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Dolomitic vegetation of South Spain

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Abstract

Large areas of rather sandy dolomites are to be found in the Betic ranges. In these soils appears a very specialized xerophilous vegetation with a high percentage of endemic species. These communities, grouped into a particular order, *Convolvuletalia boissieri*, are fully reviewed here and consist of the following syntaxa:

ROSMARINETEA Br. Bl. 1947 em. Rivas *et al.* 1991
+ CONVOLVULETALIA BOISSIERI Rivas Martínez, Pérez Raya & Molero Mesa in Pérez Raya 1987 (syn. *Pterocephaletalia spathulati* Rivas Martínez, Pérez Raya & Molero Mesa in Rivas Martínez, A. Molina & G. Navarro 1988).

- ANDRYALION AGARDHII Rivas Martínez 1961
  - Andryalo agardhii-Convolvuletum boissieri Quézel 1953 nom. inv.
    - convolvuletosum boissieri
    - centaureetosum bombycinae subass. nova
    - centaureetosum funkii subass. nova
  - Hippocrepido eriocarpae-Pterocephaletum spathulati (Quézel 1953) Rivas Goday & Mayor 1966 em. Mota & Valle 1992
  - Arenario delaguardiae-Centaureetum bombycinae ass. nova
  - Galio batici-Thymetum granatensis Mota & Valle 1992
  - Helianthemo frigiduli-Pterocephaletum spathulatae Martínez Parras & Peinado 1987
  - Scorzonero albicantis-Pterocephaletum spathulatae Martínez Parras & Peinado 1987
  - Com. de Jasione crispa subsp. segurensis
  - Thymo granatensis-Arenarietum tomentosae Mota & Valle 1991
    - arenarietosum tomentosae
    - pterocephaletosum spathulatae Mota & Valle 1992
  - Com. of Brassica almeriensis and Pterocephalus spathulatus

Resumen: Las áreas de dolomías brechoides se encuentran ampliamente extendidas en las montañas béticas. Sobre ellas se desarrolla una vegetación xerófila muy especializada, en la que se concentra un alto porcentaje de endemismos. Estas comunidades han sido agrupadas en un orden particular, *Convolvuletalia boissieri*, cuya revisión completa abordamos en este trabajo.

Nomenclature: Except for some taxa the present work complies with the nomenclature given in Castroviejo *et al.*, 1990), Greuter *et al.* (1984, 1986, 1989) or Tutin *et al.* (1964–1980). It has not been so only

for *Centaurea boissieri* subsp. *funkii* (Schultz Bip. ex Willk.) G. Blanca, Anales Jard. Bot. Madrid 36: 352 (1980); *Centaurea jaennensis* Degen & Debeaux in Degen, Magyar Bot. Lápok 5(1): 7 (1906); *Helianthemum frigidulum* Cuatrec. in Treb. Mus. Ci. Nat. Barcelona, Ser. Bot., 12: 361 (1929); *Hippocrepis eriocarpa* (Boiss.) Boiss., Diagn. Pl. Orient. ser. 2, 2: 34. 1856; *Jasione crispa* (Pourret) Samp. subsp. *segurensis* Mota *et al.*, Lagascalia 15: 479 (1988); *Odontites longiflora* (Vahl.) Webb. var. *lateritica* Charpin et Fernádez Casas, Candollea, 30(1): 56. 1975; *Scabiosa andryaefolia* (Pau) Devesa, Lagascalia, 12(2): 172. 1984; *Seseli montanum* L. subsp. *granatense* (Willk.) Pardo, Lazaroa, 3: 174 (1981); *Thymelaea tartonraira* (L.) All. subsp. *angustifolia* (Boiss.) Rivas Goday & Esteve, Anales Real Acad. Farm., 38(3): 462 (1972); *Teucrium bicoloreum* Pau ex Vicioso, Bol. Real Soc. Esp. Hist. Nat. 16: 142. 1916 (pro hybr.); *Teucrium leonis* Sennen, Diagn. Nouv.: 35. 1936; *Teucrium lerrouxi* Sennen, Diagn. Nouv.: 226. 1936; *Teucrium similatum* Navarro & Rosúa, Candollea, 45(2): 583. 1990; *Thymus funkii* Cosson var. *sabulicola* R. Morales, Anales Jard. Bot. Madrid, 43 (1986); *Thymus clandestinus* Pau, Actas Soc. Españ. Hist. Nat., 33: 31. 1899.

When subspecies or varieties are distinguished the specific epithet is omitted in the tables. This is the case for the following taxa: *Acinos alpinus* subsp. *meridionalis, Alyssum lapeyrousianum* subsp. *angustifolium, Anthyllis vulneraria* subsp. *argyrophylla, Arenaria armerina* subsp. *caesia, Arenaria tetraquetra* subsp. *murcica, Asperula aristata* subsp. *scabra, Brassica repanda* subsp. *blancoana, Brassica repanda* subsp. *almeriensis, Centaurea boissieri* subsp. *postrata, Dianthus pungens* subsp. *brachyanthus, Erysimum linifolum* subsp. *cazorlense, Helianthemum cinereum* subsp. *rotundifolium, Helianthemum crocceum* subsp. *estevei, Iberis saxatilis* subsp. *cinerea, Leucanthemopsis pallida* subsp. *spathulifolia, Linum suffruticosum* subsp. *jimenezii, Paronychia kapela* subsp. *baetica, Pimpinella tragium* subsp. *lithophila, Thymelaea pubescens* subsp. *Thymus serpyllioides* subsp. *gadorensis.*

Introduction

The order *Convolvuletalia boissieri* Rivas Martínez, Pérez & Molero Mesa in Pérez Raya 1987 comprises creeping or cushion-shaped, dwarf chamaephyte communities specialized in colonizing fractured dolomites. This phytocoenosis combined with its environment presents a peculiar profile. Plants frequently display a sericeous hair-covering and their low crowdedness give prominence to the white colour of the rocks (blanquizares).

As an ecological habitat, these dolomitic sands show well-defined features. Due to their sandy texture, the high permeability of the dolomites and the severe restrictions for the process of edaphogenesis, they become extremely dry environments. From a syndynamic viewpoint there exists a close relationship between these albescent shrubs and the cushion-shaped chamaephytic communities formed by *Echinospartum boissieri* or *Genista longipes*. Either in the clearings of these latter formations, i.e. in areas of a sandy nature on steady bedrock, or in windy crests, the communities of the order occur at their optimum development.

Likewise, certain relations with the therophytic pastures of the al. *Omhalodion commutatae* Rivas Martínez, Izco & Costa corr. on the serpentine-dolomite soils are apparent.

Prior to the creation of the order *Convolvuletalia boissieri*, its sole alliance (*Andryalion agardhii*) had been included into *Erinacetalia anthyllidis*. Nevertheless, the floristic, physiognomic and dynamic singularity of these communities, together with their chorological dispersal – broader than it had been thought before – called for the creation of the order. Furthermore, its assumed exclusive highland character had been rejected already by the most recent surveys (Pérez Raya 1987; Mota & Valle 1992).

Method

The presence of gravelly dolomites is not uncommon in the Betic ranges. In these areas an intense

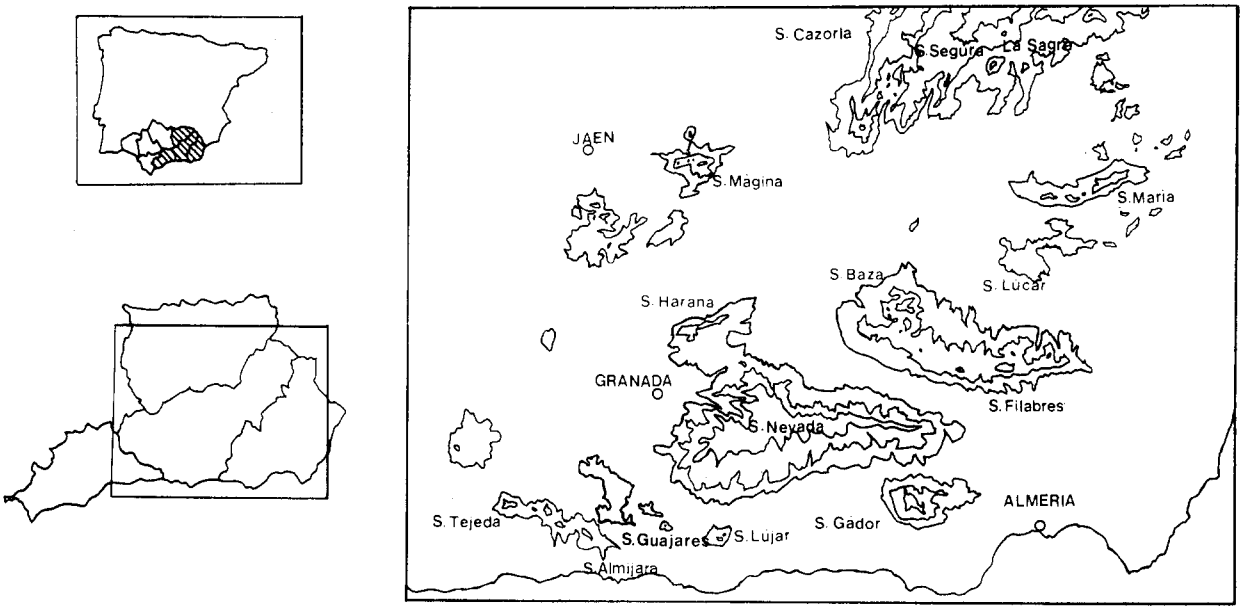

Fig. 1. The Betic Ranges and their location in South Spain.

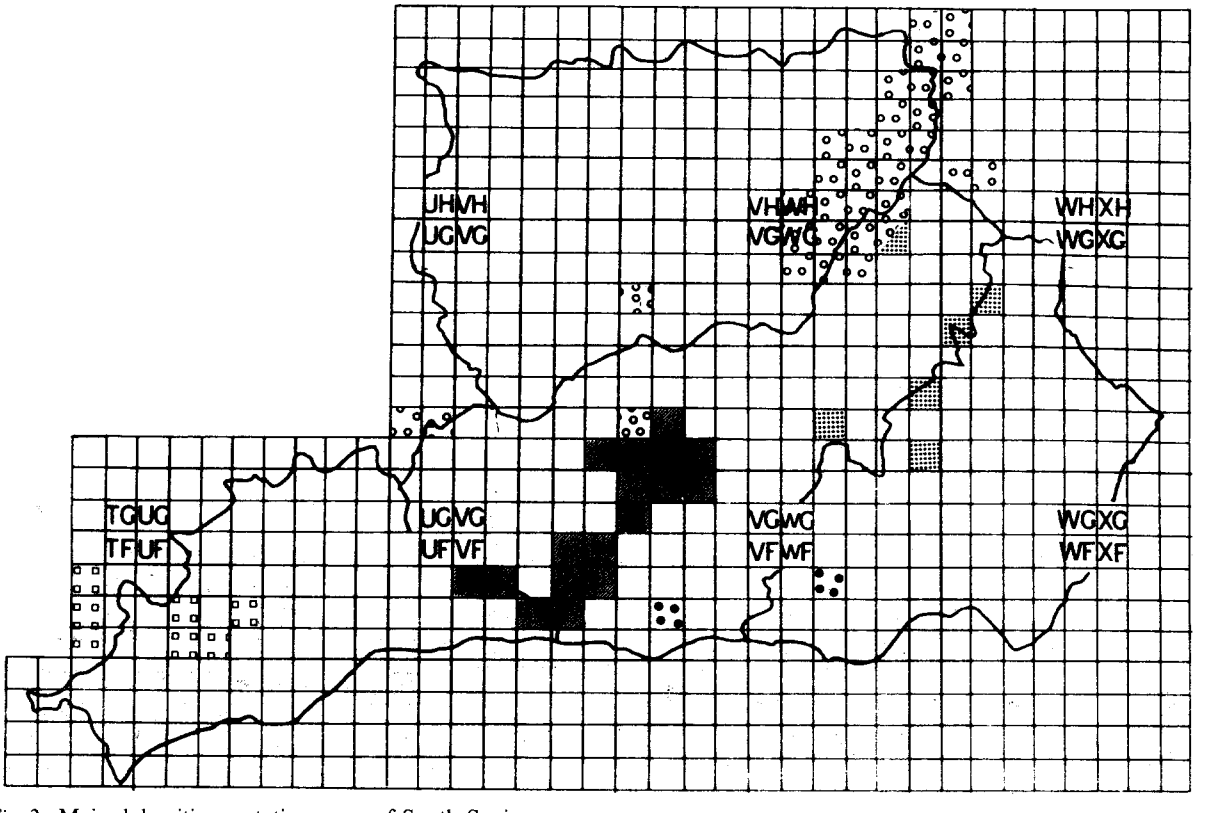

Fig. 2. Main dolomitic vegetation areas of South Spain:

Dolomites of Subbético Sector; Dolomites of Malacitano-Almijarense sector; Dolomites of Rondeño sector

Dolomites of Guadiciano-bacense sector; Dolomites of Alpujarreño-gadorense sector

Table 1. As. *Andryalo agardhii-Convolvuletum boissieri* Quézel 1953 nom. inv. subas. *convolvuletosum boissieri.*

No order	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
Altitude (m x 10)	180	180	181	182	192	185	186	160	146	150	143	204	202	145	153	148
Exposure	NO	SE	NE	N	E	S	NO	NO	NO	NE	N	NO	S	O	NO	NE
Inclination (°)	35	35	20	45	15	45	20	45	10	45	45	30	5	10	15	35
Area (m^2)	16	25	10	15	16	20	25	25	20	16	12	12	15	16	25	25
Characteristics of the association																
Helianthemum pannosum	2–2	2–2	2–2	2–2	2–2	1–1	1–1	1–1	1–1	.	.	.	.	1–1	1–1	2–2
Scabiosa pulsatilloides	2–2	2–2	2–2	2–2	2–2	1–1	.	.	2–2	.	.	.	.	.	.	.
Erodium boissieri	1–2	1–1	.	+	.	+	.	2–2	+	+	2–2	.	.	.	.	.
Helianthemum estevei	.	.	.	.	.	.	.	.	.	2–2	+	.	.	.	1–1	1–1
Characteristics of alliance and order																
Thymus granatensis	2–2	2–2	2–2	2–2	2–3	2–3	2–2	2–2	2–2	2–2	1–1	1–1	2–2	2–2	2–2	1–1
Convolvulus boissieri	+	3–3	1–1	1–1	1–1	+	2–2	.	2–2	.	.	2–3	2–3	2–2	2–2	2–2
Santolina elegans	2–2	1–1	2–2	3–3	2–2	1–1	2–2	2–2	+	.	.	.	.	.	.	.
Anthyllis argyrophylla	1–1	1–1	1–1	1–1	1–1	+	2–2	.	1–1	.	.	1–1	1–1	1–1	1–1	1–1
Rothmaleria granatensis	+	1–1	1–1	.	1–1	.	1–1	.	+	.	1–1	.	.	1–1	.	.
Arenaria caesia	1–1	.	1–1	+	1–1	.	1–1	.	1–1	1–1	1–1	+	1–1	2–2	2–2	1–1
Anthyllis tejedensis	.	.	1–1	.	+	2–2	.	.	.	1–1	.	.	.	.	+	2–2
Thymelaea angustifolia	.	+	.	.	1–1	1–1	.	.	.	+	1–1	.	.	+	.	+
Brassica latisilicua	1–1	1–1	+	.	.	.	+	.	.	.	.	.	.	.	1–1	1–1
Pterocephalus spathulatus	.	.	.	.	.	.	.	.	.	2–2	2–2	.	.	.	.	.
Characteristics of class																
Asperula scabra	+	1–1	1–1	1–1	1–1	1–1	+	1–1	+	+	+	1–1	1–1	.	+	+
Fumana ericoides	+	1–1	1–1	.	1–1	1–1	.	.	+	+	1–1	.	1–1	1–1	1–1	.
Dianthus brachyanthus	+	+	+	1–1	1–1	2–2	+	.	1–1	+	+	1–1	.	1–1	+	.
Erinacea anthyllis	+	+	1–1	1–1	1–1	2–2	2–2	+	+	.	.	2–2	1–1	.	.	.
Sideritis virgata	2–2	1–1	+	2–2	1–1	2–2	.	.	.	.	.	.	.	.	1–1	1–1
Thymelaea elliptica	1–1	+	+	+	+	.	.	.	+	.	+	1–1	1–1	.	.	.
Coris monspeliensis	+	+	1–1	.	+	+	.	.	+	.	.	.	.	+	+	.
Alyssum montanum	+	1–1	1–1	.	.	.	+	+	.	+	1–1	.	.	.	.	.
Alyssum serpyllifolium	.	.	+	.	.	.	+	+	+	+	.	.	.	+	.	.
Accompanying																
Brachypodium boissieri	2–2	1–1	2–2	.	1–2	1–2	2–2	.	2–2	1–2	1–1	.	1–1	2–2	2–2	2–2
Trisetum velutinum	2–2	2–2	+	.	+	2–2	1–1	.	1–1	.	.	1–1	+	.	1–1	1–1
Centaurea granatensis	1–1	+	.	1–1	+	+	.	+	+	.	.	+	1–1	.	+	+
Teucrium turdetanum	+	+	+	.	+	+	+	.	+	.	.	+	+	.	.	.
Echium albicans	+	.	+	1–1	+	+	.	.	+	.	+	.	.	1–1	.	.
Helianthemum crocceum	1–1	1–1	1–1	.	1–1	+	.	+	+	.	.	.	.	.	.	
Jurinea humilis	+	+	+	1–1	1–1	.	1–1	.	+	+	+	.	.	.	.	.
Avenula gervaisii	1–1	+	1–1	.	.	.	+	.	.	+	+	.	.	.	.	.
Sedum gypsicola	.	.	.	.	+	+	1–1	.	+	+	1–1	.	.	+	.	.
Koeleria humilis	.	+	1–1	1–1	.	.	+	.	.	.	.	1–1	2–2	.	.	.
Poa ligulata	.	+	+	.	.	.	+	.	1–1	.	.	.	.	2–2	+	2–2
Odontites longiflora	.	.	.	.	+	+	.	.	+	.	.	1–1	.	+	.	.
Silene bory	.	.	+	+	.	.	.	1–1	.	.	.	.	.	.	.	.

In addition: *Stipa pennata* 1–1, in 2. *Helianthemum rotundifolium* 1–1 and *Stipa pennata* 1–1, in 3. *Vella spinosa* +, *Echinospartum boissieri* +, in 4. *Ulex parviflorus* +, in 6. *Alyssum longicaule* 1–1, *Stipa pennata* +, *Saxifraga erioblasta* +, in 7. *Saxifraga erioblasta* + and *Helianthemum rotundifolium* 1–1, in 9. *Lavandula lanata* +, in 10. *Helianthemum piliferum* +, *Fumana procumbens* +, in 11. *Alyssum longicaule* +, *Echinospartum boissieri* +, in 12. *Seseli granatense* 1–1, in 13. *Helianthemum rotundifolium* 2–2, *Ulex parviflorus* + and *Cistus clusii* +, in 14. *Cistus clusii* + and *Arenaria murcica* +, in 15. *Ulex parviflorus* + and *Juniperus phoenicea* +, in 16.

Localities: 1–6. The slopes of Trevenque. 7. Collado Ruquino. 8–11. Arroyo Huenes. 12–13. Collado de las Sabinas. 14–16. S^a del Manar. All the relevés are situated in Sierra Nevada.

tectonic activity has taken place, producing the grinding of the rock. The full review of the *Convolvuletalia boissieri* communities occurring here had led us to study a broad territory in the south of Spain (Figs. 1 and 2).

More than 300 relevés using the phytosociological sigmatiste method have been carried out, some of them being offered in this work. Each of the associations and communities incorporated into the order is analysed from a floristic, phytocoenological and nomenclatural point of view. Finally, the work deals with some aspects concerning the preservation of these communities. We adopt the biogeographical typology suggested by Rivas Martínez (1987).

Description of the communities

Andryalo agardhii-Convolvuletum boissieri Quézel 1953 nom. inv.

The association promoted the creation of the all. *Andryalion agardhii* and the description of new communities. Its wide dispersal and variants have concealed its true identity (Mota & Valle 1992). It extends throughout the calcareus-dolomitic rim of S[a] Nevada (sector Malacitano-Almijarense, subsector Alfacarino-Granatense) where three associations may be recognised:

1. *convolvuletosum boissieri:* Showing an extraordinary floristic richness on the Trevenque's slopes, it presents less vigour in El Dornajo and the S[a] del Manar. Among the species best characterizing the type, subassociation stress must be placed on: *Helianthemum pannosum, Scabiosa pulsatilloides* and *Erodium boissieri* (Table 1).
2. *centaureetosum bombycinae* nova: Preluding, as a transitional stage, the association *Arenario-Centaureetosum bombycinae* (Table 2, rel. 2 holotype).
3. *centaureetosum funkii* nova: occurring in the outer zones of the subsector Alfacarino-Granatense, next to the subbetic territories. *Pterocephalus spathulatus* is frequently dominant here, *Centaurea boissieri* subsp. *funkii* and *Alyssum lapeyrousianum* subsp. *angustifolium* standing as its differential taxa Table 3 rel. 15 holotype).

Table 2. As. *Andryalo agardhii-Convolvuletum boissieri* Quézel 1953 nom. inv. *centaureetosum bombycinae* nova (Holotype: rel. 2).

No order	1	2	3
Altitude (m x 10)	135	135	141
Exposure	NO	N	NO
Inclination (°)	20	20	20
Area (m^2)	9	16	20
Characterisitics of the association, all. and ord.			
Arenaria caesia	1–1	1–1	1–1
Helianthemum stevei	1–1	2–2	2–2
Thymelaea angustifolia	+	+	2–2
Rothmaleria granatensis	2–2	2–2	.
Anthyllis tejedensis	.	.	2–2
Thymus granatensis	2–2	2–2	2–2
Convolvulus boissieri	3–3	2–2	+
Brassica latisiliqua	1–1	+	.
Chaenorrhinum degenii	.	1–1	+
Anthyllis argyrophylla	.	+	1–1
Characteristics of the class			
Coris monspeliensis	+	+	+
Fumana ericoides	+	.	+
Alyssum serpyllifolium	.	+	+
Asperula scabra	.	+	+
Dianthus brachyanthus	+	.	+
Helianthemum rotundifolium	2–2	.	2–2
Fumana procumbens	+	.	+
Lithodora fruticosa	+	+	.
Differ. subass.			
Centaurea bombycina	1–1	1–1	1–1
Accompanying			
Brachypodium boissieri	2–2	2–2	2–2
Helictotrichon velutinum	2–2	+	.
Poa ligulata	2–2	+	1–1
Centaurea granatensis	+	+	+
Jurinea humilis	1–1	1–1	1–1
Carex hallerana	2–2	1–1	+
Seseli granatense	2–2	+	.
Koeleria humilis	1–1	+	.
Paronychia suffruticosa	+	.	1–1
Odontites longiflora	+	.	+
Echium albicans	.	.	+
Trisetum velutinum	.	1–1	.
Sedum gypsicola	.	.	+

Localities: 1–3. S[a] del Manar.

Hippocrepido eriocarpae-Pterocephaletum spathulati (Quézel 1953) Rivas Goday & Mayor 1966 em It shares with the foregoing the sectors Malacitano-Almijarense, but in this case, restricted to the Sierras of Tejeda and la Almijara (subsector Almijarense). *Arenaria erinacea* and *Helianthemum viscidulum* isolate it from the latter. Related to the association *Arenario-Centaureetum bomby-*

Table 3. As. *Andryalo agardhii-Convolvuletum boissieri* Quézel 1953 nom. inv. *centaureetosum funktii* subass. nova (Holotype: rel. 15).

No order	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Altitude (m x 10)	133	135	140	125	125	140	144	144	145	146	142	142	144	149	146
Exposure	NE	O	NE	NO	NO	N	–	SE	–	O	NO	–	NE	NO	N
Inclination (°)	40	45	45	30	10	15	–	10	–	5	5	–	5	35	25
Area (m^2)	20	16	9	12	25	20	15	25	25	30	16	16	15	25	30
Characteristics of the association, all. and ord.															
Arenaria caesia	1–1	2–2	2–2	1–1	1–1	1–1	2–2	1–1	1–1	2–2	1–1	1–1	1–1	1–1	2–2
Rothmaleria granatensis	.	+	.	1–1	.	.	2–2	.	1–1	1–1	2–2	2–2	2–2	1–1	.
Anthyllis tejedensis	2–2	.	.	.	.	1–1	.	.	.	+	.	.	1–1	.	.
Pterocephalus spathulatus	3–3	2–2	3–3	2–2	2–2	.	2–2	.	.	2–2	2–2	3–3	2–2	2–2	2–2
Yhumus granatensis	2–2	2–2	.	.	.	2–2	2–2	2–2	2–2	2–2	2–2	2–2	2–2	2–2	3–3
Anthyllis argyrophylla	+	.	.	.	1–1	.	.	+	+	1–1	1–1	2–2	1–1	+	+
Convolvulus boissieri	.	.	.	.	.	3–3	.	2–2	2–2	.	.	.	2–2	.	+
Characteristics of class (and other units of *Rosmarinetea*)															
Helianthemum canum	.	.	2–2	2–2	2–2	2–2	.	2–2	2–2	2–2	2–2	2–2	2–2	2–2	2–2
Sideritis virgata	.	.	.	1–1	2–2	.	1–1	2–2	1–1	1–1	2–2	2–2	2–2	2–2	2–2
Alyssum serpyllifolium	+	1–1	1–1	1–1	1–1	1–1	1–1	+	.	1–1	.	.	.	+	+
Asperula scabra	+	+	.	.	+	.	+	1–1	.	1–1	1–1	1–1	1–1	.	+
Erinacea anthyllis	.	.	1–1	.	2–2	1–1	1–1	+	+	.	2–2	2–2	2–2	2–2	1–1
Dianthus brachyanthus	+	1–1	+	+	+	1–1	.	.	.	+	.	.	.	.	+
Helianthemum piliferum	.	+	2–2	.	1–1	+	.	.	.	1–1	+	1–1	.	1–1	.
Fumana ericoides	.	1–1	.	2–2	2–2	.	.	.	.	.	.	.	.	.	2–2
Paronychia aretioides	.	2–2	.	+	.	.	.	1–1	+	.	+	1–1	+	.	.
Thymus orospedanus	.	.	+	1–1	2–2	.	.	.	+	.	.	.	.	.	.
Lavandula lanata	2–2	.	.	1–1	.	.	+	.	+	.	.	.	.	.	.
Rosmarinus officinalis	.	+	+	.	.	.	.	+	.	1–1	.	.	.	.	.
Helianthemum rotundifolium	2–2	.	2–2	.	.	2–2	.	.	.	.	.	.	.	.	.
Thymelaea elliptica	+	1–1	.	+	.	+	+	.	.	.	.	.	.	.	.
Ulex parviflorus	+	.	.	2–2	.	.	.	.	+	.	.	.	.	1–1	+
Cistus clusii	.	+	.	+	+	1–1	.	.	.	.	.	.	.	.	.
Differ. subassociation															
Centaurea funkii	.	1–1	+	1–1	1–1	.	+	1–1	.	1–1	+	.	+	+	1–1
Alyssum angustifolium	1–1	.	.	.	.	2–2	3–3	2–2	2–2	.	2–2	1–1	1–1	1–1	2–2
Hippocrepis eriocarpa	2–2	.	+	.	.	1–1	.	.	1–1	.	.	.	.	.	.
Accompanying															
Poa ligulata	1–1	1–1	1–1	1–1	1–1	+	1–1	+	+	+	.	1–1	1–1	+	1–1
Centaurea granatensis	1–1	+	1–1	.	.	+	1–1	+	+	1–1	1–1	1–1	+	1–1	+
Erysimum myriophyllum	.	.	2–2	.	.	.	.	1–1	+	.	1–1	1–1	1–1	+	1–1
Helictotrichon velutinum	1–1	+	+	.	+	2–2	1–1	.	1–1	1–1	1–1	.	1–1	1–1	1–1
Avenula gervaisii	.	1–1	.	.	.	+	+	+	+	1–1	.	1–1	+	+	+
Jurinea humilis	.	.	.	1–1	1–1	.	1–1	2–2	1–1	1–1	+	.	1–1	1–1	+
Corynephorus canescens	.	.	2–2	+	.	.	.	+	.	1–1	.	.	+	+	+
Brachypodium boissieri	2–2	2–2	1–2	2–2	2–2	.	.	.	.	.	.	.	.	.	.
Koeleria humilis	.	.	.	.	+	1–1	1–1	1–1	1–1	.	.	.	.	.	.
Andryala ragusina	.	+	+	+	.	.	.	+	.	1–1	.	.	.	.	.
Sedum gypsicola	.	2–2	+	+	.	.	+	.	.	.	.	.	.	.	+
Santolina canescens	+	1–1	.	.	.	+	+	.	+	.	.	+	.	.	.

In addition: *Trisetum velutinum* 2–2, *Globularia spinosa* +, *Aethionema saxatile* 1–1, *Linar aeruginea* +, *Paronychia suffruticosa* +, in 1. *Trisetum velutinum* 1–1, *Echium albicans* 1–1 in 2. *Echium albicans* + *Linaria aeruginea* +, in 4. *Coris monspeliensis* 1–1, in 6. *triset velutinum* 1–1, in 14.
Localities: All relevés are situated in the Sierra de la Peza (S[a] Nevada)

Table 4. As. *Arenario delaguardiae-Centaureetum bombycinae* nova (Holotype: rel. 3).

No order	1	2	3	4	5	6	7	8	9	10	11	12	13	14
Altitude (m x 10)	123	125	127	125	117	117	110	980	105	105	120	120	121	122
Exposure	NO	SE	NO	N	NO	NO	O	NE	SE	E	NE	NE	NE	S
Inclination (°)	15	5	45	45	10	15	45	45	50	25	5	10	20	5
Area (m^2)	20	25	30	16	14	18	12	16	15	20	20	20	20	20
Characteristics of the association														
Centaurea bombycina	1–1	2–2	2–2	1–1	2–2	3–3	2–2	1–1	2–2	2–2	3–3	2–2	3–3	3–3
Thymelaea angustifolia	.	1–1	+	+	.	.	+	+	.	2–2	.	.	1–1	2–2
Arenaria delaguardiae	2–2	.	2–2	2–2	2–2	2–2	2–2	2–2	.	.	.	.	2–2	1–1
Characteristics of the alliance and order														
Helianthemum viscidulum	2–2	2–2	2–2	2–2	2–2	2–2	1–1	1–1	.	.	2–2	2–2	2–2	.
Rothmaleria granatensis	2–2	1–1	+	+	.	.	1–1	.	1–1	.	1–1	.	1–1	2–2
Hippocrepis eriocarpa	.	.	1–1	.	.	.	.	.	2–2	2–2	1–1	+	.	.
Anthyllis tejedensis	.	.	.	.	.	.	.	.	+	2–2	.	1–1	.	.
Arenaria caesia	.	2–2	.	.	.	.	1–1	.	.	.	2–2	2–2	.	.
Thymus granatensis	+	.	2–2	3–3	.	1–1	.	+	1–1	.	2–2	1–1	1–1	2–2
Brassica blancoana	.	1–1	1–1	.	.	.	.	.	2–2	1–1	.	.	.	1–1
Anthyllis argyrophylla	+	.	.	.	.	2–2	.	.	.	.	+	+	.	1–1
Characteristics of the class (and other units of *Rosmarinetea*)														
Ulex parviflorus	+	1–1	.	+	1–1	+	1–1	1–1	1–1	.	1–1	2–2	2–2	2–2
Sideritis virgata	.	.	1–1	1–1	.	2–2	1–1	+	2–2	1–1	1–1	.	2–2	.
Avenula gervaisii	1–1	+	+	.	1–1	.	1–1	+	2–2	1–1	.	1–1	1–1	.
Thymus longiflorus	1–1	+	+	.	2–2	.	+	.	2–2	2–2	+	.	.	+
Dianthus brachyanthus	1–1	.	+	1–1	2–2	.	1–1	.	1–1	.	+	1–1	1–1	.
Coris monspeliensis	1–1	.	+	.	.	.	+	.	1–1	1–1	.	.	1–1	+
Lavandula lanata	+	+	.	1–1	+	.	.	1–1	.	.	.	+	.	.
Teucrium similatum	1–1	+	1–1	.	.	1–1	.	.	.	.	1–1	.	.	.
Armeria filicaulis	1–1	.	.	.	.	2–2	.	+	.	.	.	.	+	+
Asperula scabra	1–1	1–1	.	.	.	.	.	.	.	+	.	.	+	+
Fumana ericoides	1–1	.	.	.	.	.	+	.	2–2	2–2	.	.	+	2–2
Cistus clusii	+	+	1–1	.	.	.	.	.	+	+	.	+	.	.
Rosmarinus officinalis	+	.	.	1–1	.	.	+	.	.	1–1	2–2	+	.	.
Accompanying														
Brachypodium boissieri	2–2	1–1	1–1	2–2	2–2	2–3	2–2	2–2	2–2	2–2	2–2	1–1	2–2	2–2
Reseda almijarensis	.	.	.	.	.	.	1–1	1–1	+	.	+	.	1–1	+
Trisetum velutinum	.	2–2	1–1	2–2	1–1	2–2	.	.	.	.	1–1	.	.	.
Carex hallerana	.	+	1–1	1–1	+	.	.	.	.	1–1	2–2	+	2–2	2–2
Stipa offneri	1–1	+	.	.	.	.	.	.	.	.	+	.	.	1–1
Andryala ragusina	.	.	+	.	+	2–2	.	.	.	.	.	1–1	.	.
Helianthemum crocceum	1–1	.	.	.	1–1	1–1	.	.	.	.	.	.	2–2	.
Seseli granatense	.	.	+	.	.	.	.	.	.	.	+	2–2	+	.
Sedum gypsicola	1–1	.	+	.	+	.	.	.	.	.	.	1–1	.	.

In addition: *Fumana thymifolia* 1–1, *Echinospartum boissieri* 1–1, in 3. *Helictotrichon velutinum* 1–1, in 5. *Centaurea granatensis* 2–2, in 7. *Centaurea granatensis* 1–1, *Andryala integrifolia* 2–2, in 8. *Aphyllanthes monspeliensis* 1–1, in 9. *Helianthemum rotundifolium* 1–1, in 10. *Echinospartum boissieri* 1–1, in 13. *Aphyllantes monspeliensis* 1–1 and *Echinospartum boissieri* 1–1, in 14.

Localities: 1. S[a] de Albuñuelas. 2. S[a] de los Güajares: Cerro Cañuelo. 3–4. S[a] de los Güajares: Pto. de La Lata. 5–7. S[a] de los Güajares: Ctjo. del Humo/Bco. del Cañuelo. 8. S[a] de los Güajares: Bco. de la Cruz Chiquita. 9–10. S[a] de los Güajares: Alto de los Bojes. 11–14. S[a] de la Almijara: Arroyo de las Golondrinas.

cinae (see below) from which it differs ecologically and by the absence of species as *Arenaria delaguardiae* and *Centaurea bombycina.*

Arenario delaguardiae-Centaurectum bombycinae nova

Peculiar to the subsector Almijarense, where it replaces the foregoing in foothill territories and less mountainous lands as S[a] de los Güajares and Cázulas. Orophilous elements such *Pterocephalus spathulatus* or *Convolvulus boissieri*, dominant in the two preceding associations, are absent here (Table 4, rel. 3 holotype).

Table 5. As. *Arenario delaguardiae-Centaureetum bombycinae.*

No order	1	2	3	4	5	6	7	8	9	10
Altitude (m x 10)	110	112	114	106	110	120	135	140	132	131
Exposure	N	O	E	NE	SE	N	N	N	O	NO
Inclination (°)	45	25	10	30	20	15	15	25	10	10
Area (m^2)	9	9	16	9	9	4	9	9	9	4
Characteristics of the association										
Centaurea bombycina	1–1	2–2	3–3	3–3	3–3	2–2	3–3	3–3	2–2	2–2
Arenaria delaguardiae	.	.	.	2–2	+	2–2	1–1	1–1	2–2	1–1
Characteristics of the alliance and order										
Thymus granatensis	.	.	.	2–2	2–2	2–2	.	.	.	.
Brassica blancoana	.	.	.	.	+	1–1	1–1	.	.	.
Anthyllis argyrophylla	.	.	+	.	1–1	.	+	.	.	+
Helianthemum viscidulum	1–1	2–2	1–1	2–2	2–2	2–2	2–2	2–2	2–2	2–2
Rothmaleria granatensis	.	.	.	2–2	1–1	.	2–2	2–2	.	.
Hippocrepis eriocarpa	.	1–1	.	2–2	.	.	2–2	2–2	.	.
Anthyllis tejedensis	3–3	3–3	2–2	.	.	.	+	.	.	.
Thymelaea angustifolia	.	+	.	+	1–1	+	.	.	.	.
Characteristics of the class										
Thymus longiflorus	+	1–1	+	.	.	.	1–1	1–1	.	+
Dianthus brachyanthus	+	1–1	2–2	+	+	.	1–1	.	+	.
Sideritis virgata	.	.	.	2–2	2–2	1–1	1–1	1–1	.	.
Rosmarinus officinalis	.	.	.	.	1–1	+	.	1–1	.	.
Teucrium homotrichum	.	.	.	1–1	.	+	.	.	2–2	+
Coris monspeliensis	.	1–1	.	.	.	+	.	.	1–1	+
Armeria filicaulis	1–1	.	2–2	2–2	.	.	.	.	1–1	+
Asperula scabra	.	.	1–1	.	.	+	.	.	+	1–1
Fumana ericoides	1–1	.	.	.	2–2	.	.	.	+	.
Ulex parviflorus	.	.	.	+	.	.	.	1–1	1–1	1–1
Cistus clusii	.	.	.	.	.	.	.	1–1	2–2	2–2
Accompanying										
Brachypodium boissieri	2–3	2–2	2–2	2–2	+	1–2	2–2	2–2	2–2	2–2
Avenula gervaisii	.	.	1–1	1–1	1–1	.	.	.	.	.
Reseda almijarensis	+	.	.	+	+	.	.	.	.	.
Carex hallerana	.	.	.	.	1–1	1–1	2–2	2–2	.	.
Andryala ragusina	2–2	2–2	.	1–1	.	.	.	.	+	.
Helianthemum crocceum	.	2–2	.	.	.	.	2–2	2–2	.	.

In addition: *Corynephorus canescens* 2–2, *Iberis saxatilis* +, in 1. *Echium albicans* 1–1, *Alyssum serpyllifolium* 2–2, *Stipa tenacissima* +, in 2. *Corynephorus canescens* 1–1, *Thymus mastichina* +, *Echium albicans* +, in 3. *Lavandula lanata* 1–1, *Thymus mastichina* +, in 4. *Linum jimenezii* +, *Trisetum velutinum* 1–1, *Stipa offneri* 1–1, in 5. *Arenaria caesia* 1–1, in 7. *Trisetum velutinum* 1–1, *Seseli granatense* 1–1, *Helictotrichon velutinum* 1–1, in 8. *Iberis saxatilis* 1–1, *Paronychia suffruticosa* 1–1, *Centaurea granatensis* +, in 9. Localities: 1–2. S[a] de la Almijara: Llanos de la Plancha. 3. S[a] de la Almijara: Loma del Aguila. 4–5. S[a] de la Almijara: Ctjo. Cabañeros. 7–8. S[a] de la Almijara: Between Navachica and the ctjo. de Cabañeros. 9–10. S[a] de La Pera: Cuesta de la Novia.

Galio baetici-Thymetum granatensis Mota & Valle 1992

Located outside the Malacitano-Almijarense territory and floristically poorer, its resemblance to the previous one stands beyond any doubt. It is present in the S[a] de las Nieves and probably in Grazalema (sector Rondeño). Relevés shown in this work were made in the series of pinsapos (*Abies pinsapo*). Since a table of the association has been published we just reproduce the type

relevé (Mota & Valle, 1992): *Thymus granatensis* 2–2, *Arenaria erinacea* 3–3, *Jurinea pinnata* 1–1, *Helianthemum canum* 2–2, *Asperula scabra* 1–1, *Teucrium similatum* 1–1, *Ulex baeticus* 1–1, *Koeleria vallesiana* 2–2, *Scabiosa grossi* 1–1.

Thymo granatensis-Arenarietum tomentosae Mota & Valle 1992

Restricted to the S[a] de Baza (sector Guadiciano-Bacense) and characterized by the endemism *Arenaria tomentosa*. We transcribe the type relevé (Mota & Valle, 1992): *Arenaria tomentosa* 2–2, *Thymus granatensis* 2–2, *Jurinea pinnata* 3–3, *Anthyllis argyrophylla* 2–2, *Helianthemum rotundifolium* 2–2, *Asperula scabra* +, *Alyssum longicaule* 1–1, *Bupleurum spinosum* +, *Sedum gipsicola* +, *Fumana ericoides* +, *Helianthemum lavandulifolium* 1–1, *Rosmarinus officinalis* 1–1, *Linum suffruticosum* 1–1, *Cistus clusii* 1–1, *Teucrium bicoloreum* +, *Seseli granatense* 2–2, *Koeleria vallesiana* +, *Carex hallerana* 1–1, *Avenula gervaisii* +. As it happens with regard to the other dolomitic communities, the increase of quarries has changed drastically the localities where this association might be found. The building of new highways has encouraged extractions, even inside the Parque Natural of the S[a] de Baza. This new circumstance should lead to the adoption of measures aiming at the safeguard of the richest localities of this association. Along with the highland pine forest and the locality of Prados del Rey, the blanquizares of this sierra stand as botanical places of the greatest importance.

In the neighbouring S[a] de los Filabres, in crests, spurs and rocky calcareus-dolomitic terrains, a community related with the association *Thymo-Arenarietum tomentosae*, in its variant form with *Pterocephalus spathulatus*, take place. Until a complete study of the guadiciano-bacense dolomites be carried out, we prefer not to assign the status of association to it (Table 6).

Helianthemo frigiduli-Pterocephaletum spathulati Martínez Parras & Peinado 1987

Endemic association of the Macizo de Mágina (sector Subbético, subsector Subbético-Maginense), extensive and splendidly represented in the heights known as S[a] de Huelma. It is worth noting that in the original description, taxa as characteristic, relevant and frequent as *Alyssum lapeyrousianum* subsp. *angustifolium, Lithodora nitida, Brassica repanda* subsp. *latisiliqua*, etc. are missing.

Although no subassociation has so far been recognized in the oromediterranean level it becomes richer with the presence of *Arenaria alfacariensis* (Table 7).

Scorzonero albicantis-Pterocephaletum spathulati Martínez Parras & Peinado 1987

As it may be inferred from the localities recorded in the tables, the dispersal of this association is remarkably wide, since it extends throughout the subbetic sector (subsectors Cazorlense and Alcaracense). Due to the peculiar character of this area the association displays a great variability, though no subassociation may be distinguished separately.

Table 6. Com. de *Brassica almeriensis* and *Pterocephalus spathulatus*.

No order	1	2	3	4	5	6
Altitude (m x 10)	198	199	198	197	198	199
Exposure	S	–	NO	SO	S	O
Inclination (°)	30	–	10	15	30	10
Area (m^2)	1	6	8	6	9	8
Characteristics of the com., all., ord. and class						
Pterocephalus spathulatus	2–2	1–1	1–1	1–1	1–1	3–3
Brassica almeriensis	1–1	+	+	1–1	1–1	1–1
Anthyllis argyrophylla	1–1	2–2	1–1	2–2	1–1	1–1
Jurinea pinnata	.	2–2	2–2	3–3	3–3	2–2
Fumana ericoides	2–2	3–3	2–2	2–2	2–2	2–2
Helianthemum rotundifolium	.	1–1	1–1	2–2	1–1	1–1
Helianthemum canum	.	1–1	.	1–1	.	1–1
Sedum gypsicola	+	+	+	.	.	.
Paronychia aretioides	.	.	.	+	+	.
Asperula scabra	+	.	+	.	.	.
Accompanying						
Festuca hystrix	1–1	2–2	2–2	1–1	2–2	1–1
Genista longipes	2–2	2–2	2–2	2–2	2–2	2–2
Seseli granatense	.	1–1	1–1	2–2	1–1	1–1
Arenaria armerina	.	1–1	+	1–1	.	1–1
Odontites longiflorus	.	1–1	2–2	.	+	1–1
Teucrium similatum	+	+	.	.	+	.
Helictotrichon filifolium	2–2	.	.	.	1–1	.
Avenula gervaisii	.	.	.	1–1	1–1	.
Carex hallerana	+	.	.	.	+	.
Lavandula lanata	.	.	.	+	+	.
Thymus gadorensis	+	.	.	.	.	.

Localities: 1–6. S[a] de los Filabres: Calar del Gallinero.

Table 7. As. *Helianthemo frigiduli-Pterocephaletum spathulatae* Martínez Parras & Peinado 1987.

No order	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Altitude (m × 10)	143	144	145	146	147	148	149	148	155	156	157	159	159	206	207
Exposure	E	NE	N	E	O	S	NO	N	O	O	O	SO	O	S	SE
Inclination (°)	10	10	10	30	5	10	15	5	10	15	5	15	15	10	15
Area (m^2)	9	16	25	25	16	16	12	16	16	15	25	16	16	9	16
Characteristics of the association															
Lithodora nitida	2–2	1–1	+	1–2	1–3	1–1	.	+	.	2–2	1–1	1–1	.	.	.
Helianthemum frigidulum	.	.	.	.	.	.	+	.	1–1	+	+	2–2	+	.	.
Characteristics of the alliance and order															
Convolvulus boissieri	2–2	2–2	2–2	3–3	2–2	1–1	2–2	2–2	3–3	1–1	2–2	2–2	2–2	+	1–1
Pterocephalus spathulatus	3–3	3–3	3–3	3–3	3–3	2–2	3–3	3–3	2–2	2–2	3–3	1–1	.	.	.
Hippocrepis eriocarpa	2–2	1–1	1–1	1–1	2–2	1–1	+	2–2	2–2	2–2	1–1	1–1	2–2	2–2	2–2
Alyssum angustifolium	1–1	1–1	+	1–1	+	1–1	1–1	1–1	+	1–1	+	+	.	.	.
Thymus clandestinus	2–2	2–2	1–1	.	.	2–2	.	.	.	.	.	.	+	1–1	2–2
Viola cazorlensis	.	.	.	.	.	.	1–1	.	.	1–1	1–1	+	.	.	.
Arenaria alfacariensis	.	.	.	.	.	.	.	.	.	.	.	.	.	2–2	2–2
Anthyllis argyrophylla	.	.	.	+	.	+	1–1	+	+	.	1–1	+	.	1–1	1–1
Brassica latisilicua	.	.	1–1	.	.	+	+	2–2	.	.	.	.	.	.	.
Characteristics of the class (and other units of *Rosmarinetea*)															
Fumana ericoides	2–2	2–2	2–2	2–2	2–2	2–2	2–2	2–2	1–1	2–2	2–2	1–1	.	.	.
Echinospartum boissieri	2–2	2–2	1–1	2–2	+	+	.	.	.	1–1	2–2	+	2–2	.	.
Thymus orospedanus	.	.	2–2	+	+	.	+	1–1	2–2	1–1	+	1–1	2–2	.	.
Sideritis virgata	2–2	1–1	2–2	2–2	2–2	2–2	+	1–1	+	1–1	+	.	.	.	.
Arenaria armerina	1–1	1–1	2–2	+	1–1	2–2	1–1	2–2	2–2	+	+	.	.	.	.
Teucrium angustifolium	1–1	+	1–1	+	+	+	1–1	1–1	1–1	+	+	.	+	+	.
Globularia spinosa	2–2	.	.	+	.	.	1–1	1–1	1–1	+	+	.	.	.	.
Asperula scabra	.	.	.	1–1	+	+	.	.	.	+	.	.	.	1–1	1–1
Helianthemum rotundifolium	.	.	+	+	1–1	1–1	1–1	1–1	.	.	.	.	.	.	.
Alyssum serpyllifolium	.	+	+	.	+	.	.	1–1	1–1	.	.	.	.	+	.
Helianthemum canum	.	.	.	.	.	.	+	+	+	+	.	.	+	2–2	2–2
Accompanying															
Koeleria humilis	1–1	1–1	.	+	2–2	1–1	1–1	1–1	2–2	1–1	+	1–1	1–1	.	.
Carex hallerana	1–1	2–2	2–2	2–2	2–2	2–2	2–2	2–2	2–2	2–2	2–2	1–1	1–1	.	.
Seseli granatense	1–1	1–1	1–1	1–1	1–1	1–1	+	2–2	+	+	1–1	1–1	.	2–2	1–1
Centaurea granatensis	1–1	+	1–1	+	.	1–1	+	1–1	1–1	+	+	.	+	.	.
Jurinea humilis	+	1–1	1–1	.	+	+	+	1–1	1–1	+	.	1–1	.	.	.
Odontites longiflora	+	+	1–1	1–2	+	+	.	+	+	.	1–1	.	+	.	.
Avenula gervaisii	1–1	1–1	1–1	+	1–1	1–1	.	1–1	.	.	.	.	.	.	.
Helictotrichum velutinum	.	.	.	1–1	1–1	.	1–1	2–2	.	1–1	1–1	+	2–2	.	.
Stipa pennata	.	.	.	.	.	+	+	.	.	1–1	+	.	.	.	.
Polygala rupestris	.	.	.	1–1	1–1	+	+	+	+	.	.	.	.	.	.

In addition: *Dianthus brachyanthus* +, *Paronychia aretioides* 1–1, *Aphyllanthes monspeliensis* +, *Ulex parviflorus* 1–1, in 5. *Rosmarinus officinalis* 1–1, *Lavandula latifolia* 1–1, in 6. *Pimpinella lithophylla* 1–1, *Dianthus brachyanthus* +, in 9. *Genista longipes* 1–1, in 10. *Erinacea anthyllis* 1–1, in 13. *Plantago granatensis* 1–1, *Thymelaea granatensis* +, in 15.

Localities: 1–13. Sierra de Mágina: Cañada de las Cruces. 14–15. Sª de Mágina: Pico Mágina.

Relevés have been arranged in three tables according to their provenance and regardless of any further criterion (Tables 8–10).

Community of Jasione crispa subsp. segurensis

In the foothills of the S de Segura and, in general, in the outer subbetic territory, there appears a community headed by *Jasione crispa* subsp. *segurensis*, which may be related to the preceding one. Occasionally *Thymus funkii* var. *sabulicola* has occurred in association with these phytocoenosis. Perhaps a more exhaustive inquiry of the area could lead to the creation of a new association in the future.

Table 8. As. *Scorzonero albicantis-Pterocephaletum spathulatae* Martínez Parras & Peinado 1987.

No order	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
Altitude (m x 10)	196	196	198	200	202	180	215	200	193	194	204	146	145	145	160	160
Exposure	–	E	E	SE	S	NE	SO	SO	E	N	SO	O	E	–	NO	O
Inclination (°)	–	10	25	5	15	15	15	15	5	5	10	10	5	–	15	20
Area (m^2)	16	9	12	6	4	4	9	25	25	16	25	9	9	12	20	25
Characteristics of the association																
Scorzonera albicans	1–1	2–2	2–2	1–1	2–2	.	1–1	.	.	1–1	1–1	2–2	2–2	2–2	.	.
Alyssum baeticum	.	.	.	.	.	1–1	.	1–1	+	.	.	2–2	1–1	2–2	2–2	2–2
Leucantemopsis spathulifolia	.	.	.	.	.	.	.	+	.	.	.	1–1	1–1	1–1	2–2	1–1
Plantago asperrima	.	.	.	.	.	.	.	.	.	.	.	.	.	.	2–2	2–2
Characteristics of the alliance and order																
Convolvulus boissieri	2–2	2–2	2–2	2–2	2–2	2–2	3–3	2–2	3–3	3–3	2–2	.	.	.	.	.
Anthyllis argyrophylla	.	+	1–1	1–1	.	.	2–2	.	1–1	1–1	1–1	.	.	.	.	.
Thymelaea granatensis	1–1	1–1	1–1	1–1	1–1	.	.	.	1–1	2–2	.	.	.	.	.	.
Fumana paradoxa	1–1	2–2	.	+	1–1	.	.	.	.	.	.	.	.	.	.	.
Viola cazorlensis	+	1–1	1–1	+	.	.	.	.	.	.	.	.	.	.	.	.
Paronychia aretioides	+	.	.	.	.	.	.	.	1–1	.	.	.	.	.	.	.
Paronychia baetica	.	.	.	.	.	.	+	.	.	+	+	.	.	.	.	.
Santolina elegans	.	.	.	.	.	.	2–2	.	.	1–1	.	.	.	.	.	.
Globularia spinosa	.	.	.	.	.	1–1	.	.	.	.	.	+	.	+	.	.
Characteristics of the class (and other units of *Rosmarientea*)																
Silene legionensis	+	1–1	1–1	2–2	.	.	.	2–2	+	.	1–1	.	+	.	1–1	
Helianthemum canum	2–2	2–2	2–2	1–1	2–2	2–2	2–2	2–2	2–2	2–2	1–1	.	.	.	.	.
Arenaria armerina	1–1	2–2	.	1–1	+	.	.	+	2–2	.	+	1–1	1–1	+	.	.
Teucrium leonis	+	.	+	+	1–1	1–1	+	1–1	1–1	+	+	.	1–1	.	.	.
Erinacea anthyllis	.	+	1–1	.	1–1	+	1–1	2–2	1–1	1–1	.	+	.	.	.	1–1
Scabiosa andryalifolia	+	.	.	.	+	.	.	.	.	+	+	.	.	.	.	.
Thymus gadorensis	1–1	.	.	+	.	.	.	.	.	.	+	.	+	+	.	.
Arenaria murcica	1–1	.	2–2	.	+	.	1–1	.	1–1	2–2	+	.	.	.	.	.
Asperula scabra	+	.	1–1	+	1–1	.	.	1–1	1–1	.	+	2–2	+	.	.	1–1
Armeria trachyphylla	+	.	1–1	.	.	.	.	1–1	.	1–1	+	1–1	+	+	.	.
Alyssym serpyllifolium	.	+	.	.	.	.	.	+	+	.	.	.	.	.	.	.
Erodium cazorlanum	.	.	.	.	.	.	1–1	1–1	.	1–1	.	.	.	.	2–2	2–2
Draba hispanica	+	.	.	.	.	.	+	.	.	2–2	1–1	.	.	.	.	.
Thymus orospedanus	.	.	.	.	.	.	.	.	.	.	.	1–1	2–2	+	2–2	1–1
Accompanying																
Seseli granatense	1–1	2–2	1–1	+	.	.	1–1	.	1–1	1–1	1–1	+	.	.	2–2	.
Centaurea giennensis	2–2	2–2	2–2	2–2	2–2	.	.	1–1	1–1	+	2–2	.	.	.	.	.
Koeleria humilis	1–1	+	.	.	2–2	1–1	1–1	2–2	+	1–1	.	1–1	.	.	.	.
Festuca hystrix	.	.	.	.	.	1–1	2–2	.	1–1	2–2	2–2	.	.	.	.	.
Poa ligulata	.	.	.	1–1	.	.	+	1–1	.	1–1	2–2	.	.	+	2–2	1–1

In addition: *Carex hallerana* 1–2, *Genista longipes* 2–2, *Coronilla minima* 1–1, in 6. *Acinos meridionalis* 1–1, *Ononis aragonensis* + . *Erysimum cazorlense* 1–1, *Fumana ericoides* 2–2, *Echinospartum boissieri* 1–1, in 12. *Lavandula latifolia* 1–1, *Fumana ericoides* 2–2, in 14. *Ononis pusilla* 1–1, *Acinos meridionalis* + , in 15.

Localities: 1–5. S[a] del pozo: Pico Cabañas. ». S[a] del Pozo: Pr. Collado Guajalay. 7–9. S[a] de La Empanada: Summit. 10–11. S[a] de la Cabrilla: Summit. 12–14. S[a] del Pozo: Bco. del Guadalentín. 15–16. S[a] del Pozo: Valdeazores.

Discussion

Despite being rather frequent, nowhere are the areas of gravelly dolomites in the chorological Betic province as extensive and floristically diversified as in the sector Malacitano-Almijarense (Fig. 3 and 4). The association *Andryalo-Convolvuletum boissieri* was depicted for the calcareus rim of the S[a] Nevada, though it has been allegedly recorded in other neighbouring territories (Martínez Parras & Peinado 1987). Against this view, Quézel (1953) himself suggested a subassociation with *Pterocephalus spathulatus* in the nearby ranges (Tejeda and La Almijara) which was later

Table 9. As. *Scorzonero albicantis-Pterocephaletum spathulatae* Martínez Parras & Peinado 1987.

No order	1	2	3	4	5	6	7	8	9	10	11	12
Altitude (m x 10)	184	194	192	189	185	195	196	173	174	176	178	172
Exposure	–	E	NO	E	–	SE	S	NO	SE	E	–	S
Inclination (°)	–	5	15	10	–	25	5	10	20	45	–	40
Area (m^2)	4	9	16	9	9	12	4	9	16	16	16	16
Characteristics of the association												
Scorzonera albicans	2–2	2–2	2–2	2–2	1–1	1–1	2–2	.	.	.	.	.
Characteristics of the alliance and order												
Pterocephalus spathulatus	.	1–2	2–2	.	.	2–2	1–1	3–3	2–2	2–2	2–2	2–2
Convolvulus boissieri	2–2	2–2	2–2	3–3	2–2	3–3	2–2	.	.	.	.	.
Thymelaea granatensis	.	1–1	1–1	1–1	1–1	.	.	.	.	.	.	.
Fumana paradoxa	2–2	2–2	.	.	.	1–1	.	.	.	.	.	1–1
Anthyllis argyrophylla	.	.	1–1	2–2	1–1	.	.	1–1	1–1	.	1–1	.
Paronychia aretioides	+	+	1–1	.	.	.	1–1	.	.	.	.	.
Globularia spinosa	1–1	.	.	.	.	.	.	1–1	1–1	1–1	+	+
Andryala agardhii	.	.	.	.	.	+	1–1	.	.	.	.	.
Santolina elegans	.	.	2–2	.	2–2	.	.	.	.	.	.	.
Characteristics of the class (and other units of *Rosmarinetea*)												
Arenaria murcica	.	2–2	2–2	1–1	2–2	.	.	1–1	2–2	1–1	2–2	1–1
Silene legionensis	+	.	.	.	+	1–1	.	.	1–1	1–1	.	.
Helianthemum canum	2–2	1–1	2–2	.	2–2	.	.	2–2	1–1	.	2–2	.
Asperula scabra	1–1	.	.	1–1	.	.	1–1	1–1	1–1	1–1	2–2	+
Erinacea anthyllis	+	1–1	+	.	1–1	+	+	.	.	.	.	.
Thymus orospedanus	1–1	1–1	.	.	.	.	+	.	.	.	.	.
Genista longipes	.	+	1–1	.	.	1–1	+	.	.	.	.	.
Teucrium leonis	.	+	.	1–1	1–1	1–1	+	.	.	.	.	.
Thymus gadorensis	.	.	.	.	.	.	.	2–2	2–2	2–2	1–1	1–1
Helianthemum rosmaessleri	.	.	.	.	.	2–2	2–2	.	.	.	.	.
Arenaria armerina	1–1	+	.	.	.	1–1	.	.	.	.	.	.
Accompanying												
Festuca hystrix	2–2	1–1	2–2	2–2	2–2	.	1–1	2–2	2–2	2–2	1–1	1–1
Seseli granatense	+	1–1	1–1	1–1	1–1	1–1	.	2–2	2–2	1–1	1–1	1–1
Centaurea giennensis	+	1–2	+	.	.	.	.	.	1–1	1–1	.	.
Koeleria humilis	1–1	.	.	1–1	1–1	.	.	1–1	1–1	1–1	2–2	1–1
Poa ligulata	.	1–1	+	.	.	.	.	.	1–1	.	.	.

In addition: *Sideritis virgata* 1–1, in 1. *Erodium cazorlanum* 1–1, *Centaurea boissieri* +, in 7. *Dianthus brachyanthus* 1–1, *Coronilla minima* 1–1, in 8. *Draba hispanica* 1–1, in 9. *Hippocrepis squamata* 1–1, in 10. *Centraurea granatensis* 1–1, in 12.
Localities: 1. S^a de Castril: Bco. del Quemaero. 2. S^a de Castril: Los Tejos. 3. S^a de Castril: between Los Tejos and El Buitre. 4–5. S^a Seca: Pr. La Laguna. 6–7. S^a de La Sagra. 8–12. Llanos de Hernán Pelea.

corroborated by Rivas Goday & Mayor (1966): *Hippocrepido-Pterocephaletum spathulatae*. However, these authors broadened the original biogeographical context of the syntaxon proposed by Quézel (op. cit.) and extrapoled its occurrence in other territories. In this sense the association *Hippocrepido-Pterocephaletum spathulatae* comprised formerly what is today viewed as shaping several syntaxa: *Helianthemo-Pterocephaletum spathulatae, Scorzonero-Pterocephaletum spathulatae, Thymo-Arenarietum tomentosae* and *Galio-Thymetum granatensis*. In our scheme for the order *Convolvuletalia boissieri* we retake Quézel position.

Table 10. As. *Scorzonero albicantis-Pterocephaletum spathulatae* Martínez Parras & Peinado 1987.

No order	1	2	3	4	5	6	7	8	9	10	11	12	13	14
Altitude (m x 10)	179	183	200	200	200	196	195	187	184	180	175	202	200	192
Exposure	SO	NE	NO	–	N	–	SE	NO	O	NO	NO	–	–	SE
Area (m^2)	4	12	16	12	24	25	25	9	40	15	25	9	20	12
Characteristics of the association														
Scorzonera albicans	.	2–2	2–2	2–2	2–2	2–2	.	2–2	2–2	1–1	1–1	.	.	.
Leucanthemopsis spathulifolia	+	.	.	.	1–1	.	1–1	.	.	.	.	.	.	.
Thymelaea granatensis	.	.	1–1	1–1	.	1–1	+	.	.	.	.	1–1	.	.
Fumana paradoxa	+	2–2	.	.	.	.	.	.	.	.	2–2	.	.	.
Characteristics of the alliance and order														
Pterocephalus spathulatus	2–2	3–3	3–3	3–3	1–1	3–3	3–3	3–3	3–3	3–3	3–3	+	3–3	3–3
Santolina elegans	.	.	.	2–2	3–3	.	2–2	.	.	2–2	.	.	.	.
Thymus clandestinus	.	.	.	.	.	2–2	2–2	2–2	2–2	2–2	1–1	2–2	2–2	1–1
Thymelaea granatensis	.	.	1–1	1–1	.	1–1	+	.	.	.	.	1–1	.	.
Globularia spinosa	.	2–2	+	+	.	1–1	.	.	2–2	1–1	2–2	1–1	.	.
Paronychia aretioides	.	.	.	.	1–1	.	.	1–1	.	.	.	1–1	.	.
Alyssum longicaule	.	1–1	.	.	+	.	.	.	+	.	.	.	.	.
Characteristics of the class														
Silene legionensis	.	.	1–1	.	.	+	1–1	1–1	.	.	.	.	1–1	1–1
Helianthemum canum	.	.	2–2	2–2	1–1	2–2	2–2	2–2	1–1	.	1–1	.	.	
Helianthemum rotundifolium	1–1	1–1	2–2	1–1	1–1	.	+	+	.	+	.	1–1	2–2	2–2
Erinacea anthyllis	+	+	+	1–1	1–1	1–1	2–2	+	1–1	1–1	1–1	.	.	1–1
Asperula scabra	+	.	1–1	1–1	1–1	1–1	1–1	1–1	.	+	.	1–1	.	.
Hippocrepis squamata	.	.	1–1	.	.	+	1–1	.	.	.	.	2–2	.	2–2
Scabiosa andryalifolia	.	+	+	+	+	.	.	.	.	.	.	1–1	+	+
Thymus gadorensis	+	.	.	+	.	.	1–1	.	.	.	.	.	.	.
Sideritis virgata	.	.	1–1	.	.	.	.	.	.	.	2–2	2–2	.	.
Dianthus brachyanthus	.	.	+	+	.	.	.	.	.	.	+	.	.	+
Accompanying														
Koeleria humilis	1–1	1–1	1–1	1–1	2–2	2–2	2–2	2–2	1–1	.	+	.	.	1–1
Avenula gervaisii	.	1–1	+	+	.	+	1–1	.	.	.	.	.	.	.
Stipa pennata	.	.	1–1	+	+	1–1	.	.	+	+	1–1	+	.	.
Seseli granatense	.	.	.	+	1–1	.	.	.	+	.	.	1–1	1–1	+
Carex hallerana	.	.	1–1	1–1	.	1–1	.	.	1–1	.	1–1	+	.	.
Festuca hystrix	.	.	.	+	.	.	.	.	.	.	.	1–1	+	.
Jurinea humilis	.	.	.	.	+	.	.	1–1	1–1	.	.	.	.	.
Centaurea granatensis	.	+	1–1	.	.	+	.	.	.	.	.	+	.	+

In addition: *Centaurea postrata 1–1, in 1. Thymus sabulicola* 2–2, in 2. *Erodium cazorlanum* 1–1, *Jasonia tuberosa* 1–1, in 5. *Genista longipes* 1–1, *Teucrium leonis* +, *Odontites lateritica* 2–2, in 12. *Draba hispanica* 1–1, *Paronychia baetica* 1–1, in 13. *Teucrium leonis* +, *Odontites lateritica* 1–1, in 14.
Localities: 1–11. S[a] de las Cabras. 12–14. Revolcadores.

Taking into account recent surveys, there exists another association in the mesomediterranean foothills (Pérez Raya 1987; Mota & Valle 1992). By no means does this one correspond to the as. *Helianthemo-Anthyllidetum argyrophyllae* Rivas Goday in Rivas Goday & Esteve 1972 as it has been stated by Pérez Raya (op. cit.), who, in addition, calls for a neotype considering the original relevés too heterogeneous. His view is incompatible with the article no. 21 of the CNF (Barkman *et al.* 1986) since two concrete relevés are provided in the original table. We stand for con-

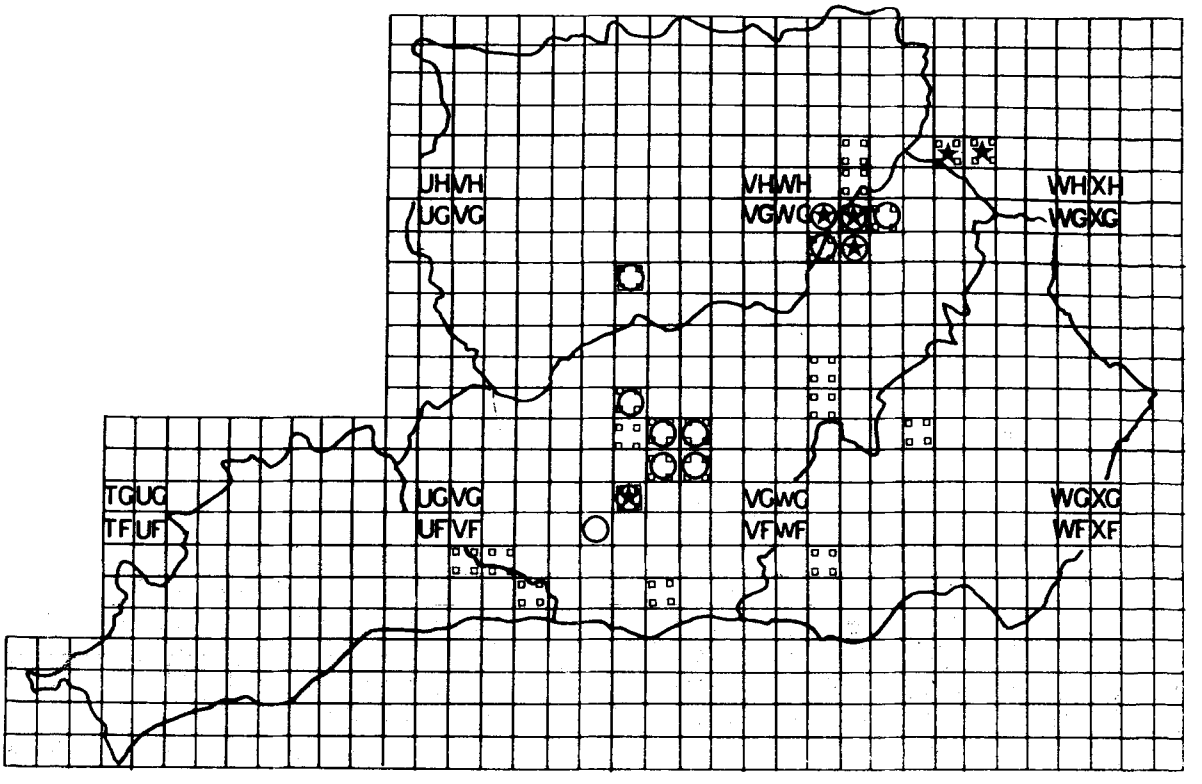

Fig. 3. Distribution of species according to UTM System (USO 30S):

○ *Convolvulus boissieri*

⬚ *Pterocephalus spathulatus*

★ *Santolina elegans*

sideration of the ass. *Helianthemo-Anthyllidetum argyrophyllae* and the as. *Centaureo-Lavanduletum lanatae* (Rivas Goday & Esteve 1972) Martínez Parras *et al.* 1983 as synonyms, since they both were described as belonging to the all. *Lavandulo-Echinospartion boissieri* Rivas Goday & Rivas Martínez 1968. Our proposal of the as. *Helianthemo-Centaureetum bombycinae* aims at overcoming this insufficiency. Anyhow, it seems pointless, in the light of the data afforded in this and other previous works to hold only one association malacitano-almijarense.

In spite of being floristically poorer, the as. *Galio-Thymetum granatensis* may be classified in the same group of the preceding ones.

On the other hand, the subbetic associations with a singular floristic pool and also rich in endemisms are worthy of note, too: *Lithodora nitida, Helianthemum frigidulum, Alyssum baeticum, Scorzonera albicans, Leucanthemopsis pallida* subsp. *spathulifolia, Jasione crispa* subsp. *segurensis*, etc. This circumstance could possible allow us to create a new subbetic alliance leaving the all. *Andryalion agardhii* available for comprising the associations malacitano-almijarenses and rondeñas. In this case there is a remarkable floristic pool as well: *Rothmaleria granatensis, Arenaria armerina* subsp. *caesia, Anthyllis tejedensis, Helianthemum viscidulum*, etc. Nonetheless the creation of a new alliance should provide an answer for the syntaxonomic location of the ass. *Thymo-Arenarietum tomentosae* which presents some elements malacitano-almijarense (*Thymus granatensis, Hippocrepis eriocarpa*). Before holding any definitive view

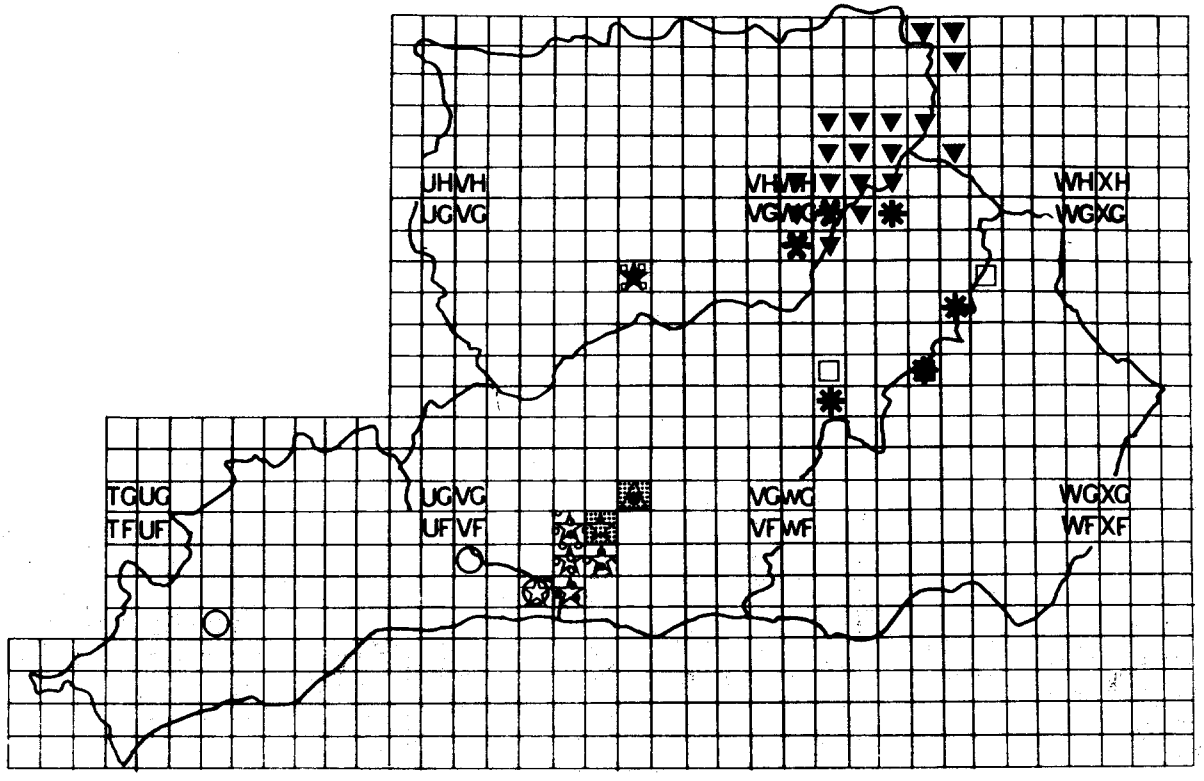

Fig. 4. Distribution of species according to UTM System (USO 30S):

- *Alyssum baeticum*
- *Arenaria arcuatociliata*
- *Arenaria delaguardiae*
- *Arenaria erinacea*
- *Arenaria tomentosa*
- *Centaurea bombycina*
- *Erodium boissieri*
- *Helianthemum frigidulum*
- *Helianthemum pannosum*
- *Lithodora nitida*
- *Scabiosa pulsatilloides*
- *Scorzonera albicans*

the study of these communities in the guadiciano-bacenses territories must be completed; the matter still remains open. Finally the synthetic table disposes the characteristic taxa in associations, alliance and order.

Conclusions

The order *Convolvuletalia boissieri* contains seven associations (see syntaxonomic scheme) and the following characteristic taxa: *Thymus granatensis, Hippocrepis eriocarpa, Pterocephalus spathulatus, Convolvulus boissieri, Andryala agardhii, Santolina elegans, Alyssum angustifolium, Helianthemum viscidulum, Arenaria erinacea, Rothmaleria granatensis, Arenaria armerina* subsp. *caesia, Anthyllis tejedensis* and *Thymelaea granatensis.*

The communities of this order are widely spread in the chorological Betic province. Sector and even subsector boundaries serve to delimit the dispersal of the associations: *Andryalo-Convolvuletum boissieri* and *Arenario-Centeureetum bombycinae* (Malacitano-Almijarense), *Hippocrepido-Pterocephaletum spathulati* (Malacitano-Almijarense and Alpujarreño-Gadorense?),

Table 11. Synthetic table (Elaborated with our own data, provided in this work and Mota & Valle 1992).

	1	2	3	4	5	6	7
Helianthemum pannosum	IV	.	.	.	.	.	.
Scabiosa pulsatilloides	III	.	.	.	.	.	.
Erodium boissieri	III	.	.	.	.	.	.
Helianthemum stevei	II	.	.	.	.	.	.
Centaurea funkii	(1)	.	.	.	.	.	.
Helianthemum viscidulum	.	V	V	.	.	.	.
Arenaria erinacea	(2)	V	.	III	.	.	.
Centaurea bombycina	.	.	V	.	.	.	.
Arenaria delaguardiae	.	.	IV	.	.	.	.
Galium baeticum	.	.	.	III	.	.	.
Ulex baeticus (terr.)	.	.	.	V	.	.	.
Jurinea pinnata (terr.)	.	.	.	IV	V	.	.
Arenaria tomentosa	.	.	.	.	V	.	.
Lithodora nitida	.	.	.	.	.	IV	.
Helianthemum frigidulum	.	.	.	.	.	III	.
Scorzonera albicans	.	.	.	.	.	.	IV
Alyssum baeticum	.	.	.	.	.	.	I
Leucanthemopsis spathulifolia	.	.	.	.	.	.	II
Rothmaleria granatensis	IV	II	III	.	.	.	.
Arenaria caesia	IV	I	II	.	.	.	.
Anthyllis tejedensis	III	V	II	.	.	.	.
Thymelaea granatensis	.	.	.	.	.	I	II
Thymus clandestinus (terr.)	.	.	.	.	.	II	II
Viola cazorlensis (terr.)	.	.	.	.	.	II	I
Thymus granatensis	V	IV	IV	V	V	.	.
Anthyllis argyrophylla	IV	III	III	III	II	III	III
Hippocrepis eriocarpa	(1)	IV	II	.	I	V	.
Pterocephalus spathulatus	III	V	.	.	I	V	III
Convolvulus boissieri	III	.	.	.	.	V	IV
Andryala agardhii	II	I	.	.	.	I	I
Santolina elegans	III	.	.	.	.	.	I
Alyssum angustifolium	(1)	.	.	.	.	IV	.
Some characteristics of the class and other units of Rosmarinetea and accompanying fair frequent:							
Echinospartum boissieri	I	II	I	I	I	IV	I
Sideritis virgata	III	II	III	.	II	IV	I
Alyssum serpyllifolium	II	IV	I	.	I	III	I
Helianthemum rotundifolium	I	.	I	V	IV	III	III
Thymus orospedanus	(1)	.	.	.	.	IV	II
Genista longipes	.	III	.	.	.	I	I
Lavandula lanata	I	.	II	III	.	.	.
Coris monspeliensis	III	.	III	.	I	.	.
Thymus longiflorus	.	II	IV	.	.	.	.
Brachypodium boissieri	V	II	V	.	.	.	.
Trisetum velutinum	IV	.	II	.	.	.	.
Echium albicans	III	.	I	I	.	.	.
Centaurea granatensis	IV	.	I	.	III	IV	.
Centaurea giennensis	.	.	.	.	.	.	II
Lavandula latifolia	.	.	.	.	III	I	I
Globularia spinosa	.	.	.	.	.	III	III
Silene legionensis	.	.	.	.	.	.	III
Helianthemum lavandulifolium	.	.	.	.	III	.	.

1. *Andryalo-Convolvuletum boissieri* (Typicum) (1) Only in the subas. *centaureetosum funktii*/(2) Only in the subas. *centaureetosum bombycinae* (16 relevés).
2. *Hippocrepido-Pterocephaletum spathulatae* (10 relevés, Mota et Valle, 1992).
3. *Arenario-Centaureetum bombycinae* (10 relevés).
4. *Galio-Thymetum granatensis* (7 relevés, Mota et Valle, 1992).
5. Thymo-Arenarietum tomentosae (12 relevés, Mota et Valle, 1992).
6. *Helianthemo-Pterocephaletum spathulatae* (15 relevés).
7. *Scorzonero-Pterocephaletum spathulatae* (42 relevés).

Galio-Thymetum granatensis (Rondeño), *Helianthemo-Pterocephaletum spathulati* and *Scorzonero-Pterocephaletum spathulati* (Subbético), *Thymo-Arenarietum tomentosae* (Guadiciano-Bacense).

In the gravelly dolomites areas a large amount of betic endemisms are present, many of them have been already mentioned to characterize the order *Convolvuletalia boissieri*. Attention must be paid to the sector Malacitano-Almijarense where low-scattered species take place: *Helianthemum pannosum, Scabiosa pulsatilloides, Erodium boissieri, Helianthemum crocceum* subsp. *estevei, Centaurea boissieri* subsp. *funkii, Centaurea bombycina* and *Arenaria delaguardiae*. The same goes for those subbetic territories where the following species are present: *Lithodora nitida, Helianthemum frigidulum, Scorzonera albicans, Alyssum baeticum* and *Leucanthemopsis pallida* subsp. *spathulifolia*.

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