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# On the class *Pegano harmalae-Salsoletea vermiculatae* Br.-Bl. & Bolòs 1957 in the Duero basin (Spain)

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## RESUMEN

LADERO ÁLVAREZ, M., C. J. VALLE GUTIÉRREZ & A. GUTIÉRREZ BALBÁS (1994). Sobre la clase *Pegano harmalae-Salsoletea vermiculatae* Br.-Bl. & Bolòs 1957 en la cuenca del Duero (España). *Candollea* 49: 499-507. En inglés, resúmenes en español y en inglés.

Se estudian las comunidades pertenecientes a la clase *Pegano-Salsoletea vermiculatae* Br.-Bl. & Bolòs 1957 desarrolladas, bajo ombroclima seco-semiárido, en las llanuras castellano-leonesas (España). Se analizan los "harmagales" de *Salsolo-Peganetum harmalae*, en el extremo occidental de su área, y las fitocenosis dominadas por *Santolina canescens* y *S. rosmarinifolia*; se propone una nueva subasociación *kochietosum prostratae*. La asociación *Artemisio herbae-albae-Santolinetum squarrosae* propia de suelos margo-yesíferos y margoso-calcáreos es descrita por primera vez.

## ABSTRACT

LADERO ÁLVAREZ, M., C. J. VALLE GUTIÉRREZ & A. GUTIÉRREZ BALBÁS (1994). On the class *Pegano harmalae-Salsoletea vermiculatae* Br.-Bl. & Bolòs 1957 in the Duero basin (Spain). *Candollea* 49: 499-507. In English, Spanish and English abstracts.

The communities belonging to the class *Pegano-Salsoletea vermiculatae* Br.-Bl. & Bolòs 1957 are studied. They are found in a dry-semiarid ombroclimate in the Castilla and the León plains (Spain). The "harmagales" communities of *Salsolo-Peganetum harmalae*, found in the western limits of their area, are analysed. Also studied are the phytocoenoses dominated by *Santolina canescens* and *S. rosmarinifolia*; a new subassociation *kochietosum prostratae* is proposed. The association — *Artemisio herbae-albae-Santolinetum squarrosae* — belonging to marly-gypsiferous and marly-calcareous soils is described for the first time.

**KEY-WORDS:** *Pegano-Salsoletea vermiculatae* — *Santolina* — Phytosociology — Duero basin — Spain.

## Introduction

The class *Pegano-Salsoletea vermiculatae* Br.-Bl. & Bolòs 1957, with a Saharian-Sindian and Iranian-Turanian optimum, also reaches the arid and semi-arid areas of the Mediterranean region. In Spain, this vegetation is developing on thermo- and mesomediterranean belts, with ombroclimates ranging from arid to dry, although exceptionally, in a residual fashion, some communities reach the supramediterranean belt and even the lower oromediterranean (PEINADO & al., 1986: 2).



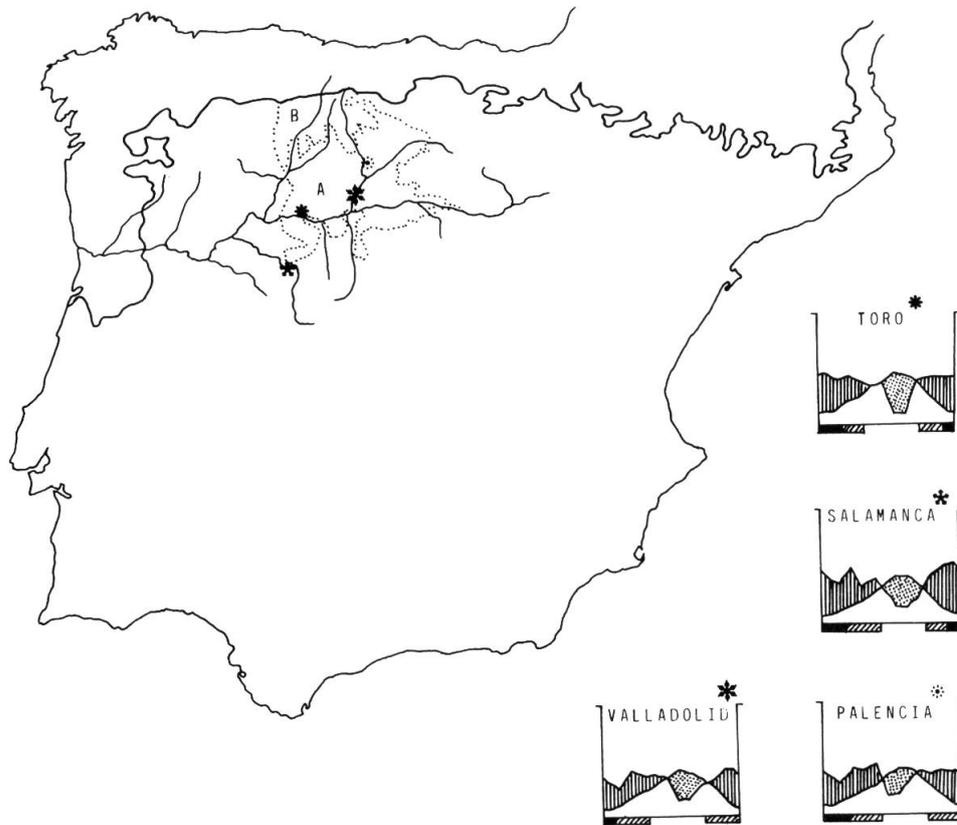


Fig. 2. — Biogeography of the central Duero basin area. A, Castellano-Duriense sector; B, Leonés sector (RIVAS-MARTÍNEZ & al., 1990). Climate diagrams of some meteorological stations mentioned in Table 1 are added.

### Materials and methods

The vegetation was studied following the phytosociological method proposed by BRAUN-BLANQUET (1979). The floristic relevés taken in the field, from July to October, under homogeneous conditions, were ordered and grouped in tables, later comparing the groups of relevés with tables of other similar groups studied by different authors; this allowed us to assimilate the brushwoods studied in this work to models already described if concordance was good or, if not, to propose new syntaxonomic units.

### Description of communities

#### Salsolo-Peganetum harmalae Br.-Bl. & Bolòs (1954) 1957.

The “harmagales” of *Salsolo-Peganetum harmalae peganetosum* described for the Ebro valley by BRAUN-BLANQUET & BOLÒS (1957: table 4) arrive here impoverished and highly localized, although, as may be seen from the relevés in Table 2, they outscop in strongly nitrified emplacements.

It reaches its western limit in the Tierra del Pan and the basin of the river Guareña (province of Zamora) within the series *Junipero thuriferae-Querceto rotundifoliae* S.; GUTIERREZ

Station	Alt.	Years	T	M	m	It	P	Pv
Castronuño (VA) .....	660	30	11.7	6.6	-0.1	182	376	59
Palencia (P) .....	739	40	11.7	6.7	0.0	184	412	64
Peleagonzalo (ZA) .....	650	30	—	—	—	—	291	43
Salamanca (SA) .....	797	39	12.0	8.0	-0.7	193	421	57
Valladolid (VA) .....	693	30	12.0	7.3	-0.6	187	373	62
Toro (ZA) .....	735	30	13.4	6.5	-0.5	194	364	62

Table 1. — Climatic table (alt: altitude; years: years of observations; T: mean annual temperature (°C); M: mean temperature of the maximals of the coldest month; m: mean temperature of the minimals of the coldest month; It: thermicity index; P: Mean annual rainfall (mm); Pv: mean summer rainfall (june + july + august).

<b>Salsolo vermiculatae-Peganetum harmalae</b> Br.-Bl. & Bolòs 1957 ( <i>Pegano harmalae-Salsoletea vermiculatae</i> , <i>Salsolo-Peganetalia</i> , <i>Salsolo-Peganion</i> ) subass. <b>peganetosum harmalae</b> subass. <b>santolinetosum squarrosae</b> Peinado & al. (1986)							
Altitude m.a.s.l. (l = 10 m) .....	82	76	79	75	80	70	
Cover % .....	80	90	70	70	70	70	
Area (sq m) .....	50	60	50	50	50	10	
No. order .....	1	2	3	4	5	6	
Char. species of the assoc. and higher syntaxa:							
<i>Salsola vermiculata</i> .....	3.3	4.5	3.3	3.3	3.4	.	V
<i>Marrubium vulgare</i> .....	1.1	1.1	.	1.1	1.1	+2	V
<i>Pegano harmala</i> .....	1.2	+	.	.	.	2.3	II
<i>Plumbago europaea</i> .....	1.2	+	.	.	.	.	II
<i>Artemisia glutinosa</i> .....	1.1	.	.	.	.	.	I
<i>Mercurialis tomentosa</i> .....	.	.	.	.	+	.	I
Differ. of subass. <i>santolinetosum squarrosae</i> :							
<i>Santolina squarrosa</i> .....	.	.	1.1	+2	+2	.	III
<i>Dorycnium pentaphyllum</i> .....	.	.	.	1.1	+	.	II
Accompanying:							
<i>Onopordum nervosum</i> .....	.	1.1	.	1.1	.	+2	III
<i>Nepeta amethystina</i> .....	1.1	+	.	.	.	.	II
<i>Salvia lavandulifolia</i> + en 1; <i>Centaurea latronum</i> 1.1 en 1; <i>Foeniculum vulgare piperitum</i> 1.1 en 2; <i>Lepidium subulatum</i> 1.1 en 3; <i>Atriplex rosea</i> + en 3; <i>Scolymus hispanicus</i> 1.1 en 4; <i>Centaurea aspera</i> 1.1. en 4; <i>Echium asperrimum</i> +.2 en 4; <i>Carlina hispanica</i> 1.1 en 5; <i>Malva parviflora</i> + en 6; <i>Plantago lanceolata</i> 2.2 en 6; <i>Hordeum murinum</i> 1.1 en 6.							
Localities:							
1 VA: Iscar, castillo, 30TUL78				4 VA: Pesquera de Duero, 30TVM01			
2 VA: Portillo, 30TUL68				5 VA: Molpeceres, 30TVM00			
3 VA: Peñafiel, castillo, 30TVM00				6 GUTIÉRREZ BALBÁS (1988: 128)			

Table 2.

BALBÁS (1988: 128, table 13) offers two relevés of Castronuño (VA), where a progressive loss of elements of the community are seen when it approaches the limits of its area.

PEINADO & al. (1986) who take *Artemisio herbae-albae-Salsoletum vermiculatae* to be a valid name for this association — an idea in conflict with our beliefs since the confusions reported by those authors have not been found PEINADO & al. (1986: 6) — propose the subassociation *santolinetosum squarrosae* to signal the passage of these communities to those of *Santolinion pectinato-canescens*; this is also reflected in the Castilla y León landscape (Table 2, rel. 3-5), the transit towards the association *Artemisio herbae-albae-Santolinetum squarrosae*, broadly extended over the marly and marly-gypsiferous slopes of the Castilla hills of Tierra de Campos and Valles de Cerrato, in the potential area of evergreen oaks with sabina albar (*Junipero thuriferae-Querceto rotundifoliae* S.).

#### **Artemisio-Santolinetum canescens** Martínez Parras & Peinado 1984.

A community described by PEINADO & MARTÍNEZ PARRAS (1984: 439) of the Malacitano-Almijarensis and Subbético sectors (Bética chorological province) and that also occurs in the Castellano-Duriense sector of the Castellano-Maestrazgo-Manchega province, being articulated in the *Junipero thuriferae-Querceto rotundifoliae* S.

The floristic composition, ecological behaviour and parallelism in the dynamic significance of the betic communities and those of the northern submeseta are concordant.

Additionally, in this association it has been possible to distinguish a new subassociation *kochietosum prostratae nova* (Typus: Table 3, rel. 5-9, typus rel. 7) typical of marly substrates and durian areas where the summer rainfall is lower than 30 mm.

From the floristic point of view, one of the questions to be solved has been to determine the identity of the populations of *Santolina* “canescente” that mainly appear in ruderalized environments over basic substrates of Miocene age (clays, marls, detritic and calcareous rocks) or sandstones of Eocene age.

*Santolina rosmarinifolia* L. is, according to most authors, endemic to the western Mediterranean, widespread across the Iberian Peninsula, that is usually associated with subnitrophile, viarian or ruderalized ecotopes within physiognomically well-characterized chamaephytic communities.

Its great variability has been repeatedly stressed and this has given rise to the description of numerous taxa of diverse categories (sp., subsp., var.) that have been subordinated to the Linnean species.

After the review by GUINEA (1970) and the later studies by GUINEA & TUTIN (1976), VALDÉS BERMEJO & LÓPEZ (1977) and VALDÉS BERMEJO & ANTÚNEZ (1981) of this latter, from the karyological point of view, as well as the type, three subspecies are recognized: *S. rosmarinifolia* subsp. *canescens* (Lag.) Nyman, *S. rosmarinifolia* subsp. *sedimentata* (Hoffmans. & Link) Valdés Bermejo and *S. rosmarinifolia* subsp. *pectinata* (Lag.) Guinea.

*S. rosmarinifolia* subsp. *canescens* has been assigned a restricted dispersion to the south of Spain (GUINEA, 1970), although other authors, such as VALDÉS BERMEJO & ANTÚNEZ (1981), PEINADO & MARTÍNEZ PARRAS (1984) or VELASCO & MARCOS (1986) later broadened this area, at least to the southern submeseta, always on basic substrates.

In this regard, it should be pointed out that the populations of *Santolina* “canescente” appearing, with identical edaphic behaviour, in the Duero basin undoubtedly correspond to the above-mentioned taxon; this aspect is not reflected in today’s literature even though WILLKOMM & LANGE (1865-1870) state: “in utraque Cast.”.

Additionally although the possibility has been raised of hybridization between *S. rosmarinifolia* subsp. *rosmarinifolia* and *S. rosmarinifolia* subsp. *canescens* by VALLE TENDERO & al. (1987: 217), this does not seem to occur in the Duero basin; here, both taxa may appear forming perfectly well delimited mosaics, depending on the chemical nature of the substrate, without the appearance of populations displaying intermediate characters.

Accordingly, in view of the coincidence of areas, different soil requirements and the absence of firm evidence supporting the existence of hybrids among them, we believe that they would be

<b>Artemisio glutinosae-Santolinetum canescens</b> Martínez-Parras & Peinado 1984 ( <i>Pegano harmalae-Salsoletea vermiculatae</i> , <i>Helichryso-Santolinetalia</i> , <i>Santolinion pectinato-canescens</i> ) subass. <b>santolinetosum canescens</b> subass. <b>kochietosum prostratae</b> subass. nov.										
Altitude m.a.s.l. (1 = 10 m) . . . . .	75	80	80	85	72	70	70	69	74	
Cover % . . . . .	70	70	80	60	80	50	70	80	50	
Area (sq m) . . . . .	50	50	50	15	50	50	40	40	40	
No. order . . . . .	1	2	3	4	5	6	7	8	9	
Char. species of the assoc. and higher syntaxa:										
<i>Artemisia glutinosa</i> . . . . .	2.3	2.3	3.3	.	2.2	1.1	2.2	2.3	1.1	V
<i>Santolina canescens</i> . . . . .	1.1	2.2	2.2	2.2	1.1	1.1	+2	1.1	2.2	V
<i>Dorycnium pentaphyllum</i> . . . . .	1.1	.	.	2.3	1.1	.	1.1	.	1.1	III
<i>Helichrysum serotinum</i> . . . . .	2.2	.	.	.	.	2.2	1.1	.	.	II
<i>Plantago sempervirens</i> . . . . .	2.2	.	.	.	.	.	1.1	.	.	II
<i>Marrubium vulgare</i> . . . . .	.	.	.	.	2.2	.	.	1.2	1.1	II
<i>Peganium harmala</i> . . . . .	.	.	.	.	.	1.2	.	.	.	I
Difference of subass. <i>kochietosum prostratae</i> :										
<i>Kochia prostrata</i> . . . . .	.	.	.	.	3.3	2.3	2.3	3.3	2.2	III
Accompanying:										
<i>Thymus zygis</i> . . . . .	1.1	2.2	2.2	+2	1.1	1.1	.	.	1.1	IV
<i>Centaurea ornata</i> . . . . .	.	.	+	.	1.1	1.1	.	.	+	III
<i>Foeniculum vulgare</i> . . . . .	.	1.1	.	.	.	.	.	1.2	+	II
<i>Centaurea aspera</i> . . . . .	.	.	.	.	.	.	.	1.1	1.1	II
<i>Antirrhinum majus</i> 1.2 en 2, 1.1 en 3; <i>Helianthemum pilosum</i> 1.1 en 2 y 3; <i>Helianthemum hirtum</i> 1.1 en 2 y 3; <i>Centaurea paniculata</i> 1.1 en 2 y 5; <i>Asperula aristata</i> 1.1 en 2, + en 5; <i>Reseda lutea</i> 1.1 en 3, + en 8; <i>Linum suffruticosum</i> 1.1 en 1; <i>Matthiola fruticulosa</i> 1.1 en 2; <i>Helianthemum asperum</i> 1.1 en 2; <i>Plantago albicans</i> 2.2 en 3; <i>Hippocrepis scabra</i> 1.1 en 3; <i>Astragalus monspessulanus</i> 1.1 en 3; <i>Centaurea alba</i> 1.1 en 3; <i>Teucrium capitatum</i> +.2 en 3; <i>Trifolium angustifolium</i> 2.2 en 4; <i>Plantago acanthophylla</i> 2.2 en 4; <i>Eryngium campestre</i> 1.2 en 4; <i>Koeleria vallesiana</i> 1.2 en 4; <i>Velezia rigida</i> 1.2 en 4; <i>Avenula bromoides</i> 1.1 en 4; <i>Coronilla scorpioides</i> 1.1 en 4; <i>Andryala integrifolia</i> 1.1 en 4; <i>Convolvulus arvensis</i> 1.1 en 4; <i>Ononis spinosa</i> +.2 en 4; <i>Phlomis herba-venti</i> +.2 en 4; <i>Lotus corniculatus</i> +.2 en 4; <i>Allium sphaerocephalon</i> +.2 en 4; <i>Linum narbonense</i> + en 4; <i>Rhus coriaria</i> 1.2 en 5; <i>Carlina hispanica</i> 1.1 en 6; <i>Verbascum sinuatum</i> 2.2 en 8; <i>Onopordum nervosum</i> 1.1 en 9; <i>Echium asperrimum</i> +.2 en 9.										
Localities:										
1 VA: Alaejos, 30TUL17					6 ZA: Toro, 30TUL08					
2 SA: Cabrerizos, 30TTL83					7 ZA: Venialbo, 30TTL88					
3 SA: La Flecha — Aldealengua, 30TTL83					8 VA: Castronuño, 30TUL08					
4 LE: Antimio, 30TTN80					9 VA: Cigales, 30TUM42					
5 VA: Simancas, 30TUM40										

Table 3.

two different species (*S. rosmarinifolia* L. and *S. canescens* Lag.) that originated following a model of parapatric or clinal speciation (MURRAY, 1972; JEANMONOD, 1984).

We believe that the rest of the lineages described can be subordinated to *S. rosmarinifolia* or *S. canescens*; these are clinal variations that are also common in widely dispersed taxa (STEBBINS, 1950).

#### **Artemisio herbae-albae-Santolinetum squarrosae** assoc. nov. (Holotypus: Table 4, rel. 3)

Widespread on the marly-gypsiferous and marly-limestone substrates surrounding the Miocene of the Tierra de Campos and Valles de Cerrato, these communities are dominated by *Artemisia herba-alba* and *Santolina squarrosa* (edaphic vicariant of *S. canescens*) that we believe to form the newly proposed association.

<b>Artemisio herbae-albae — Santolinetum squarrosae assoc. nov.</b>							
<i>(Pegano hermalae-Salsoletea vermiculatae, Helichryso-Santolinetalia, Santolinion pectinato-canescens)</i>							
subass. <b>camphorosmetosum monspeliacae nov.</b>							
Altitude m.a.s.l. (1 = 10 m) .....	75	72	70	72	77	76	
Cover % .....	60	80	60	70	90	40	
Area (sq m) .....	40	50	50	50	60	40	
No. order .....	1	2	3	4	5	6	
Char. species of the assoc. an dhigher syntaxa:							
<i>Artemisia herba-alba</i> .....	2.2	3.3	2.3	2.3	2.2	2.2	V
<i>Santolina squarrosa</i> .....	2.2	1.1	1.1	2.2	+2	2.3	V
<i>Dorycnium pentaphyllum</i> .....	.	1.1	1.1	2.2	1.2	1.2	V
<i>Helichrysum stoechas</i> .....	.	1.1	.	1.1	.	.	II
<i>Kochia prostrata</i> .....	.	.	1.2	.	.	.	I
Differ. of subass. <i>camphorosmetosum monspeliacae</i> :							
<i>Camphorosma monspeliaca</i> .....	.	.	.	.	3.3	1.1	II
Accompanying:							
<i>Onopordum nervosum</i> .....	1.1	+	.	1.1	.	.	III
<i>Eryngium campestre</i> .....	1.1	+	.	1.1	.	.	III
<i>Carlina hispanica</i> .....	.	1.1	1.1	1.1	.	.	III
<i>Scolymus hispanicus</i> 1.1 en 1, + en 2; <i>Phlomis herba-venti</i> +.2 en 1 y 2; <i>Koeleria vallesiana</i> 1.2 en 5 y 6; <i>Centaurea aspera</i> +.2 en 2; <i>Lepidium subulatum</i> 1.1 en 4; <i>Dactylis glomerata hispanica</i> 2.2 en 5; <i>Phleum bertolonii</i> 1.1 en 5; <i>Scabiosa maritima</i> 1.1 en 5; <i>Thymus zygis</i> 2.2 en 6; <i>Astragalus alopecuroides</i> 1.1 en 6.							
Localities:							
1 VA: Villabáñez, 30TUM60				4 VA: Valoria la Buena, 30TUM62			
2 VA: Renedo, 30TUM60				4 P: Monzón de Campos, 30TUM66			
3 VA: Cabezón de Pisuerga, 30TUM62				6 P: Palencia, campo de Tiro, 30TUM64			

Table 4.

The presence of *Camphorosma monspeliaca* on more compact and clayrich substrates permits us to recognize the subassociation *camphorosmetosum monspeliacae* (Table 4, rel. 5 and 6).

**Artemisio glutinosae-Santolinetum rosmarinifoliae** Costa 1975.

Distributed throughout the Carpetano-Ibérico-Leonesa province, the communities dominated by *Santolina rosmarinifolia* L. (glabrous or at most pruinous, silicicolous), they attain their optimum in the Guadarrámico sector (SÁNCHEZ-MATA, 1989: 204). They are the most widely represented and appear on distric or chromic cambisols or arenosols, bound to all the series of evergreen oak and decidous oak forests of the territory including *Junipero thuriferae-Querceto rotundifoliae* S. (LADERO & al., 1987-1988: 13) to which the relevés in Table 5 correspond.

This has been reported by NAVARRO & VALLE (1983: 82) on fallow land, slopes, roadsides and similar environments of the central western part of the province of Zamora.

Owing to the occasional concurrence of acid and basic substrates, it is not uncommon to find *Santolina rosmarinifolia* and *S. canescens* coexisting (Table 5, rel. 7).

Artemisio glutinosae — Santolinetum rosmarinifoliae Costa, 1975 ( <i>Pegano harmalae-Salsoletea vermiculatae</i> , <i>Helichryso-Santolinetalia</i> , <i>Artemisio-Santolinion</i> )									
Altitude m.s.a.l. (l = 10 m) .....	74	75	4	75	85	75	74	70	
Cover % .....	80	70	60	60	70	50	70	70	
Area (sq m) .....	50	50	30	50	50	50	50	40	
No. order .....	1	2	3	4	5	6	7	8	
Char. species of the assoc. and higher syntaxa:									
<i>Artemisia glutinosa</i> .....	3.3	2.2	2.2	2.2	3.3	3.3	2.2	3.3	V
<i>Helichrysum serotinum</i> .....	2.2	1.1	1.1	2.2	2.2	1.1	1.2	2.2	V
<i>Santolina rosmarinifolia</i> .....	2.2	2.2	2.2	+	+2	+	2.2	3.3	V
<i>Andryala ragusina</i> .....	1.1	1.1	.	2.2	1.1	.	1.1	1.1	IV
<i>Rumex roseus</i> .....	.	.	.	1.1	1.1	1.1	.	1.1	III
<i>Scrophularia canina</i> .....	.	.	.	.	.	1.1	1.1	+	II
<i>Marrubium vulgare</i> .....	.	.	+2	.	.	.	+	+	II
<i>Santolina canescens</i> .....	.	.	.	.	.	.	+2	.	II
Accompanying:									
<i>Chondrilla juncea</i> .....	1.1	1.1	.	1.1	1.1	1.1	1.1	1.1	V
<i>Centaurea latronum</i> .....	1.1	1.1	.	1.1	.	1.1	+	.	IV
<i>Thymus mastichina</i> .....	.	1.1	.	1.1	1.2	1.1	.	1.1	IV
<i>Thymus zygis</i> .....	1.1	1.1	.	.	.	.	1.1	.	II
<i>Scolymus hispanicus</i> .....	.	1.1	1.1	.	.	.	.	+	II
<i>Eryngium campestre</i> .....	.	1.1	.	.	.	.	+	1.1	II
<i>Centaurea paniculata</i> .....	.	+	.	.	.	.	1.1	1.1	II
<i>Centaurea ornata</i> .....	.	.	1.1	.	.	.	+	+	II
<i>Centaurea aspera</i> 1.1 en 1 y 6; <i>Carthamus lanatus</i> + en 2, 1.1 en 3; <i>Seseli tortuosum</i> 1.1; <i>Astragalus boissieri</i> 1.2 en 2; <i>Foeniculum vulgare piperitum</i> 1.1 en 2; <i>Verbascum pulverulentum</i> 1.1. en 3; <i>Onopordum acanthium</i> + en 3; <i>Pimpinella villosa</i> 1.1 en 6.									
Localities:									
1 VA: Cogeces de Iscar, 30TUL68					5 VA: Torrecárcela — Montemayor de Pililla, 30TUL89				
2 VA: Olmedo, ribera del río Adaja, 30TUL66					6 VA: Peñafiel, 30TVM00				
3 VA: Olmedo — Pedrajas de S. Esteban, 30TUL66					7 y 8 VA: Alaejos — Castronuño, 30TUL06				
4 VA: Pedrajas de S. Esteban, 30TUL66									

Table 5.

### Conclusions

After analyzing the fruticose, nitrophile vegetation of the Duero basin, the following conclusions can be drawn:

1. The Iberian area of the associations *Salsolo vermiculatae-Peganetum harmalae* and *Artemisio glutinosae-Santolinetum canescentis* can be extended to the Duero basin; new data are provided on *Artemisio glutinosae-Santolinetum rosmarinifoliae*.
2. A new subassociation *Artemisio-Santolinetum canescentis kochietosum prostratae* is proposed, whose distribution coincides with the areas of least rainfall in the Duero basin.
3. A new association *Artemisio herba-albae-Santolinetum squarrosae* represents the nitrophile chamaephytic vegetation typical of marly-gypsiferous and marly-limestone substrates.

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