria alfacariensis</i>	+	+	+	•	•	•	•	+
<i>Erodium cheilanthifolium</i>	+	+	•	•	•	•	•	+
<i>Draba hispanica</i>	1-1	+	•	•	•	•	•	+
<i>Globularia spinosa</i>	1-1	1-1	•	•	•	•	•	•

Species present in only one relevé: *Alyssum spinosum* 1-1, *Thymus gadorensis* +, en 1. *Helianthemum frigidulum* 1-1, *Antirrhinum australe* 1-1, en 2. *Poa ligulata* 1-1, en 9. *Moehringia giennensis* 2-2, en 8.

Localities: All relevés are situated in the Sierra de Mágina: 1-4. Pico Mágina. 5-8. Almadén.

Moehringietum giennensis Fernández Casas 1972 corr. (Table 9)

Similar to the foregoing in its stations, restricted to limestone caves and hollow walls. Its greatest development takes place in the subbetic sectors except for the S^a Mágina and la Sagra.

Sarcocapnetum integrifoliae Fernández Casas & Molero Briones in Fernández Casas 1972 (Table 10)

Cave-living association covering limestone or dolomitic overhangs in the subbetic chorological territory (cazorlense and subbético-magínense subsectors).

Table 7. Jasiono minutae-Saxifragetum rigoi ass. nova (Holotype: rel. 14).

Nr. order	1	2	3	4	5	6	7	8	9	10	11	12	13	14
Altitude (m × 10)	195	193	193	229	229	228	228	200	169	192	192	181	177	183
Exposure	NO	NO	N	NO	N	N	NE	NO	N	N	O	N	O	O
Area (m ²)	16	6	9	4	4	4	9	12	6	4	4	12	8	10
Characteristics of the association and alliance														
<i>Potentilla petrophila</i>	2-2	3-3	2-2	2-2	•	1-1	1-1	2-2	+	+	2-2	2-2	•	2-2
<i>Teucrium rotundifolium</i>	1-1	+	2-2	1-1	+	1-1	•	1-1	2-2	•	1-1	2-2	•	2-2
<i>Saxifraga rigoi</i>	•	•	•	1-1	2-2	1-1	1-1	•	•	2-2	+	1-1	2-2	1-1
<i>Jasione minuta</i>	1-1	+	1-1	+	1-1	1-1	•	1-1	•	1-1	+	•	•	1-1
<i>Kernera boissieri</i>	1-1	1-1	+	•	•	•	•	1-1	•	+	1-1	•	•	•
<i>Linaria lilacina</i>	+	1-1	2-2	•	•	•	•	•	•	1-1	•	•	1-1	•
<i>Saxifraga camposii</i>	2-2	2-2	2-2	•	•	•	•	•	•	•	•	•	2-2	1-1
<i>Anthyllis ramburii</i>	•	1-1	1-1	•	•	•	•	•	•	•	•	•	•	+
Characteristics of the order and class														
<i>Festuca plicata</i>	2-2	1-1	•	1-1	+	1-1	•	•	1-1	2-2	+	1-1	1-1	•
<i>Silene saxifraga</i>	1-1	2-2	+	•	•	•	•	•	+	1-1	+	1-1	•	1-1
<i>Hieracium elisaeanum</i>	1-1	•	+	1-1	•	•	•	1-1	+	•	•	1-1	•	•
<i>Hieracium amplexicaule</i>	1-1	•	•	•	•	•	•	+	2-2	•	•	•	•	•
<i>Moehringia intricata</i>	+	1-1	+	•	•	1-1	•	•	2-2	•	•	•	•	•
<i>Asplenium quadrivalens</i>	+	•	•	•	•	•	•	•	1-1	1-1	•	•	•	•
<i>Rhamnus pumilus</i>	•	1-1	•	•	•	+	1-1	•	•	•	•	•	•	•
<i>Sedum dasyphyllum</i>	•	+	•	•	•	•	•	•	•	+	•	•	2-2	+
<i>Cystopteris fragilis</i>	•	•	•	•	1-1	1-1	•	•	•	2-2	•	•	•	•
Accompanying														
<i>Arenaria grandiflora</i>	•	1-1	+	1-1	1-1	1-1	+	+	•	1-1	•	1-1	1-1	•
<i>Draba hispanica</i>	•	+	1-1	•	+	•	•	•	•	•	•	+	1-1	•
<i>Galium album</i>	•	+	1-1	•	•	•	•	•	•	•	•	•	1-1	•
<i>Bunium macuca</i>	•	•	•	+	•	+	•	•	•	•	•	•	2-2	1-1
<i>Erodium cheilanthifolium</i>	+	•	•	•	•	•	•	•	•	•	•	•	1-1	1-1
<i>Silene boryi</i>	•	2-2	•	•	•	•	•	•	+	•	•	•	2-2	•

Species present in only one or two relevés: *Phyteuma charmelii* 1-1, en 4 y 7. *Alyssum longicaule* 1-1, *Campanula hispanica* 1-1, en 8. *Erinus alpinus* 1-1, en 10. *Hieracium laniferum* 1-1, en 11. *Poa ligulata* 1-1, en 13. *Erinus alpinus* 1-1, *Alyssum reverchonii* +, en 14.

Localities: 1-7. S^a de la Sagra; west face and summit. 8. S^a de Taibilla-Las Cabras. 9. Revolcadores. 10-11. S^a de Castril: Los Tejos. 12. Llanos de Hernán Pelea. 13-14. S^a de la Cabrilla.

Discussion

Despite being the first association described, the *Kernero-Teucrietum rotundifolii* does not include any exclusive taxon although it may easily be distinguished by its floristic combination. Among the rupicolous species the *Centranthus nevadensis* has a prominent position. The wide range of its

distribution allow the recognition of several geographical races or subsociations, one of them, *alyssetosum cadevalliani*, being proposed here as new.

As it has been noted before, the association *Hieracio-Moehringietum tejedensis* stands out for its floristic elements in spite of its sparse occurrences. Both its ecological requirements in north-

Table 8. Ass. *Rumici-Aguilegium cazorlensis* Fernández Casas 1972.

Nr. order	1	2	3
Altitude (m × 10)	198	200	200
Exposure	N	N	SE
Area (m ²)	2	2	2
Characteristics of the association and alliance			
<i>Aquilegia cazorlensis</i>	2-3	3-3	2-2
<i>Geranium cazorlense</i>	2-2	+	•
<i>Moehringia giennensis</i>	2-2	•	•
<i>Saxifraga rigoi</i>	1-1	•	•
<i>Linaria lilacina</i>	•	1-1	•
<i>Potentilla petrophilla</i>	1-1	•	•
Characteristics of the order and class			
<i>Cystopteris fragilis</i>	1-1	2-2	2-2
<i>Asplenium quadrivalens</i>	1-2	•	1-1
<i>Festuca plicata</i>	1-1	•	1-1
<i>Silene saxifraga</i>	•	+	•
<i>Erinus alpinus</i>	•	1-1	•
Accompanying			
<i>Poa trivialis</i>	1-1	1-1	+
<i>Arenaria grandiflora</i>	+	1-1	•
<i>Viola reichenbachiana</i>	•	+	•
<i>Sysimbrium hispanicum</i>	•	•	+

Localities: 1-3. S^a del Pozo: Cabañas.

facing slopes and exposures without direct insolation and the frequent neighbourhood of the *Eucladio-Pinguiculetum vallisneriifoliae* Díaz *et al.* 1982 association account for its relict character.

With regard to the *Athamanto-Sideritetum stachydioidis* association, its inclusion into the alliance *Saxifragion camposii* seems beyond any reasonable doubt. However, the provisional character of the association had not been so far abrogated. Emphasis must be placed on the huge influence played by the alliance *Teucrion buxifolii* on the localities where the relevés were carried out (Rigual *et al.* 1963). To this respect, the occurrence of both *Teucrium buxifolium*, this species not appearing in the original table, and *Athamanta hispanica* is quite significant. The replacement of the this latter alliance by the *Saxifragion camposii* reveals a biogeographical boundary. On the other

Table 9. Ass. *Moehringietum giennensis* Fernández Casas 1972 corr.

Nr. order	1	2	3	4
Altitude (m × 10)	125	130	120	130
Area (m ²)	10	10	10	15
Characteristics of the association				
<i>Sarcocapnos baetica</i>	2-2	2-2	2-2	2-2
<i>Moehringia giennensis</i>	•	•	•	1-2
Characteristics of the alliance, order and class				
<i>Asplenium quadrivalens</i>	1-1	+	1-1	+
<i>Campanula mollis</i>	+	1-1	1-1	+
<i>Silene saxifraga</i>	+	•	1-1	+
<i>Linaria lilacina</i>	•	•	+	+
<i>Erinus alpinus</i>	+	•	•	+
<i>Geranium cataractarum</i>	•	•	•	1-2
<i>Sedum dasyphyllum</i>	•	•	1-1	•
<i>Potentilla petrophilla</i>	•	•	1-1	•
<i>Chaenorhinum villosum</i>	•	•	•	+
Accompanying				
<i>Geranium lucidum</i>	+	•	•	•
<i>Geranium robertianum</i>	•	•	•	+

Localities: 1. Near Nava de San Pedro. 2. Between El Chorro-La Iruela. 3. Nacimiento de Fuente del Tejo. 4. Near Nava de San Pedro.

hand on the south slopes of the S^a María the *Sideritis stachydioides* communities occur at their best at higher elevations, between 1,800 and 2,000 m. In this case there exist an apparent correspondence between the variation of the ecological conditions and the presence of *Teucrium rotundifolium*. In the light of these data a new and more orophilous subassociation may be distinguished. Therefore it seems reasonable to recognize two subassociations: the typical one, which coincides well with that depicted by Rigual *et al.* (1963), and a second one with a higher altitudinal character and genuinely betic.

By no means may the *Centaureo macrorrhizae-Sideritetum stachydioidis* association be regarded as belonging to the *Saxifragion camposii* alliance, though this view has been maintained (Martínez Parras & Peinado 1987: 297). A superficial analysis of the synthetic table given by Rivas Goday and Mayor (1966) suffices to understand that it

Table 10. Ass. *Sarcocapnetum integrifoliae* Fernández Casas & Molero Briones in Fernández Casas 1972.

Nr. order	1	2	3
Altitude (m × 10)	177	193	194
Exposure	O	N	N
Area (m ²)	16	15	9
Characteristics of the association			
<i>Sarcocapnos integrifolia</i>	2-2	2-2	2-2
Characteristic of the alliance, order and class			
<i>Moehringia giennensis</i>	+	1-1	1-1
<i>Teucrium rotundifolium</i>	1-1	1-1	+
<i>Potentilla petrophila</i>	2-2	2-2	•
<i>Kernera boissieri</i>	+	•	•
<i>Silene saxifraga</i>	•	•	+
Accompanying			
<i>Carex hallerana</i>	•	1-1	•

Localities: All relevés are situated in the Sierra de La Sagra, west slope.

was carried out from complex relevés with a predominant presence of taxa included in the order *Erinacetalia anthyllidis* Quézel 1953.

The presence of a rupicolous community with a well-defined identity in the S^a Mágina has been recorded by several authors (Cuatrecasas 1929; Melchior & Cuatrecasas 1935; Rivas Goday 1954) before. Nevertheless no sufficient diagnosis in accordance with the article 7 of the Code of Phytosociological Nomenclature had ever been provided. The present paper aims at overcoming this deficiency by proposing the *Sileno-Saxifragetum camposii* association which has a very original floristic combination though it lacks an exclusive taxon.

In close relation with the preceding community, the association *Jasiono-Saxifragetum rigoi* occurs in the cazorlense territory. In this case some new taxa as *Saxifraga rigoi* and *Kernera boissieri* take place and, on the other hand, other species as *Saxifraga erioblasta* or *Linaria verticillata* are missing.

The association *Linario lilacine-Saxifragetum rigoi* suggested by Boucher (1982) must be taken as a 'nomen nudum' since this author fails to give the

nomenclatural type. In addition, our concept of association is more extensive as far as it comprises the rupicolous community of *Saxifraga camposii* recorded by him in the S^a de la Sagra.

In relation to the *Rumici-Aquilegietum cazorlensis* association no difficulty arises from its inclusion in the class *Asplenieta trichomanis* and more precisely in the alliance *Saxifragion camposii*, in the light of the relevés shown in Table 8. So far its study and taxonomic interpretation has been delayed by its scarce distribution and topographical peculiarities.

We agree with the view distinguishing two associations in the subbetic overhangs: *Sarcocapnetum integrifoliae* and *Moehringietum giennensis*. The first confined to the S^a Mágina, though it penetrates through the boundaries of the subsector Cazorlense; the second, more extensive, occurring throughout the other portion of the subbetic chorological sector. In any case it has been necessary to correct the former name *Moehringietum intricatae* to *Moehringietum giennensis* according to new data available on the genus *Moehringia* provided by Díaz de la Guardia *et al.* 1991).

We accept the associations of shady rock faces. However, the order *Sarcocapnetalia enneaphyllae*, validly described by Fernández Casas (1972), must be rejected. Syntaxonomic problems relating to this order have already been pointed out by Díaz González (1989).

Finally, associations mentioned here are shown in the synthetic Table 11. It comprises the characteristic species of the alliance and all associations. Elaborated with our own data, unless special provision to the contrary be made.

Conclusions

1. The alliance *Saxifragion camposii* comprises eight associations that, on the whole, shape the highlands of the Chorological Betic province.
2. Characteristic species of the alliance are: *Saxifraga camposii*, *Jasione foliosa* subsp. *minuta*, *Potentilla petrophila*, *Kernera boissieri*, *Linaria verticillata*, *Saxifraga erioblasta*, *Linaria*

Table 11. Synthetic table.

	1	2	3	4	5	6	7	8
<i>Centranthus nevadensis</i>	II	•	•	•	•	•	•	•
<i>Moehringia tejedensis</i>	•	V	•	•	•	•	•	•
<i>Hieracium texedense</i>	•	V	•	•	•	•	•	•
<i>Alyssum cadevallianum</i>	(1)	•	II	•	•	•	•	•
<i>Moehringia intricata</i>	•	•	V	•	•	•	•	•
<i>Sideritis stachydioides</i>	•	•	V	•	•	•	•	•
<i>Silene andryalifolia</i>	•	•	•	V	•	•	•	•
<i>Linaria lilacina</i>	•	•	•	III	II	II	III	•
<i>Anthyllis ramburii</i>	•	•	•	•	III	•	•	•
<i>Saxifraga rigoi</i>	•	•	•	•	IV	II	•	•
<i>Aquilegia cazorlensis</i>	•	•	•	•	•	V	•	•
<i>Geranium cazorlensis</i>	•	•	•	•	•	IV	•	•
<i>Sarcocapnos baetica</i>	•	•	•	•	•	•	V	•
<i>Sarcoicapnos integrifolia</i>	•	•	•	•	•	•	•	V
<i>Jasione minuta</i>	I	IV	I	I	IV	•	•	•
<i>Potentilla petrophila</i>	IV	V	(2)	V	IV	II	II	IV
<i>Saxifraga erioblasta</i>	II	II	•	I	•	•	•	•
<i>Linaria verticillata</i>	III	I	•	II	•	•	•	•
<i>Saxifraga camposii</i>	•	•	I	IV	III	•	•	•
<i>Kernera boissieri</i>	II	•	•	•	III	•	•	II

1. *Kernera boissieri*-*Teucrietum rotundifolii* Quézel 1953

2. *Hieracio texedensi*-*Moehringietum tejedensis* ass. nova

3. *Athamanto hispanicae*-*Sideritetum stachydioidis* Rigual, Esteve & Rivas Goday ass. nova

4. *Sileno andryalifoliae*-*Saxifragetum camposii* ass. nova

5. *Jasione minatae*-*Saxifragetum rigoi* ass. nova

6. *Rumici scutati*-*Aquilegietum cazorlensis* Fernández Casas 1972

7. *Moehringietum giennensis* Fernández Casas 1972 corr.

8. *Sarcocapnetum integrifoliae* Fernández Casas & Molero Briones in Fernández Casas 1972

(1) Only in the subassociation *alyssetosum cadevalliani* (Sierra de Baza).

(2) In accord with Rigual *et al.* (1963).

lilacina, *Alyssum cadevallianum*, *Silene andryalifolia* (differ. of the ass.), *Aquilegia cazorlensis* (ass.), *Geranium cazorlense* (ass.), *Sideritis stachydioides* (ass.), *Sarcocapnos integrifolia* (ass.), *Moehringia tejedensis* (ass.), *Hieracium texedense* (ass.).

3. Rupicolous vegetation of the highlands Betic ranges consist of the following syntaxa:

* **ASPLENIETEA TRICHOMANIS** (Br.-Bl. in Meier & Br.-Bl. 1934) Oberdorfer 1977

+ *Potentilletalia cauleccentis* Br.-Bl. in Br.-Bl. & Jenny 1926 (syn. *Sarcocapnetalia enneaphyllae* Fernández Casas 1972 p.p.)

– *Saxifragion camposii* Cuatrecasas ex Quézel 1953

(syn. *Saxifragion camposii* Cuatrecasas in Melchior & Cuatrecasas 1935 nom. nudum; *Sarcocapnion crassifoliae* Fernández Casas 1972 p.p.)

• *Kernera boissieri*-*Teucrietum rotundifolii* Quézel 1953 nom. inv.

teucrietosum rotundifolii

anthyllidetosum ramburii (Valle 1981)

Pérez Raya 1987 (syn. *Saxifrago-Teucrietum rotundifolii* Valle 1981)

erodietosum daucoidis (Losa & Pérez Raya 1981) Pérez Raya 1987

alyssetosum cadevalliani subass. nova

• *Hieracio texedensi*-*Moehringietum tejedensis* ass. nova

• *Athamanto hispanicae*-*Sideritetum stachy-*

dioidis Rigual, Esteve & Rivas Goday ass. nova

(pseudonym. *Centaureo-Sideritetum stachydioidis* sensu Martínez Parras & Peinado 1987 non Rivas Goday & Mayor)

teucrietosum buxifolii (syn. *Athamanto-Sideritetum stachydioidis* Rigual, Esteve & Rivas Goday 1963 nom. nudum)

teucrietosum rotundifolii subass. nova

- *Sileno andryalifoliae-Saxifragetum camposii* ass. nova (syn. *Saxifragetum camposii* Cuatrecasas in Melchior & Cuatrecasas 1935 nom. nudum; asociación de *Saxifraga camposii* y *Linaria lilacina* Rivas Goday 1954 nom. nudum)
- *Jasiono minutae-Saxifragetum rigoi* ass. nova (syn. *Linario lilacinae-Saxifragetum camposii* Boucher 1982 nom. nudum; community of *Saxifraga camposii* Boucher 1982)
- *Rumici scutati-Aquilegietum cazorlensis* Fernández Casas 1972
- *Sarcocapnetum integrifoliae* Fernández Casas & Molero Briones in Fernández Casas 1972
- *Moehringietum giennensis* Fernández Casas 1972 corr. (syn. *Moehringietum intricatae* Fernández Casas 1972)

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References

- Boucher, C. 1982. Contribution a l'étude de la végétation orophile des sierras d'Andalousie calcaire (Espagne). Ecol. Medit. 8(3): 69–85. Marseille.
- Castroviejo, S. & col. (ed.). 1986–1990. Flora Ibérica. Vols. I y II. Real Jardín Botánico. C.S.I.C. Madrid.
- Cuatrecasas, J. 1929. Estudios sobre la flora y vegetación del macizo de Mágina. Trab. Mus. Ci. Nat. 12: 3–510. Barcelona.
- Díaz de la Guardia, C., Mota, J. F. & Valle F. 1991. New taxonomic contributions to the *Moehringia* (*Caryophyllaceae*) genus. Plant Syst. Evolution (en prensa).
- Díaz Gonzalez, T. 1989. Biogeografía y sintaxonomía de comunidades rupícolas (Ensayo preliminar para una revisión de la cl. *Asplenietea trichomanis* en la Península Ibérica, Baleares y Canarias). Ponencia presentada a las IX Jornadas Internacionales de Fitosociología. Alcalá de Henares.
- Fernández Casas, J. 1972. Notas fitosociológicas breves II. Trab. Dep. Bot. Univ. Granada 1: 21–57.
- Greuter, W., Burdet, H. M. & Long C., 1984, 1986 and 1989. Med-Checklist 1,3,4. Genève.
- Martínez Parras, J. M. & Peinado, M. 1987. La vegetación de la al. *Andryalion agardhii* Rivas Martínez 1961. Lazaroa 7: 293–300. Madrid.
- Melchior, H. & Cuatrecasas, J. 1935. La *Viola cazorlensis*, su distribución, sistemática y biología. Cavanillesia 7: 133–148.
- Quézel, P. 1953. Contribution a l'étude phytosociologique et géobotanique que de la Sierra Nevada. Mem. Soc. Brot. 9: 5–82. Coimbra.
- Rigual, A., Esteve, F. & Rivas Goday, S. 1963. Contribución al estudio de la *Asplenietea rupestris* en la región sudoriental de España. Anales Inst. Bot. Cavanilles 20: 129–158. Madrid.
- Rivas Goday, S. 1954. Algunas asociaciones de la Sierra de Callosa de Segura (prov. de Murcia) y consideraciones acerca de la *Potentilletalia mediterránea*. Anales Inst. Bot. Cavanilles 12(1): 469–500. Madrid.
- Rivas Martínez, S. 1987. Memoria del mapa de series de vegetación de España, 1: 400.000, ICONA. Madrid.
- Tutin, T. G. & col. (ed.). 1964–1980. Flora Europaea. Vols. 1–5. Cambridge University Press.