

Perennial nitrophilous vegetation of the northern Iberian Peninsula

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Abstract. The syntaxonomy of the perennial nitrophilous vegetation assigned to the *Artemisietea vulgaris* of the northern part of the Iberian Peninsula (Basque Country and surrounding areas) was revised. The study area is of biogeographic importance due to its transitional character - here, the ruderal vegetation of the Mediterranean and that of temperate Europe meet. Numerical ordination of the communities was performed in order to reveal systematic relations between the syntaxa. Two subclasses, *Artemisienea vulgaris* and *Onopordenea*, encompassing five orders, *Convolvuletalia*, *Galio-Alliarietalia*, *Artemisietalia*, *Onopordetalia*, *Carthametalia lanati*, and seven alliances with 12 associations and two rank-less communities were distinguished.

Keywords: *Artemisietea vulgaris*; Northern Spain; Ordination; Phytosociology; Syntaxonomy.

Nomenclature: Tutin et al. (1964-1980) and Castroviejo et al. (1986-1993) for plants; Rivas-Martínez (1987, 1993) and Loidi et al. (1994) for biogeographical and bioclimatic terms.

Introduction

Nitrophilous ruderal vegetation is found in places very rich in organic material which is rapidly decomposed releasing nitrogen and phosphorus into soil. The organic material might be accumulating in natural ways such as by tides and destruction of plants and upper soil layers by forest fires, or might be man-made, usually in the form of organic waste of various origin. Due to the high spatial heterogeneity following the unequal distribution of nutrient-rich patches, as well as the coincidence of certain other ecological variables (primarily human disturbance) very diverse plant communities may be formed in such habitats. The diversity of nitrophilous vegetation, which is widespread over large areas, and its undeniable importance in modern, man-made landscapes, has attracted the attention of vegetation scientists. Several monographic treatments of ruderal vegetation are available from Central Europe (Hejný et al. 1979; Müller 1983; Kopecký & Hejný 1992; Mucina 1993). Currently a detailed syntaxonomic system for

this kind of vegetation was elaborated for northern Spain (Rivas-Martínez et al. 1991; Díaz & Fernández Prieto 1994; Loidi et al. 1994).

The aim of this paper is to revise the syntaxonomy of nitrophilous communities dominated by perennial herbs (the class *Artemisietea* sensu Tüxen 1950) in the northern part of the Iberian Peninsula - an area more or less confined to the Basque Country and surrounding regions (Fig. 1). Here we will accept the wider concept of this class, while considering also the *Galio-Urticetea* Passarge ex Kopecký 1969 and the *Onopordetea acanthii* Braun-Blanquet 1964 as constituents of the *Artemisietea vulgaris*. Following the suggestions by Rivas-Martínez et al. (1991) and Rivas-Martínez et al. (1992) we divide the *Artemisietea vulgaris* into two subclasses, the *Artemisienea vulgaris* and the *Onopordenea acanthii* (App. 1). The first subclass includes forb-rich vegetation on nutrient-rich, mesic to damp soils; the second subclass is typical of disturbed, moderately dry to dry soils of high nitrogen status. The *Onopordenea* communities are rich in thistles of the genera *Onopordon*, *Carduus*, *Cirsium*, *Scolymus*, *Cynara*, *Carthamus* (all *Asteraceae*), and are more diverse in the Mediterranean. The *Artemisienea* communities have a largely temperate distribution (Atlantic Domain, Central and East Europe). In the Mediterranean Basin they are confined to riversides or are found at high altitudes in regions of high precipitation.

The study may contribute to the European Vegetation Survey (Rodwell et al. 1995).

Material and Methods

397 published and unpublished phytosociological relevés (made using field-survey methods according to the Braun-Blanquet approach) were collected in the northern part of the Iberian Peninsula (Fig. 1). Using the synthetic classification procedures as described by Braun-Blanquet (1964) and revised by Westhoff & van der Maarel (1973) these relevés were classified into associations or rank-less plant communities and summarized in a synoptic table (App. 2).



Fig. 1. Location of the studied area subdivided into biogeographic units following the concept by Rivas-Martínez (1987).

In order to depict the relations between the vegetation types obtained by classification, Correspondence Analysis (CA) and Principal Components Analysis (PCA) were performed, using the CANOCO package (ter Braak 1988). The TABLAS programme (Quintana 1993) was used to insert the relevés; data transformation was carried out using the TRAFQA programme (Fischer 1989). Low-frequency species were omitted in order to eliminate noise. Each ordination was graphically represented using the programme CANODRAW-3 by Šmilauer (1992).

Results and Discussion

Ordination

For convenience we split the entire data set into two sets corresponding to the two subclasses, *Artemisienea vulgaris* and *Onopordenea acanthii*.

Artemisienea vulgaris

In the ordination of all 239 relevés of communities

belonging to the *Artemisienea* (Fig. 2) most of the relevés are grouped in the centre of the diagram. Three groups have an outlying position: the *Picrido-Eupatorium cannabini* along the positive part of Axis 2, and the *Oxalido-Geranium robertianii* and *Carduo-Cirsietum richterani* along the negative part of Axis 2. In a second ordination run these three groups of relevés, as well as the relevés representing the *Arundini-Convulvuletum*, were omitted. The latter relevés were not clearly separated on the ordination plane, because the character-species of the *Arundini-Convulvuletum* had been omitted from the analysis due to their low frequency.

In the second ordination (Fig. 3), 201 relevés were involved. These correspond to the *Artemisietalia* and a part of the *Galio-Alliarietalia*. The relevés of the *Smyrnium olusatrum* community separated clearly along the positive parts of Axes 1 and 2.

The clusters of relevés with *Geranium robertianum* and those dominated by *Anthriscus sylvestris* are more or less separated along the negative part of Axis 1 and positive part of Axis 2 in the ordination diagram. The remainder of the relevés are attributable to the *Urtico-Sambucetum ebuli*.

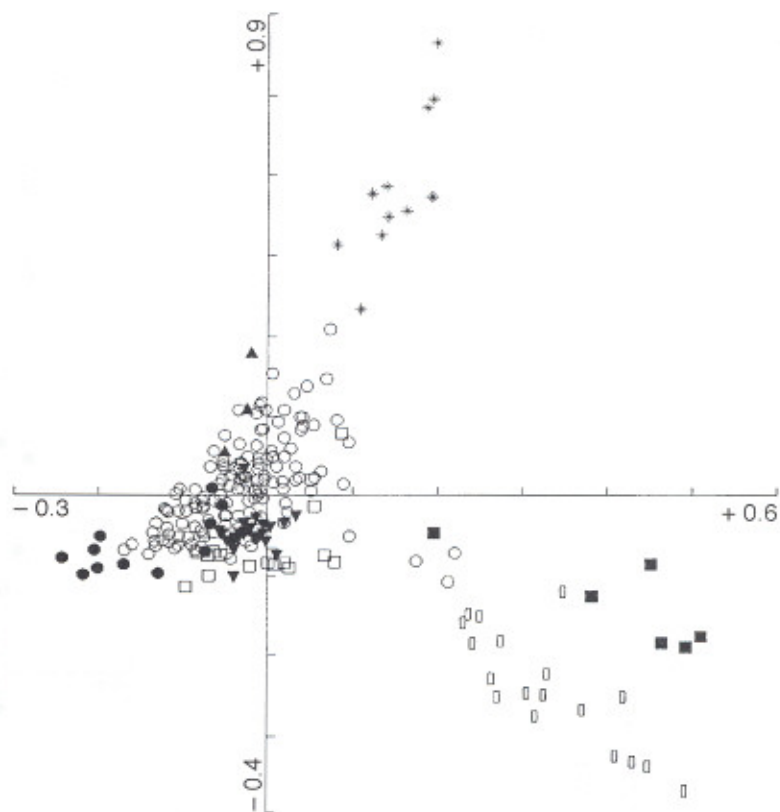


Fig. 2. PCA ordination of the entire *Artemisia vulgaris* data set:

- *Geranietum robertiano-lucidi*;
- *Oxalido acetosellae-Geranietum robertiani*;
- *Urtico-Sambucetum ebuli*;
- ▼ *Galio-Anthriscetum sylvestris*;
- *Smyrniun olusatrum comm.*;
- ▲ *Arundini-Convolutetum sepium*;
- * *Picrido-Eupatorietum cannabini*;
- *Carduo-Cirsietum richterani*.

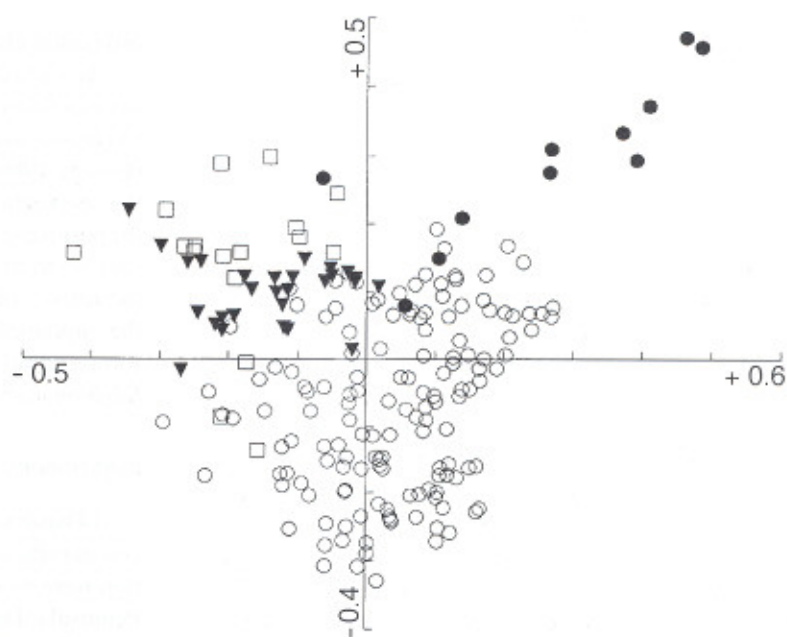


Fig. 3. PCA ordination of the reduced *Artemisia vulgaris* data set:

- *Geranietum robertiano-lucidi*;
- *Urtico-Sambucetum ebuli*;
- ▼ *Galio-Anthriscetum sylvestris*;
- *Smyrniun olusatrum comm.*

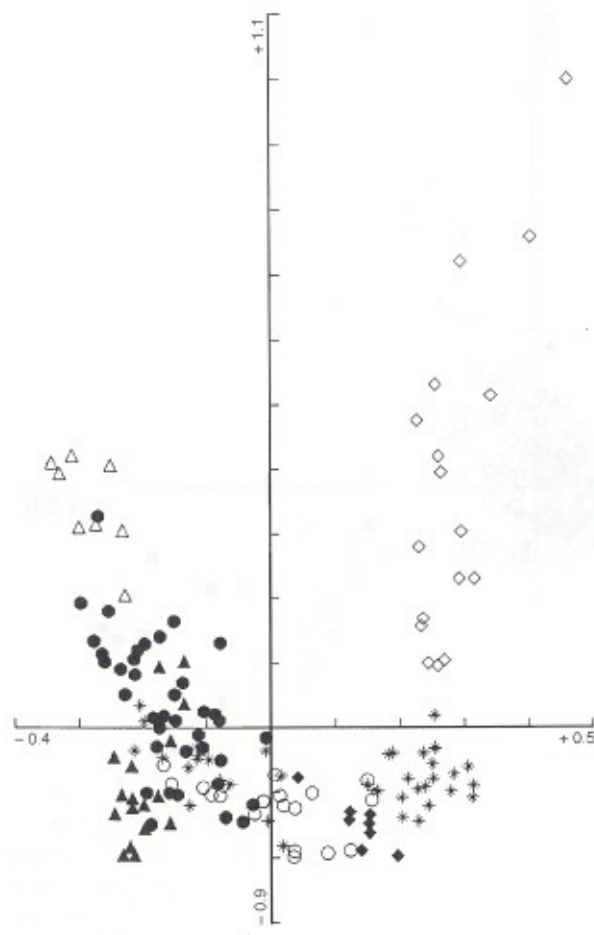


Fig. 4. Ordination of the entire *Onopordenea* data set:

- ◇ *Picrido-Raphanetum maritimi*;
- ◆ *Pastinaca sylvestris-Heracleum sphondylium* comm.;
- * *Picrido-Melilotetum albae*;
- *Carduo-Silybetum mariani*;
- ▲ *Onopordetum acantho-nervosii*;
- △ *Onopordetum nervosii*;
- *Silybo-Onopordetum acanthii*.

Onopordenea acanthii

The ordination of all 147 relevés of the *Onopordenea* communities (Fig. 4) shows the *Picrido-Raphanetum* relevés to be clearly clustered and separated along the positive part of Axis 2. They are similar to the *Picrido-Melilotetum albae* relevés, which form an adjacent group of relevés.

After the *Picrido-Raphanetum maritimi* relevés were omitted (Fig. 5), the *Dauco-Melilotion* relevés (e.g. *Picrido-Melilotetum albae*) were separated on one pole of the horseshoe revealed on the ordination plane, while the *Carthametalia lanati* relevés (e.g. *Onopordetum nervosii*) appeared to be separated at the other pole. The *Pastinaca sylvestris-Heracleum sphondylium* community and the *Picrido-Melilotetum albae* (both assigned to the *Dauco-Melilotion*) are clearly separated in the

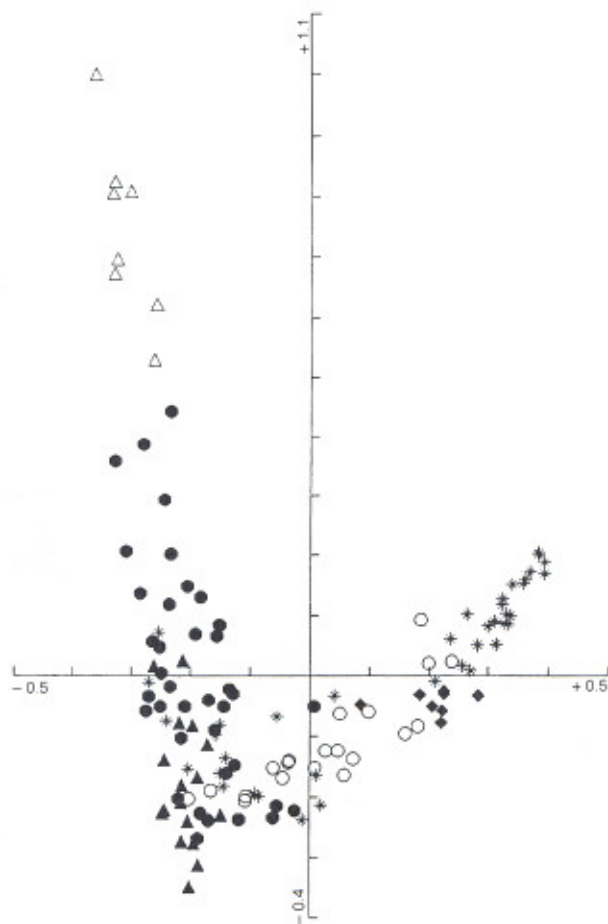


Fig. 5. Ordination of a reduced *Onopordenea* data set (*Picrido-Raphanetum* relevés were discarded). For legend see Fig. 4.

ordination plane of Axes 1 and 3 (not shown).

An ordination of 83 relevés of the *Carthametalia lanati* was also carried out. Seven relevés of the *Carduo-Silybetum mariani* from La Mancha in central Spain (Laorga 1986), representing a well-developed form of this association, were also included for comparison. On the positive side of Axis 2 the relevés of the *Onopordetum nervosii* from the Ebro Valley appear (Fig. 6). Most of the relevés of the *Onopordetum acantho-nervosii* from the supramediterranean zone of the Castilian Plateau form a group of their own. These show similarity to the *Silybion mariani* (*Carduo-Silybetum mariani*) relevés.

Syntaxonomic interpretation

14 basic vegetation types (associations and rank-less communities) of nitrophilous perennial ruderal vegetation were recognized in the northern part of the Iberian Peninsula. These are grouped into two subclasses, which are further subdivided into five orders: *Convolvuletalia*, *Galio-Alliarietalia*, *Artemisietalia vulgaris*, *Onopor-*

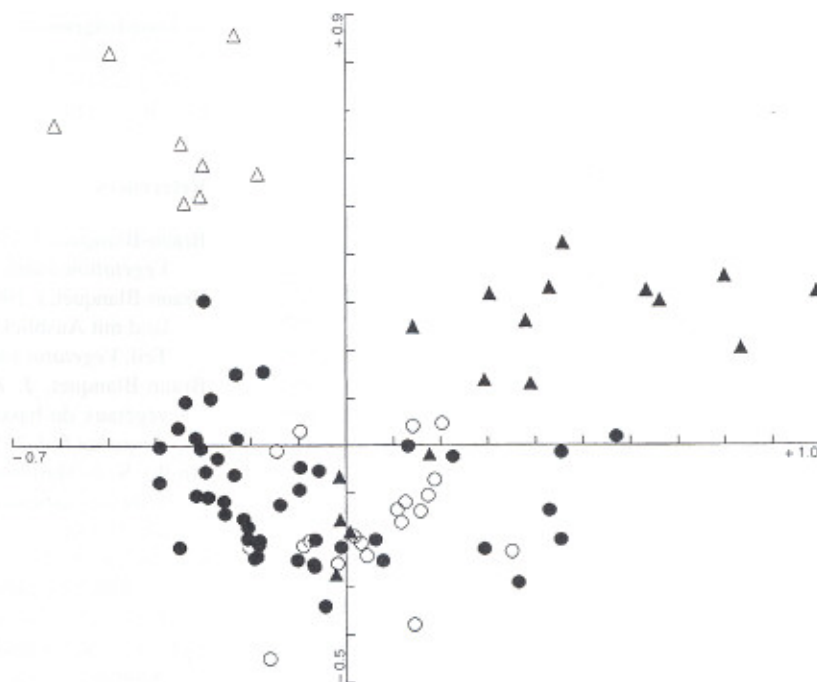


Fig. 6. Ordination of a reduced *Onopordeneae* data set (*Picrido-Melilotetum albae* and *Pastinaca sylvestris-Heracleum sphondylium* community were discarded, leaving only the *Carthametalia*). For symbols see Fig. 4.

detalia acanthii and *Carthametalia lanati*, seven alliances, and two suballiances (see App. 1). App. 2 presents the floristic relations of the communities involved. The order of communities in the table follows the major moisture gradient, from communities of damp and mesic sites (*Convolvuletalia sepium*) towards those showing a preference for dry habitats (*Carthametalia lanati*).

Artemisienea vulgaris (App. 2, columns 1-21)

A group of communities belonging to the *Convolvuletalia sepium* (cols. 1-3) is floristically clearly differentiated both from the *Galio-Alliarietalia* (cols. 4-7) and the *Artemisietalia vulgaris* (cols. 8-21). The shade-tolerant communities of the *Galio-Alliarietalia* are intermediate between the *Convolvuletalia* and the *Artemisietalia*. The *Galio-Alliarietalia* is the only alliance of the order recognized in the study area. It contains the *Geranietum robertiano-lucidi*, the *Oxalido-Geranietum robertiani* and the *Galio-Anthriscetum sylvestris*.

The order of *Artemisietalia vulgaris* is represented by two alliances, the *Arction lappae* and the *Cirsion richterano-chodati*. The former alliance shows a wide distribution in Europe, whereas the latter is a Cantabro-Pyrenean endemic vegetation unit. The bulk of the *Arction* is represented by the *Urtico-Sambucetum* (cols. 10-18), and the remainder of the alliance is the *Smyrniolum olusatrum* community (synecologically very similar to the *Urtico-Sambucetum*). The *Carduo-Cirsietum richterani* (cols. 19-22) is the only association of the *Cirsion richterano-chodati* occurring in the study area. The

syntaxonomic position of the *Arction* is problematic. The *Cirsion richterano-chodati* is typically found on disturbed soils and its communities are rich in thistles, which is a common structural feature of the *Onopordeneae*. On the other hand, the low species richness and geographic limitation to high precipitation regions suggests relationship to the *Artemisienea*, despite the absence of many typical elements of this subclass. In a sense the *Cirsion richterano-chodati* resembles the marginal position of the *Cirsietum eriophori* (*Onopordion acanthii*, *Onopordetalia acanthii*), found in Central European mountain ranges, again at higher altitudes with high precipitation (L. Mucina pers. comm.). *Cirsium richterianum* and *C. chodatium* are taxonomically close relatives of *C. eriophorum*.

Onopordeneae acanthii (App. 2, columns 22-38)

This subclass encompasses two orders such as the *Onopordetalia acanthii* (cols. 22-27), in the study area with only one alliance and the *Carthametalia lanati* (cols. 28-38).

The former order is represented by the *Daucumelilotion*, that contains the *Picrido-Melilotetum albae* the *Picrido-Raphanetum* and the *Pastinaca sylvestris-Heracleum sphondylium* community. The *Picrido-Raphanetum* is found on deep, nitrogen-rich, loamy and disturbed soils in habitats near to the coast and subject to the influence of airborne salt. Many species in this community are *Artemisietaea* elements. On the other hand, the halo-nitrophilous *Raphanus raphanistrum* ssp.

maritimus, *Beta vulgaris* var. *maritima*, *Elymus pycnanthus* and *Atriplex prostrata* as well as the halophilous *Daucus carota* ssp. *gummifer*, *Crithmum maritimum*, *Festuca rubra* ssp. *pruinosa* and *Euphorbia portlandica* (all typical of coastal cliff communities) meet in this community. The classification of the *Picrido-Raphanetum* is difficult due to its transitional position between the *Dauco-Melilotion* and the *Crithmo-Staticetea*.

The community of *Pastinaca sativa* ssp. *sylvestris* and *Heracleum sphondylium* occupies roadside ditches in the Navarro-Alavés subsector. This vegetation is dominated by the large umbellifers *Heracleum sphondylium* and *Pastinaca sativa* ssp. *sylvestris* accompanied by *Hypericum perforatum*, *Picris hieracioides*, *Sinapis arvensis*, *Lactuca virosa*, *Picris echioides* and *Dipsacus fullonum*. Pasture elements such as *Festuca arundinacea*, *Dactylis glomerata*, *Holcus lanatus*, *Achillea millefolium*, *Trifolium pratense* and *Brachypodium pinnatum* ssp. *rupestre* suggest a strong relation of the *Pastinaca sylvestris*-*Heracleum sphondylium* community to the *Arrhenatheretalia* (*Molinio-Arrhenatheretea*). Therefore its inclusion within the *Dauco-Melilotion* is of a preliminary nature. An analogous transitional situation is well-known from Central Europe, where communities with *Pastinaca sativa* ssp. *sativa* and *Arrhenatherum elatius* on abandoned fields, roadsides and other formerly heavily disturbed sites are found (L. Mucina pers. comm.).

The order *Carthametalia lanati* is represented by the *Carduo-Silybetum mariani* (*Silybion mariani*), and the *Onopordetum acantho-nervosi* and *Onopordetum nervosi* (the latter two belonging to the *Onopordion nervosi*). This order is a vicariant unit of the temperate *Onopordetalia acanthii* (Brullo & Marcenò 1983; Rivas-Martínez et al. 1986; Penas et al. 1988; Mucina 1989).

There are two principal vegetation units which can be singled out in the Ebro Valley. One of them is rich in thistles in humid soils found along river margins and locally in high precipitation zones, in which the principal species is *Silybum marianum*. This type is the *Carduo bourgeani-Silybetum mariani* - an association of wide Iberian distribution present also in the Castilian-Cantabrian region (García-Mijangos 1994). The other type is limited to dry soils and corresponds to the *Onopordion nervosi* (Ladero et al. 1983; Penas et al. 1988). The *Onopordetum nervosi* of the Ebro Valley and the *Onopordetum acantho-nervosi* of the Duero Valley (Rivas-Martínez unpubl.) belong to this alliance. The main differentiating feature between these two associations is the presence of *Onopordum corymbosum* in the *Onopordetum nervosi*.

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- App. 1.** Syntaxonomic scheme for perennial nitrophilous vegetation of the *Artemisietea vulgaris* in the northern part of the Iberian Peninsula.
- Artemisietea vulgaris** Lohmeyer, Preisling et Tüxen in Tüxen 1950
- Artemisietea vulgaris* Rivas Goday et Borja Carbonell 1961 em. Rivas-Martínez et al. 1991
- Convolvuletalia sepium** Tüxen 1950
- Senecionion fluviatilis* Tüxen 1947
- Arundini-Convolvuletum sepium* (Tüxen et Oberd. 1958) Bolòs 1962
- Picridio hieracioidis-Eupatorietum cannabini* Loidi et C. Navarro 1988
- Galio-Alliarietalia** Görs et Müller 1969 em. Rivas-Martínez et al. 1991
- Galio-Alliarion** (Oberd. 1957) Lohmeyer et Oberd. in Oberd. et al. 1967
- Geranietum robertiano-lucidi* Loidi et al. ined.
- Oxalido acetosellae-Geranietum robertiani* Loidi et al. ined.
- Galio aparines-Anthriscetum sylvestris* Loidi et al. ined.
- Artemisietalia vulgaris** Lohmeyer in Tüxen 1947
- Arction lappae** Tüxen 1937
- Sambucenion ebuli* Bolòs et Vigo ex Ladero, F. Navarro et Valle-Gutiérrez 1987
- Smyrniolum olusatrum* comm.
- Urtico dioicae-Sambucetum ebuli* Br.-Bl. in Br.-Bl., Roussine et Nègre 1952
- Cirsion richterano-chodati** (Rivas-Martínez in Rivas-Martínez et al. 1984) Rivas-Martínez et al. 1991
- Cirsionion richterano-chodati*
- Carduo nutantis-Cirsietum richterani* Loidi 1983
- Onopordetalia acanthii* Rivas-Martínez et al. 1991
- Onopordetalia acanthii** Br.-Bl. et Tüxen ex Klika et Hadač 1944
- Dauco-Melilotion** Görs 1966
- Pastinaca sylvestris-Heracleum sphondylium* comm.
- Picridio echinoidis-Raphanetum maritimi* Loidi et al. ined.
- Picridio echinoidis-Melilotetum albae* Loidi et C. Navarro 1988
- Carthametalia lanati** Brullo in Brullo et Marcenò 1985
- Silybion mariani** Rivas-Martínez in Rivas-Martínez, Costa et Loidi 1992
- Carduo bourgeani-Silybetum mariani* Rivas-Martínez in Rivas-Martínez, Costa et Loidi 1992
- Onopordion nervosi** Br.-Bl. et Bolòs 1958 corr. Rivas-Martínez 1975
- Onopordetum acantho-nervosi* Rivas-Martínez ined.
- Onopordetum nervosi* Br.-Bl. et Bolòs 1958 corr. Rivas-Martínez 1975

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App. 2. Synoptic tables of the nitrophilous perennial ruderal vegetation in the northern part of Iberian Peninsula. The combinations of numbers or letters in Column 0 indicate for which syntaxon the species is considered to be of diagnostic value. Legend: AV = *Artemisienea vulgaris*; C = *Convolvuletalia*; G = *Galio-Alliarietalia*; A = *Artemisietalia*; O = *Onopordetalia*; L = *Carthametalia lanati*; f = *Senecionion fluviatilis*; g = *Galio-Alliarion*; a = *Arction lappae*; c = *Cirsion richteriano-chodati*; d = *Dauco-Melilotion*; s = *Silybion mariani*; o = *Onopordion nervosi*; 1 = *Arundini-Convolvuletum septium*; 2-3 = *Picrido-Eupatorietum cannabini*; 4-5 = *Geranietum robertiano-lucidi*; 6 = *Oxalido-Geranietum robertiani*; 7 = *Galio-Anthriscetum sylvestris*; 8-9 = *Smyrniolum olusatrum* comm.; 10-18 = *Urtico-Sambucetum ebuli*; 19-21 = *Carduo-Cirsietum richterani*; 22 = *Pastinaca sylvestris-Heracleum sphondylium* comm.; 23-24 = *Picrido-Raphanetum maritimi*; 25-27 = *Picrido-Melilotetum albae*; 28-35 = *Carduo-Silybetum mariani*; 36-37 = *Onopordetum acantho-nervosi*; 38 = *Onopordetum nervosi*.

Column number	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38		
Order		C	C	C	G	G	G	G	A	A	A	A	A	A	A	A	A	A	A	A	A	A	O	O	O	O	O	O	L	L	L	L	L	L	L	L	L	L	L		
Alliance		f	f	f	g	g	g	g	a	a	a	a	a	a	a	a	a	a	a	a	c	c	c	d	d	d	d	d	d	s	s	s	s	s	s	s	s	o	o	o	
Number of relevés		3	8	3	5	12	6	28	7	4	7	12	7	6	7	28	38	36	4	9	4	5	8	9	8	4	19	16	3	3	4	20	12	4	3	12	8	6	8		
<i>Cynanchum acutum</i>	1	2																																							
<i>Phragmites australis</i>	1	1												I																											
<i>Eupatorium cannabinum</i>	2+3		V	3				+						I		+		+	3						I																
<i>Solanum dulcamara</i>	2+3		II	2													+	+																							
<i>Hypericum androsaemum</i>	2+3		I	2																																					
<i>Solidago virgaurea</i>	2+3		I	1																																					
<i>Teucrium scorodonia</i>	2+3		II	1																																					
<i>Geranium lucidum</i>	4+5			V	IV		II		1		+						+	+																							
<i>Fragaria vesca</i>	6				+		IV										+																								
<i>Oxalis acetosella</i>	6						V																																		
<i>Savifraga hirsuta</i>	6						II																																		
<i>Viola reichenbachiana</i>	6						III																																		
<i>Cardamine flexuosa</i>	6						II																																		
<i>Anthriscus sylvestris</i>	7				+		V		1								+	1																							
<i>Cruciata laevipes</i>	G				IV	II		III		1						1	+	+					2	1																	
<i>Alliaria petiolata</i>	G				I	III		II		1							+	+																							
<i>Smyrniolum olusatrum</i>	8+9				1				V	4	1						+	1																							
<i>Cirsium richterianum</i>	c				1												+																								
<i>Carduus nutans</i>	c																+																								
<i>Galium aparine</i>	AV			1	II	V		V	III	3	III	IV	V		V	III	IV	IV	2					IV																	
<i>Sambucus ebulus</i>	AV	1	1		II		I	IV			V	IV	V	V	V	IV	IV	III	3					I																	
<i>Rumex obtusifolius</i>	AV		1					III	1	1	III	II	III				1	1	III	2					II				1												
<i>Geranium robertianum</i>	AV		II		III	V	V	I			II	II					II	1	1	1	II	4																			
<i>Ranunculus repens</i>	AV		IV	1		1	III	II								1	+	II	2	1		1																			
<i>Lamium maculatum</i>	AV				+		III		1	III	III	III		III	1		II								I																
<i>Pastinaca sylvestris</i>	22				II		+										1	1					V					+	1												
<i>Festuca arundinacea</i>	22							1		1	II												IV		1		II														
<i>Phleum bertolonii</i>	22									2														IV																	
<i>Lavatera cretica</i>	23+24								1	1		1				+		+								II	III	4													
<i>Atriplex prostrata</i>	23+24																									IV	1														
<i>Raphanus maritimus</i>	23+24																										V	IV													
<i>Elymus pycnanthus</i>	23+24																										IV	1													
<i>Desmazeria marina</i>	23+24																											II													
<i>Euphorbia portlandica</i>	23+24																											II													
<i>Daucus gummifer</i>	23+24																											IV													
<i>Daucus carota</i>	d		III	1	1					2							1	+	+	1				III	II	V	4	V	IV		3		II		1			II	1		
<i>Plantago lanceolata</i>	d		II						1	1	1						1	+	+				III	III	V	2	IV	II													
<i>Picris echioides</i>	d													III			+	+	+				III	IV	V	3	IV	III	2								II	1			
<i>Trifolium pratense</i>	d		1		1				1								+	+	+				V	1		2	III	III													
<i>Hypericum perforatum</i>	d		II					+	1														IV		1	3	IV	IV													
<i>Conyza canadensis</i>	d		II																									III	V	4	III	II									

Column number	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38		
Order		C	C	C	G	G	G	G	A	A	A	A	A	A	A	A	A	A	A	A	A	O	O	O	O	O	O	L	L	L	L	L	L	L	L	L	L	L	L		
Alliance		f	f	f	g	g	g	g	a	a	a	a	a	a	a	a	a	a	a	c	c	c	d	d	d	d	d	s	s	s	s	s	s	s	s	s	s	s	s		
Number of relevés		3	8	3	5	12	6	28	7	4	7	12	7	6	7	28	38	36	4	9	4	5	8	9	8	4	19	16	3	3	4	20	12	4	3	12	8	6	8		
<i>Rubus ulmifolius</i>	-	-	2	-	-	-	I	-	2	III	III	III	-	V	IV	II	I	3	-	-	-	I	-	II	-	-	I	-	-	1	+	-	-	-	-	-	-	-	-	-	
<i>Bromus diandrus</i>	-	-	-	III	1	-	II	III	I	III	-	-	I	-	-	III	II	-	-	-	-	II	III	-	-	+	III	-	-	-	1	1	-	-	-	-	IV	-	-	-	
<i>Hordeum murinum</i>	-	-	-	-	I	-	I	I	I	I	-	-	-	-	I	I	+	-	-	-	-	II	II	-	-	+	I	-	-	-	II	-	-	-	3	I	-	II	-	-	
<i>Mentha suaveolens</i>	-	V	2	-	-	-	+	-	-	I	II	-	-	-	-	+	II	1	-	-	1	-	II	II	2	III	+	-	-	-	-	-	-	-	-	-	+	-	-	-	
<i>Tortilis arvensis</i>	-	-	-	IV	III	-	I	-	1	-	+	-	I	III	+	II	II	-	-	-	-	III	-	-	-	III	-	1	-	II	-	-	-	-	-	-	1	-	-	-	
<i>Geranium dissectum</i>	-	-	-	-	+	II	I	-	III	II	III	-	III	+	II	+	II	+	-	-	-	1	II	1	-	+	-	-	-	-	-	-	+	-	-	-	-	-	-	-	-
<i>Avena barbata</i>	-	1	-	-	-	-	+	1	-	-	-	-	-	-	I	+	1	-	-	-	-	-	-	1	1	2	1	III	-	-	1	+	-	-	-	-	III	-	-	-	-
<i>Vicia nigra</i>	-	-	-	II	+	-	+	-	2	-	-	-	-	-	-	+	+	+	-	-	-	1	III	-	-	+	II	-	-	1	+	-	-	-	-	-	+	-	-	-	-
<i>Bromus hordeaceus</i>	-	-	-	-	II	-	II	-	-	-	-	-	-	-	-	1	+	1	-	-	-	1	III	-	-	+	-	1	1	-	+	+	-	-	-	1	-	-	-	III	-
<i>Medicago sativa</i>	-	-	-	-	-	-	+	II	-	-	-	-	-	-	-	1	+	+	-	-	-	II	-	-	II	IV	1	-	-	II	-	1	-	II	II	IV	III	-	-	-	-
<i>Brachypodium rupestre</i>	-	III	1	-	-	-	-	1	-	-	-	-	I	-	II	+	+	+	-	-	1	IV	I	-	1	-	+	-	-	-	+	-	-	-	-	-	-	-	-	-	-
<i>Poa pratensis</i>	-	-	-	-	+	-	I	1	1	-	+	-	-	-	I	1	1	1	III	-	1	II	-	-	-	I	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
<i>Lolium perenne</i>	-	-	-	1	-	I	-	2	1	-	-	-	-	-	+	+	+	-	-	-	-	III	1	-	2	II	-	-	-	+	-	-	-	-	-	-	J	-	-	-	
<i>Achillea millefolium</i>	-	-	-	-	-	II	1	-	-	-	-	-	-	-	+	1	1	-	II	2	3	V	-	-	1	I	-	-	II	-	2	-	-	-	-	-	-	-	-	-	
<i>Potentilla reptans</i>	-	II	-	-	1	+	-	1	-	-	II	-	-	-	I	-	1	-	-	-	1	1	-	II	-	III	II	-	-	-	-	-	-	-	-	-	-	-	-	-	-
<i>Poa trivialis</i>	-	-	-	-	II	III	-	2	II	+	-	-	-	-	III	+	II	-	-	-	-	II	I	-	-	-	-	-	-	-	+	-	1	-	-	-	-	-	-	-	-
<i>Rumex crispus</i>	-	-	-	-	-	-	II	-	2	+	-	-	-	-	+	II	II	-	-	-	-	III	-	-	-	1	III	-	-	+	-	4	-	II	-	-	-	-	-	-	
<i>Humulus lupulus</i>	2	1	-	1	-	-	+	-	-	-	-	II	-	-	+	+	1	-	-	-	-	-	-	1	-	+	-	-	1	-	-	-	-	-	-	-	-	-	-	-	
<i>Pteridium aquilinum</i>	-	II	-	-	-	-	-	-	1	1	1	-	-	-	1	+	1	1	-	3	-	-	-	-	-	-	-	+	-	-	-	-	-	-	-	-	-	-	-	-	-
<i>Sisymbrium officinale</i>	-	-	-	1	-	I	III	-	-	-	-	-	-	-	II	1	+	1	-	-	-	-	-	-	-	+	-	-	1	IV	-	-	-	II	-	-	-	-	-	-	
<i>Hirschfeldia incana</i>	-	-	-	-	-	-	+	1	-	-	-	-	-	-	+	-	-	-	-	-	-	-	-	-	2	+	II	-	II	II	-	-	-	-	II	V	-	-	-	-	
<i>Crepis baensteri</i>	-	-	-	-	-	-	1	-	2	-	-	-	-	-	+	+	-	1	-	-	II	1	-	-	-	+	II	-	-	+	-	-	-	-	-	-	-	-	1	-	
<i>Rumex pulcher</i>	-	-	-	-	-	-	-	-	-	-	+	-	-	-	II	1	+	-	-	-	-	-	-	-	-	-	1	-	-	1	II	-	-	1	III	-	1	-	-		
<i>Pulicaria dysenterica</i>	1	IV	1	-	-	-	-	-	-	-	-	I	-	-	+	-	-	-	-	-	-	-	-	-	-	II	1	1	IV	-	-	-	-	-	-	-	-	-	-		
<i>Heracleum sphondylium</i>	-	-	-	1	-	-	V	-	3	-	-	-	-	-	-	III	1	-	-	-	-	V	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	
<i>Angelica sylvestris</i>	-	2	3	-	+	-	-	-	-	1	-	II	-	-	-	-	+	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
<i>Beta maritima</i>	-	-	-	-	-	-	-	-	-	-	-	-	-	-	+	-	-	-	-	-	-	-	-	III	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	IV	-

Legend to App. 2.

Community name	Col.	Source	
			<i>Carduo-Cirsietum richterani</i>
			19 Loidi (1983: Tab. 19)
			20 Onaindia (1986: Tab. 54)
			21 Loidi et al. (ined.: Tab. 5)
			22 Loidi et al. (ined.: Tab. 7)
			23 Loidi et al. (ined.: Tab. 6)
			24 M. Herrera (1989: Tab. 44)
			25 Loidi & C. Navarro (1988: Tab. 1, rels. 20-23)
			26 Loidi & C. Navarro (1988: Tab. 1, rels. 1-19)
			27 García-Mijangos (1994: Tab. 42)
			28 Ursúa (1986: Tab. 37)
			29 Ursúa (1986: Tab. 36, rels. 1,2,4)
			30 Braun-Blanquet & Bolós (1958: Tab. 7)
			31 García-Mijangos (1994: Tab. 43)
			32 Ladero et al. (1983: Tab. 14)
			33 Penas et al. (1988: Tab. 4)
			34 Rivas-Martínez et al. (1986: Tab. 7)
			35 Loidi et al. (ined.: Tab. 8)
			<i>Onopordetum acantho-nervosi</i>
			36 Ladero et al. (1983: Tab. 13)
			37 Penas et al. (1988: Tab. 3)
			<i>Onopordetum nervosi</i>
			38 Braun-Blanquet & Bolós (1958: Tab. 6)
			sub <i>Onopordetum arabici</i>
<i>Arundini-Convulvuletum sepium</i>	1	Ursúa (1986: Tab. 30)	
sub <i>Cynancho-Calystegion sepium</i>			
<i>Picridio-Eupatorietum cannabini</i>	2	Loidi & C. Navarro (1988: Tab. 2)	
	3	Loidi et al. (ined.: Tab. 1)	
<i>Geranietum robertiano-lucidii</i>	4	García-Mijangos (1994: Tab. 41)	
	5	Loidi et al. (ined.: Tab. 2, rels. 1-12)	
<i>Oxalido-Geranietum robertiani</i>	6	Loidi et al. (ined.: Tab. 2, rels. 13-18)	
<i>Galio-Anthriscetum sylvestris</i>	7	Loidi et al. (ined.: Tab. 3)	
<i>Smyrniolum olusatrum</i> comm.	8	García-Mijangos (1994: Tab. 40)	
	9	Loidi et al. (ined.: Tab. 4, rels. 37-40)	
<i>Urtico-Sambucetum ebuli</i>	10	M. Herrera (1989: Tab. 43)	
	11	Loidi (1983: Tab. 17)	
	12	Onaindia (1986: Tab. 53)	
	13	Ursúa (1986: Tab. 31)	
	14	C. Navarro (1982: Tab. 16, rels. 1,3,4,6,8-10)	
	15	Braun-Blanquet (1967: Tab. 8)	
	16	García-Mijangos (1994: Tab. 39)	
	17	Loidi et al. (ined.: Tab. 4, rels. 1-36)	
	18	Loidi (1983: Tab. 18)	