

## ***Violion caninae* grasslands (*Nardetea strictae*) in the North and North-West of Spain**

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**Abstract.**- This paper is a phytosociological study of the associations included in the *Violion caninae* alliance which occur in the Eurosiberian Region of the north and north-west of the Iberian Peninsula (Cantabrian-Atlantic and Orocantabric chorological subprovinces). For this purpose we have taken into consideration the composition, distribution and comparative analysis of the respective synthetic tables from the associations presented in the area. In the more oceanic mountains of Galicia, this type of vegetation adopts the form of acidophilous pasture land clearly located below an altitude of 1,000 m and directly related both to the high rainfall rates of these ranges and the pressure induced by the free grazing of horses all the year round. The study illustrates the relationships between the alliance associations growing in the north and north-west of the Iberian Peninsula and a new association (*Galio viviani-Danthonietum decumbentis*) is described. We extend the concept of *Violion caninae* to include the Cantabrian-Atlantic and British-Atlantic associations growing on the mesotemperate and supratemperate belts which belong to the *Agrostienion curtisii* suballiance.

**Key words :** Habitats Directive - natural grasslands - free grazing - Cantabrian-Atlantic vegetation - mat-grass communities.

**Résumé.**- On présente une étude phytosociologique des associations appartenant à l'alliance *Violion caninae* qui se trouvent au nord et nord-ouest de la péninsule Ibérique, prenant en considération leur distribution et l'étude comparative avec des tableaux synthétiques. Dans les montagnes les plus océaniques de la Galice, on trouve des groupements de pâturages acidiphiles, en-dessous de 1000 m d'altitude, liés aux importantes précipitations que reçoivent ces montagnes, ainsi que la pression du bétail équin. À partir de cette étude une nouvelle association (*Galio viviani-Danthonietum decumbentis*) est décrite, laquelle s'intègre à l'ensemble des associations reconnues pour l'alliance dans les territoires cantabro-atlantique et oro-cantabrique de la péninsule Ibérique. Nous étendons le concept de *Violion caninae* pour y inclure les associations cantabro-atlantiques et britanniques-atlantiques des étages mesotempérés et supratempérés de la suballiance *Agrostienion curtisii*.

**Mots clés :** Directive Habitats - pâturages naturels - pacage à bétail - végétation cantabro-atlantique - pelouses à nard.

## I. INTRODUCTION

Both in Eurosiberian Europe and in the Mediterranean ranges with high rainfall rates and no intense dry season, natural, dense, acidophilous pastures tend to grow on seasonally waterlogged soils, dominated by caespitose and graminoid hemicryptophytes. These pastures belong to the *Nardetalia strictae* order, the only order of the *Nardetea strictae* class. These communities occur as a result of man's exploitation of the natural vegetation, based on the eradication of the former forests and the woody vegetation, which is dominated by different species of Ericaceae, in order to encourage caespitose and rhizomatous hemicryptophytes tolerant of the pressure induced by herbivores.

These pastures tend to grow in mountainous or high mountainous areas where plants can find that extra amount of climatic and edaphic moisture they need along the relative dry summer season. They have also served as an age-old resource for cattle grazing when the rigours of the Mediterranean summer made lower altitude areas unsuitable for this purpose. The frequent occurrence and dominance of *Nardus stricta*, *cervuno* in Spanish, led to the coining of the vernacular Spanish name of *cervunales*. However, as a result of the heavy rainfall during most of the year and the moderate rainfall rates in summer, in Atlantic territories this kind of pasture may also thrive at much lower altitudes. In this respect, the only requirements are heavy rainfall on acid soil (alternatively, on basic rocks but with deep, heavily base-leached soils) and intense herbivory.

The diversity of this class in the Iberian Peninsula allows us to distinguish the following categories: orotemperate Alpine-Pyrenean and Orocantabrian mat-grass communities (*Nardion strictae*), oro- and cryorotemperate mat-grass communities occurring in the Mediterranean-Ibero-Atlantic ranges and the Orocantabrian western regions (*Campanulo herminii-Nardion strictae*), oro- and cryoromediterranean Baetic pastures (*Plantaginion nivalis*) and Central European, Cantabrian-Atlantic and Orocantabrian pastures belonging to the meso- and supratemperate bioclimatic belts, with or without mat-grass (*Violion caninae*) (Rivas-Martínez *et al.*, 2002b).

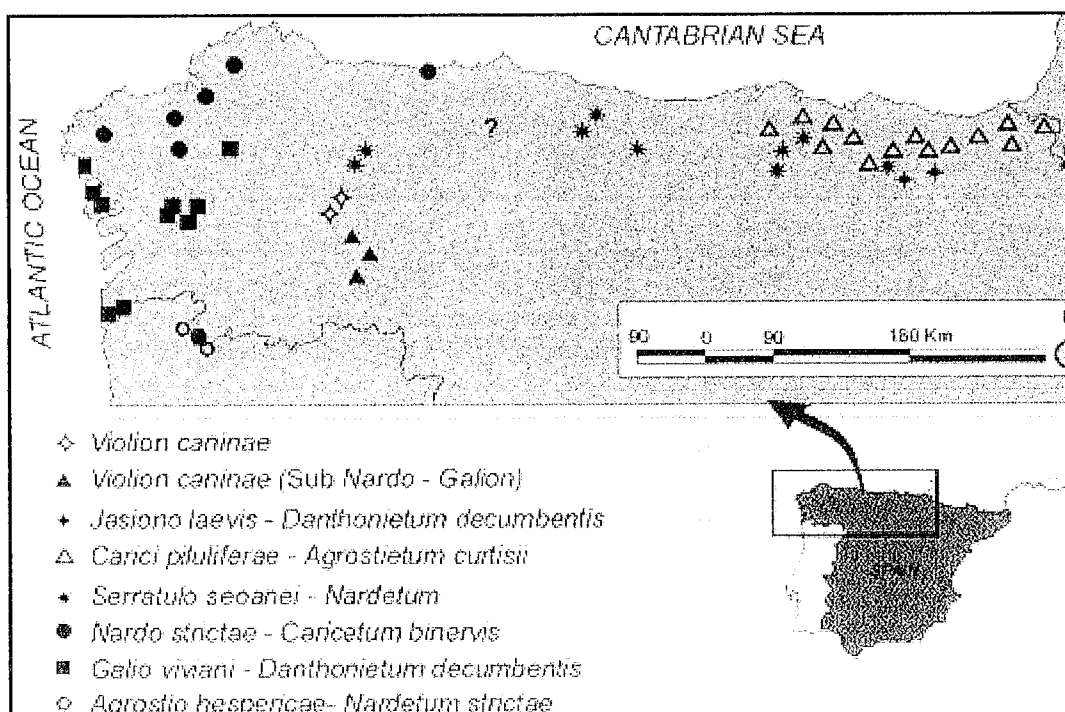


Fig. 1. -Distribution of the *Violion caninae* associations in the north of Spain.

Fig. 1.- Distribution des associations du *Violion caninae* au nord de l'Espagne.

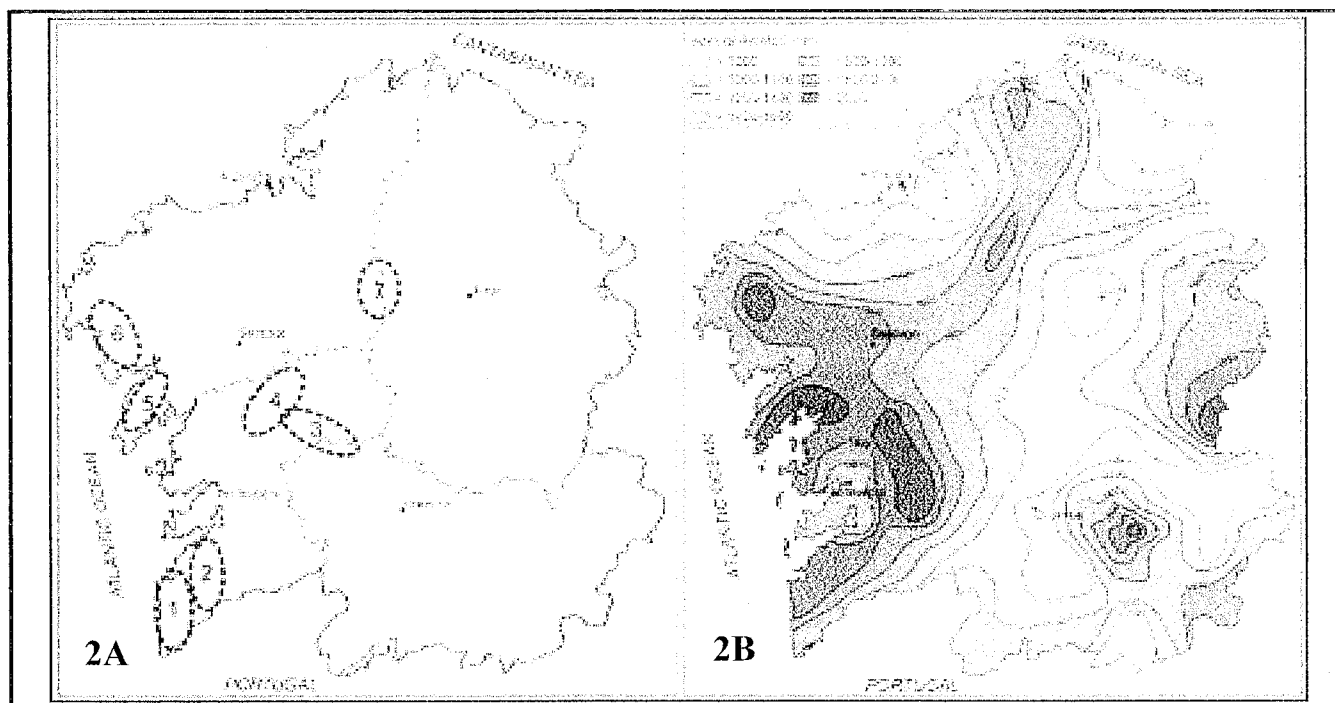


Fig. 2.- Yearly average rainfall value in Galicia (2A); location of the sampled areas and mountainous areas (2B). 1: Sierra de A Groba; 2: Sierra de Galiñeiro; 3: A Estrada-Campo Lameiro 4: Sierras de Candán and Cando; 5: Sierra de Barbanza; 6: Montes del Pindo; 7: Sierra de Careón.

Fig. 2.- Carte des précipitations moyennes annuelles en Galice (2B) ; localisation des aires de montagne où les relevés ont été réalisés (2A).

In the Iberian Cantabrian-Atlantic territory (Fig. 1), five associations have so far been recognized as belonging to this last alliance, including *Nardo-Caricetum binervis*, already described in Ireland (Braun-Blanquet & Tüxen, 1952). However, recent studies in Galicia have revealed the occurrence of certain *Violion caninae* pastures which cannot be identified in previous proposals for the territory (see Izco *et al.*, 2001). This paper aims at filling this gap and to clarify the relationships of the whole group of associations. The *Violion caninae* pastures are included in the group « Grass-like formations with *Nardus*, which encompass numerous species growing on siliceous substrates of mountainous areas (and submountainous areas of continental Europe) » (Code 6230 of the Habitats Directive 92/43).

## II. STUDY AREA

The pastures under study occur on the coastal ranges along the Atlantic rim of Galicia (N-W of Spain), with peaks varying from 500 to 600 m in the ranges nearest to the coast and from 800 to 900 m in a mountainous range slightly further inland (Fig. 2). The original materials are always siliceous, alkaline schists and granitoid (Loureiro & Matía, 2001: 85) producing sandy soils of a more or less fine texture. According to the typology of Rivas-Martínez *et al.* (2002a), the area belongs to the chorological Cantabrian-Atlantic Subprovince, Galician-Portuguese Sector. Some of the relevés come from the coastal mountains (Compostelanian and Miñense Subsectors) and others from more inland areas ascribed to the so-called Dorsal Gallega (Lucense Subsector).

Rainfall is regular and abundant: with yearly average values over 2,000 l/m<sup>2</sup> (Fig. 2B), 10% or more of the over 140-150 days of rain corresponds to the summer season (Uña, 2001). The meteorological station of Barbanza (600 m a.s.l., see Fig. 2A) is particularly remarkable in the area with a yearly average rainfall value of over 2,200 l (Martínez & Pérez, 1999: 200) according to the representative maps, but with actual average rainfall values of 3,370 l/m<sup>2</sup> for the period 1945-1974 (Carballeira *et al.*, 1983). To these rainfall values recorded by the rain gauges, we must add both the hidden rainfall values as a result of condensation induced by the frequent mist and fog, even in summer, caused by the barrier effect which halts the incoming clouds from the ocean and also the decrease of desiccation as a result of diminished sunlight. Both circumstances counteract the relative absence of summer rainfall all along the Atlantic rim of the north of Spain, and it is most noticeable at the lower altitudes of the sampled areas.

According to the criteria and maps of Rivas-Martínez *et al.* (2002a), the territories under study present a Temperate Hyperoceanic Submediterranean and Temperate Oceanic Submediterranean bioclimate ascribed, as far as temperatures are concerned, to the Mesotemperate Submediterranean bioclimatic belt. Atlantic submediterranean oak woods belonging to the *Rusco aculeati-Quercetum roboris* association are the potential vegetation. However, these woods have been destroyed by the traditional exploitation of the territory and nowadays there are only very few remnants of them. By contrast, the potential forests have been substituted by gorse-heath bushes growing on dry soils or with a certain amount of edaphic moisture. These serial communities belong to several *Daboecion cantabricae* associations (Izco *et al.*, 2006) are widely distributed in the area and give rise to a mosaic-like landscape with pastures grazed by cattle.

The pastures under study are not only induced by climatic and edaphic conditions, but also by extensive livestock farming which, although less intense than in the past, still persists (Table I). Although horse raising activities tend to be dominant there is also cattle farming. Free grazing farming forms part of an ancient ecosystem which systematically makes fires to eliminate woody plants and promote the development of herbaceous plants suitable for cattle farming (Fig. 3). Since this kind of cattle farming delays or slows down the succession towards woody vegetation stages, the close cause-effect relationship bet-

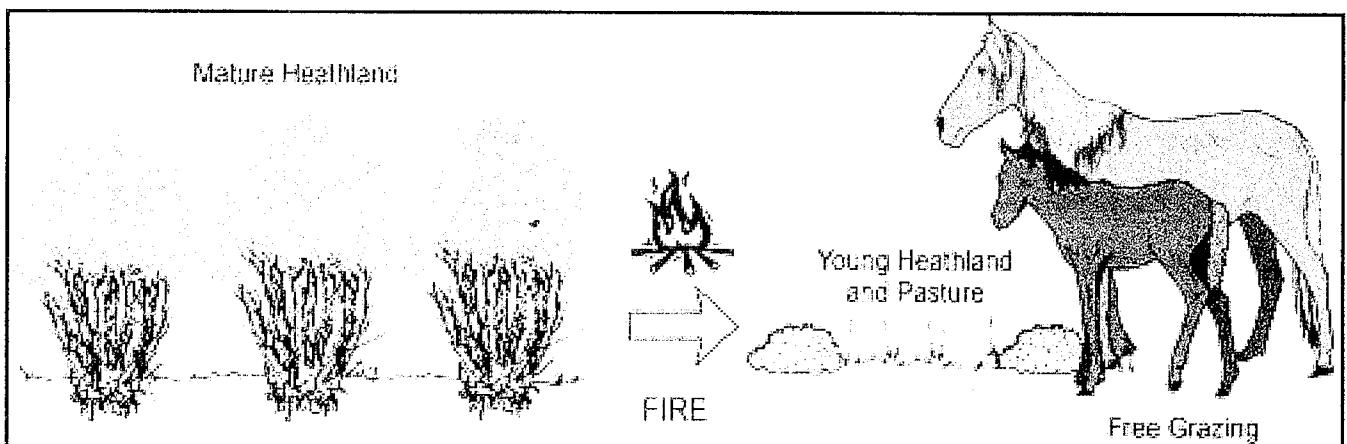


Fig. 3.- Diagram of the traditional treatment of gorse-heaths bushes in the coastal ranges of Galicia based on repeatedly burning the vegetation and free range grazing of livestock.  
 Fig. 3.- Schéma de l'usage traditionnel des landes à ajonc et bruyère dans les aires montagneuses côtières de la Galice : brûlages réitérés de la végétation arbustive et pâturage libre du bétail.

Table I.- Horse and bovine cattle census (Anuario de Estadística Agraria) in some localities with coastal ranges. Province codes - C: A Coruña; Po: Pontevedra. Numbers accompanying the provincial code refer to the areas represented in Fig. 2A.

Tableau I.- Recensement du bétail bovin et équin dans quelques localités des montagnes côtières de Galice.

Council (Province - Area)	Horses 1989	Horses 1999	Cows for meat 2002
Boiro (C - 5)	293	333	555
Pobra do Caramiñal (C - 5)	23	138	37
Ribeira (C - 5)	48	163	335
Outes (C - 6)	3	10	1103
Porto do Son (C - 5)	138	430	470
Tui (Po - 2)	235	278	132
Barro (Po - 3)	31	103	56
Campo Lameiro (Po - 3)	180	155	178

ween free grazing farming and this grassland community will provoke the disappearance of this vegetation when this type of farming ceases to be profitable. The current models produce mosaic-like landscapes of either pine woods (*Pinus pinaster* and *P. radiata*)-grassland or scrubland-grassland (*Calluno-Ulicetea*, *Daboecion cantabricae*). In some cases these two models are mixed one with the other.

### III. METHODOLOGY

The research surveys the main ranges of Galicia facing the Atlantic and included in the Galician-Portuguese Sector. With a rainy climate, these territories have traditionally been exploited for forest industry activities and cattle farming. The relevés of the communities were carried out using the phytosociological method of Braun-Blanquet (1979), later updated by Géhu & Rivas-Martínez (1981).

As far as taxonomical nomenclature is concerned, we have basically complied with the proposals of *Flora Iberica* (Castroviejo, 1986-2007) for the published groups and *Flora Europaea* (Tutin *et al.*, 1964-1980). Following Aizpuru *et al.* (1999) and Greuter (2008), we recognized *Serratula tinctoria* L. subsp. *seoanei* (Willk.) Láinz, although in Spain the name *Serratulo tinctoriae-Nardetum* is also used. The occurrence of *Galium saxatile* var. *vivianum*, with  $2n = 22$ , as opposed to the typical variety, with  $2n = 44$ , in the Iberian northwest has recently been confirmed by Ortega-Olivencia & Devesa (2007). *Gentiana pneumonanthe* var. *aloiana* (Merino, 1906) has also been described in the territory of the relevés; however, according to the criterion of the monograph of this genus (Renobales, 2003), the features of the var. *aloiana* are generally shared by the species and consequently no taxonomical independence should be granted.

As far as syntaxonomical systematics is concerned at alliance level, we comply with Rivas-Martínez *et al.* (2001).

### IV. RESULTS

The pastures under study are a type of herbaceous graminoid-like community which is dominated by hemicryptophytes and grows on siliceous, acid substrates with relatively deep soils, slightly humid during most of the year and with Mesotemperate Hyperhumid bioclimates. The community is dominated by perennial gramineae, mostly caespitose (*Agrostis capillaris*, *A. curtisii*, *Danthonia decumbens*, *Molinia caerulea*, *Avenula sulcata*) and graminoid, rhizomatous Cyperaceae (*Carex binervis*, *C. pilulifera*). For characteriza-





Table III, Tableau III.- *Galio viviani-Danthonietum decumbentis* Izco, Amigo & Pulgar ass. nova, subassociation *juncetosum squarrosi* subass. nova (*Agrostienion curtisii*, *Violion caninae*, *Nardetalia strictae*, *Nardetea strictae*).

Order n°	1	2	3	4	5	6	7
Altitude (m a.s.l.)	600	610	600	520	630	960	965
Slope (°)	5	0	<5	5	<5	0	0
Aspect	N	-	NW	E	E	-	-
Plot area (m <sup>2</sup> )	60	30	40	25	50	40	30
N° of species	14	15	13	12	14	13	12
<b>Ass., All., Or. &amp; Class species</b>							
<i>Agrostis capillaris</i>	3	3	3	3	2	1	1
<i>Potentilla erecta</i>	2	1	1	+	+	.	+
<i>Danthonia decumbens</i>	3	3	1	.	1	4	3
<i>Carum verticillatum</i>	1	1	2	1	.	2	3
<i>Carex binervis</i>	1	2	1	+	1	.	+
<i>Molinia caerulea</i>	2	1	2	3	3	3	.
<i>Gentiana pneumonanthe</i>	+	+	.	+	+	.	.
<i>Ranunculus bulbosus</i>	r	.	.	.	r	+	1
<i>Carex pilulifera</i>	.	1	.	.	.	+	.
<i>Veronica serpyllifolia</i>	.	.	.	.	r	1	.
<i>Galium saxatile</i> var. <i>vivianum</i>	.	.	.	.	.	1	1
<i>Festuca nigrescens</i>	.	.	.	.	.	1	3
<b>Differentials subas. <i>juncetosum squarrosi</i></b>							
<i>Juncus squarrosus</i>	1	1	2	3	1	3	3
<i>Carex panicea</i>	2	1	2	2	2	2	2
<i>Nardus stricta</i>	.	3	.	2	3	3	1
<i>Arnica montana</i> subsp. <i>atlantica</i>	.	.	1	1	2	.	.
<b>Companion species</b>							
<i>Merendera pyrenaica</i>	+	1	+	.	.	.	.
<i>Agrostis truncatula</i> subsp. <i>commista</i>	r	3	.	.	.	.	.
<i>Calluna vulgaris</i>	.	+	.	.	+	.	.
<i>Juncus acutiflorus</i>	.	.	.	r	+	.	.

Species present in only 1 relevé - *Avenula sulcata* 1 in 2; *Drosera intermedia* 1 in 3; *Hypochaeris radicata* + in 1; *Juncus bulbosus* + in 3; *Leontodon taraxacoides* + in 1; *Lotus corniculatus* 1 in 3; *Polygala serpyllifolia* + in 6; *Serratula tinctoria* subsp. *seoanei* + in 7; *Succisa pratensis* 3 en 3.

Localities (Galician provinces: Po = Pontevedra; C = Coruña) - 1. C: Pobra do Caramiñal, Postmarcos; Barbanza Range by the contact between A Pobra, Porto do Son & Boiro councils (29T NH0324). 2. C: Mazaricos, between Olveiroa and Arcos; Cruz de Basteira (29T MH9553). 3. C: Pobra do Caramiñal, Postmarcos; by the Barbanza Range (29T NH0324). 4. C: Boiro, Cures; by the Barbanza Range near Balteiro (29T NH0527). 5. Po: A Estrada, Souto (29T NH4114) (HOLOTYPUS). 6. Po: Forcarei, Cando Range (29T NH 5204). 7. Po: Forcarei, Cando Range (29T NH 5105).

tion purposes other species, moderately hygrophilous hemicryptophytes (*Potentilla erecta*, *Carum verticillatum*, *Gentiana pneumonanthe*, *Galium saxatile* var. *vivianum* or *Serratula tinctoria* subsp. *seoanei*) are also important. Some of these gramineae, particularly *Agrostis curtisii*, play the role of *Nardus stricta* in analogous communities and form a dense and flat vegetal carpet which can cover extensive areas.

The occurrence of *Galium saxatile* var. *vivianum* is particularly interesting. This taxon is widely distributed in Europe and well adapted to cattle grazing because of its small size and congested configuration. Meanwhile, the typical tetraploid variety tends to grow on gorse-heath bushes, where it is protected from the pressure of herbivores and can grow to a larger size. Exceptionally, at higher altitudes than usual and in depressions which give rise to a greater degree of wetness which is also longer-lasting, more hygrophilous plants (*Juncus squarrosus*, *Carex panicea*, *Arnica montana* subsp. *atlantica*) tend to occur. The mat-grass (*Nardus stricta*) occurs in these environments too.

Table II comprises 24 relevés of the typical community and Table III includes another 7 relevés under slightly different conditions. The community grows at altitudes lower than others communities subordinated to the *Violion caninae* alliance. The average altitude of the relevés of Table II is 600 m, albeit the community also occurs under 400 m a.s.l. (relevés 9, 10) and over 900 m a.s.l. (relevés 19, 20, 21). The relevés of Table III were taken in an altitudinal strip ranging from 520 to 965 m a.s.l. With an average value of 15 sp./rele-

vé in Table II, there are poor relevés (9-13 sp.) and comparatively rich relevés (18-20 sp.); Table III is more homogeneous, with 12-15 species per relevé.

As far as floristic composition is concerned, a series of characteristic species belonging to the *Nardetea strictae* class stand out. As can be seen in Table II, more than half of the relevés include *Agrostis capillaris*, *Potentilla erecta*, *Danthonia decumbens*, *Galium saxatile*, *Carum verticillatum* and *Ranunculus bulbosus*. Environmental conditions are also coincidental with those corresponding to this class.

## V. DISCUSSION

Within the *Nardetea strictae* class and as far as floristic composition and environmental conditions are concerned, the community under study is integrated into the *Violion caninae* alliance. For a comparative analysis of the affinities and differences in relation to the associations included in the alliance, we give in Table IV an overview of the already available relevés (some of them still unpublished) of the communities belonging to *Violion caninae* and occurring in the Cantabrian-Atlantic and Orocantabric subprovinces of the Iberian Peninsula. Although some of the relevés shown in Table IV are relatively old and were published under the name of *Nardo-Galion saxatilis* alliance (columns 5 and 8), we opted for their inclusion because they provide data taken from the same biogeographical territory under study and there is a general lack of information on this class in the Iberian north-west. Likewise, column 13 corresponds to the descriptive table of the *Nardo-Caricetum binervis*, with 9 relevés made in Ireland. However, since this association has been repeatedly recorded in Galicia, we thought it was convenient to include it too.

An analysis of Table IV reveals some trends in the characterization and differentiation of the *Violion caninae* associations in the north of the Iberian Peninsula. Although *Nardus stricta* is a common element in this table, its behaviour is remarkable both in the *Jasiono laevis-Danthonietum* and *Carici piluliferae-Agrostietum curtisii* and in the community under study, only associated with environments relatively wetter than those corresponding to the rest of the relevés, as part of more hygrophilous subassociations. These three communities include other species of gramineae (*Agrostis curtisii*, *Festuca nigrescens* subsp. *microphylla*) which play the same soil-fixing role as *Nardus stricta* in the rest of the associations.

The associations *Serratulo seoanei-Nardetum*, *Carici piluliferae-Agrostietum curtisii* and *Jasiono laevis-Danthonietum decumbentis* grow on substrates derived from the calcareous rocks of the eastern Cantabrian and Orocantabrian territories, and include a group of shared species which differentiate them from the rest: *Jasione laevis*, *Carex caryophyllea*, *Plantago media* and *Potentilla montana*, peculiar to compact, slightly loamy soils. As a result of its floristic composition, ecology and chorology, column 12, identified simply as the *Nardo-Galion saxatilis* community, with relevés made in the area round Oviedo (Asturias) (Navarro, 1974), integrates into this group. The presence or absence of *Carex binervis*, *C. panicea*, *C. pilulifera*, *Gentiana pneumonanthe*, *Carum verticillatum*, *Avenula sulcata*, *Agrostis curtisii* and *Erica vagans* makes these three associations clearly distinguishable (see also Table V). Columns 13 and 14, based on some relevés made on the ranges of Caurel (Lugo) (Guitián, 1984) should probably be integrated into this group of orocantabrian pastures, as part of *Serratulo-Nardetum*. At all events these pastures require a more detailed study.

Table IV.- Comparative floristic analysis of the published associations and communities of *Violin caninae* in the north and north-west of the Iberian Peninsula. Species present only in two or fewer columns have been removed.  
 Tableau IV.- Analyse floristique comparative entre les différents associations et groupements du *Violin caninae* au nord et nord-ouest de la Péninsule Ibérique.

Order n°	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23
No. of relevés	12	3	14	6	9	37	25	5	12	9	3	7	3	2	7	9	4	7	4	9	10	24	7
Average altitude	1150	-	985	-	-	950	1200	1050	1200	1350	1350	1400	1350	1350	-	-	515	1115	800	500	1170	600	700
Species/relève	16	12	16	15	-	14	17	26	9	13	21	18	11	12	10	18	23	10	15	12	14	15	13
Ass. discriminative species	V	3	I	IV	V	I	III			II		III		2									
<i>Jasione laevis</i>	III	3	III	IV	III	I	I	5	I	III		III											
<i>Carex caryophylla</i>	IV	1	III	I	I	I	I	3		II		II											
<i>Plantago media</i>	V	1	III	IV	V	I	I	3		II					III				II				II
<i>Potentilla montana</i>						IV	IV													II			
<i>Carex pilulifera</i>						I	III																
<i>Erica vagans</i>						I	III																
<i>Hieracium pilosella</i>	V	1	I	V	IV	I	III	3	III	III	3	I	I	I	II					II			
<i>Serratula tinctoria sensu amplo</i>						II	III	4	II											II			
<i>Succisa pratensis</i>							I	4	I							V							
<i>Gentiana pneumonanthe</i>							I	5	I													III	III
<i>Carex verticillatum</i>							I	5	II													III	V
<i>Carex panicea</i>							III	5	II													III	V
<i>Ulex minor</i>																						+	V
<i>Agrostis trancanula</i> subsp. <i>commista</i>											1											II	II
<i>Veronica serpyllifolia</i>																						II	II
<b>Subal. Agrostion differentials</b>																							
<i>Carex binervis</i>									III	II					III	IV		III	4	V	V	III	V
<i>Agrostis curtisii</i>																				1	I	II	III
<i>Avenula sulcata</i>																						IV	I
<i>Pseudarrhenatherum longifolium</i>																							
<i>Agrostis hesperica</i>																							
<b>All. &amp; Class characteristics</b>																							
<i>Potentilla erecta</i>	V	3	II	V	V	V	V	4	IV	IV	1	IV	2	2	III	IV	4	III	3	III	V	V	V
<i>Galium saxatile sensu amplo</i>	V	3	II	IV	V	V	V	2	IV	IV	2	III	3	2	III	IV	4	II	4	III	IV	IV	IV
<i>Danthonia decumbens</i>	V	1	IV	V	IV	V	V	5	V	II	3	V	3	2	II	V	4	II	4	V	IV	V	IV
<i>Nardus stricta</i>																							
<i>Polygala serpyllifolia</i>	III	1	III	I	IV	III	III		I	II	1	III		1	II	II							
<i>Luzula campestris</i>																							
<i>Veronica officinalis</i>																							
<i>Festuca nigrescens</i>	V	3*	V*	V*	V*	IV*	V*		III	V			2		IV		2	III			IV*		II
(* = subsp. <i>microphylla</i> )																							
<i>Juncus squarrosus</i>									III	II			3		V	III		III	1	II	IV	V	V
<i>Molinia caerulea</i>								3	II	II			1		II	II	4	III	4	IV	I	II	V
<i>Pedicularis sylvatica</i>									I						II	IV	4		1	II	I*	I	
(* = subsp. <i>lusitanica</i> )																							
<i>Merendera pyrenatica</i>	III		II	IV	II						2	II	1	2		II						I	III
<i>Polygala vulgaris</i>	IV							1				IV	2		II	II						I	
<i>Luzula multiflora</i>								2				II			II	II	3						
<i>Scilla verna</i>																							
<i>Arnica montana</i> subsp. <i>atlantica</i>																							
<i>Euphrasia hirtella</i>																							
<i>Carex leporina</i>																							
<b>Companion species</b>																							
<i>Agrostis capillaris</i>	V	3	V	V	V	III	IV	3	V	IV	3	i	2	1	i	V		III	1	II	III*	V	III
<i>Ranunculus bulbosus</i>		1	III	II		I	I				2	1	1	1				II	2	III	III*	III	III



**Procedence of the columns of Table IV (No T = thallophytes in relevés not included)**

- 1.- *Jasiono laevis-Danthonietum decumbentis* (Loidi, 1983; Tb. 29)
- 2.- *Jasiono laevis-Danthonietum decumbentis nardetosum strictae* (Rivas-Martínez *et al.*, 1991; Tb. 59 pp)
- 3.- *Jasiono laevis-Danthonietum decumbentis* (Loidi *et al.*, 1997; Tb. 37)
- 4.- *Jasiono laevis-Danthonietum decumbentis* (Rivas-Martínez *et al.*, 1991; Tb. 59 pp)
- 5.- *Jasiono laevis-Danthonietum decumbentis* (Onaindía, 1988; Tb. 18)
- 6.- *Carici piluliferae-Agrostietum curtisii* típica (Darquistade *et al.*, 2004; Tb. 1)
- 7.- *Carici piluliferae-Agrostietum curtisii nardetosum strictae* (Darquistade *et al.*, 2004; Tb. 2)
- 8.- *Serratulo seoanei-Nardetum* (Tüxen & Oberdorfer, 1958; Tb. 57) (No T)
- 9.- *Serratulo tinctoriae-Nardetum* (Herrera, 1995; Tb. 59)
- 10.- *Serratulo tinctoriae-Nardetum* (Loidi *et al.*, 1997, Tb. 36)

- 11.- *Serratulo tinctoriae-Nardetum strictae* (Silva-Pando, 1990; Tb. 50)
- 12.- *Nardo-Galion saxatilis* (Navarro, 1974; Tb. 32)
- 13.- *Dry Violion caninae* (Guitián, 1984; Tb. 31)
- 14.- *Wet Violion caninae* (Guitián, 1984; Tb. 32)
- 15.- *Nardo-Galion saxatilis* (Bellot, 1968; Tb. 12)
- 16.- *Nardo-Caricetum binervis* (Braun-Blanquet & Tüxen, 1952; Tb. 50) (No T)
- 17.- *Nardo-Caricetum binervis* (Díaz, 1975; Tb. 32)
- 18.- *Nardo-Caricetum binervis* (Pulgar, 1999; Tb. 27)
- 19.- *Nardo-Caricetum binervis* (Rodríguez-Oubiña, 1982; Tb. 7)
- 20.- *Nardo-Caricetum binervis* (Rodríguez-Oubiña, 1986; Tb. 18)
- 21.- *Agrostio hespericae-Nardetum strictae* (Honrado *et al.*, 2004; Tb. VII) (No T)
- 22.- *Galio viviani-Danthonietum decumbentis* (Izco *et al.*, present paper; Tb. 2)
- 23.- *Galio viviani-Danthonietum decumbentis juncetosum squarrosi* (Izco *et al.*, present paper; Tb. 3)

**Table V.- Discrimination between the *Violion caninae* associations previously described and the new *Galio viviani-Danthonietum decumbentis* association.**

**Tableau V.- Discrimination floristique entre les différents associations et groupements du *Violion caninae* et la nouvelle association *Galio viviani-Danthonietum decumbentis*.**

<i>Serratulo seoanei-Nardetum strictae</i>	V	<i>Galio viviani-Danthonietum decumbentis</i>
<i>Carex caryophyllea</i>	E	<i>Agrostis curtisii</i>
<i>Hieracium pilosella</i>	R	<i>Avenula sulcata</i>
<i>Nardus stricta</i>	S	<i>Carex pilulifera</i>
<i>Succisa pratensis</i>	U	<i>Ulex minor</i>
<i>Nardo strictae-Caricetum binervis</i>	S	
<i>Carex nigra</i>	V	<i>Galio viviani-Danthonietum decumbentis</i>
<i>Luzula multiflora</i>	E	<i>Agrostis curtisii</i>
<i>Nardus stricta</i>	R	<i>Agrostis truncatula commista</i>
<i>Succisa pratensis</i>	S	<i>Avenula sulcata</i>
<i>Ulex gallii</i>	U	<i>Merendera pyrenaica</i>
	S	<i>Ulex minor</i>
<i>Agrostio hespericae-Nardetum strictae</i>	V	<i>Galio viviani-Danthonietum decumbentis</i>
<i>Agrostis hesperica</i>	E	<i>Agrostis capillaris</i>
<i>Carex echinata</i>	R	<i>Agrostis curtisii</i>
<i>Genista micrantha</i>	S	<i>Avenula sulcata</i>
<i>Hieracium pilosella</i>	U	<i>Carex pilulifera</i>
<i>Nardus stricta</i>	S	
<i>Carici piluliferae-Agrostietum curtisii</i>	V	<i>Galio viviani-Danthonietum decumbentis</i>
<i>Agrostis hesperica</i>	E	<i>Carum verticillatum</i>
<i>Erica vagans</i>	R	<i>Gentiana pneumonanthe</i>
<i>Festuca hirtula</i>	S	<i>Merendera pyrenaica</i>
<i>F. nigrescens microphylla</i>	U	<i>Ulex minor</i>
<i>Jasione laevis</i>	S	<i>Veronica serpyllifolia</i>
<i>Jasiono laevis-Danthonietum decumbentis</i>	V	<i>Galio viviani-Danthonietum decumbentis</i>
<i>Carex caryophyllea</i>	E	<i>Agrostis curtisii</i>
<i>Festuca nigrescens microphylla</i>	R	<i>Avenula sulcata</i>
<i>Hieracium pilosella</i>	S	<i>Carex binervis</i>
<i>Jasione laevis</i>	U	<i>Carex pilulifera</i>
<i>Plantago media</i>	S	<i>Gentiana pneumonanthe</i>
<i>Potentilla montana</i>	S	<i>Ulex minor</i>

Another group of associations [*Nardo-Caricetum binervis*, *Agrostio hespericae-Nardetum*, Column 15, likewise, simply ascribed to *Nardo-Galium saxatilis* (Bellot, 1968) and the community dealt with here] grows on the siliceous substrates of the western territories of the Iberian Peninsula, *i.e.* the Galician-Portuguese and Galician-Asturian Sectors. Once again, Table V shows easy discrimination within this group. Incidentally, *Carici piluliferae-Agrostietum curtisii*, distributed in the eastern Cantabrian area, has also been postulated for the north of Portugal (Honrado *et al.*, 2004) by virtue of some floristic affinities and the presence of both *Carex pilulifera* and *Agrostis curtisii* in the Portuguese community. However, we think that this Portuguese community is likely to be coincidental with the one we are studying, since it occurs in the same chorological area, under the same environmental conditions and with clear floristic similarities.

#### A. The Cantabrian-Atlantic and oceanic *Violion caninae*

The alliance *Violion caninae* was described by Schwickerath (1944) on the basis of associations located in North-Atlantic territories. The alliance was later recognized in Atlantic, southern oceanic territories: in France (Wattez & Godeau, 1986), Spain (Darquistade *et al.*, 2004; Herrera, 1995; Loidi, 1983; Díaz, 1975; Díaz & Fernández Prieto, 1994; Lence, 2007) and Portugal (Honrado *et al.*, 2004). In many other cases similar grasslands have been identified as belonging to the *Nardo-Galium saxatile* alliance, a more recent syntaxonomical synonym for *Violion caninae*.

In the pasturelands of a British oceanic and southern Cantabrian-Atlantic character growing on the mesotemperate and lower supratemperate belts there is either no presence of *Nardus stricta* or the presence of this taxon is associated with ground depressions with clearly humid soils. In these cases *Agrostis curtisii*, *Agrostis capillaris* (*A. vulgaris*), *Avenula sulcata* and other gramineae tend, in variable combinations, to play the soil-fixing role peculiar to *Nardus stricta*. These kinds of grasslands were grouped into the *Agrostion curtisii* alliance (de Foucault, 1986) which, with some new ascriptions at a later date (de Foucault, 1993, 1994), grow along the French and Spanish Cantabrian-Atlantic coastline, and are characterized by *Agrostis curtisii*, *Carex pilulifera*, *Danthonia decumbens*, *Polygala serpyllifolia*, *Potentilla erecta*, *Pseudarrhenatherum longifolium*, *Viola lactea*, etc.

The name and concept of *Agrostion curtisii* has been used on more recent occasions (Anonymous, s/a; Bardat *et al.*, 2004). According to these works, the *Agrostion curtisii* alliance extends over the mesotemperate and supratemperate belts along the French Cantabrian-Atlantic coastline (Gascogne, Périgourdine, Montmorillon, Touraine, Loire-atlantique, Bretagne). In the southwest of Great Britain there are also communities potentially ascribable to this alliance, the so-called « *Agrostis curtisii* grasslands » (Rodwell, 1992). Some associations brought together in Table IV also belong to the same Iberian, Cantabrian-Atlantic group: *Carici piluliferae-Agrostietum curtisii* (columns 6 and 7; Cantabrian-Basque sector), that of *Galiob viviani-Danthonietum decumbentis* (columns 22 and 23; Galician-Portuguese sector) described here, some of the communities growing in the Iberian northwest which were originally identified as *Nardo-Caricetum binervis* (columns 16 and 18 to 20) and finally, some communities in the north of Portugal (*Agrostio hespericae-Nardetum strictae*).

The name *Agrostion curtisii* (de Foucault, 1986: 215-216) has been validly published. We consider that the expression « L'association-type de cette alliance nouvelle peut être représentée par le *Simethi mattiazzii-Pseudarrhenatheretum longifolii*... » is acceptable, despite the ambiguity involved in typifying something with the formula « peut être ».

In our opinion the *Violion caninae* alliance must be dissociated into two suballiances. The group of Cantabrian-Atlantic and British-Atlantic, oceanic, mesotemperate and supra-temperate southern communities form a peculiar suballiance of *Violion caninae* and is characterized by *Agrostis curtisii*, *Agrostis hesperica*, *Avenula ludonensis* (*Avenula sulcata*), *Carex binervis*, *Pseudarrhenatherum longifolium*, *Viola lactea*, with the name *Agrostienion curtisii* Izco, Amigo & Pulgar *suball. nova*. This led us to the consideration of a new suballiance: *Violenion caninae* Schwickerath 1944, which corresponds to the original concept of the *Violion caninae* (Art. 24 b). Since, as far as we know, the *Violion caninae* alliance has not yet been typified, we propose its typification, *Lectotypus (hoc loco): Luzuletum multiflorae* Schwickerath 1944: 160-163. The authorship of the suballiance *Violenion caninae* must comply with the Art. 46, and the suballiance has the same typus as the alliance (Art. 19 b, 24 b). *Holotypus: Luzuletum multiflorae* Schwickerath 1944.

Under optimal conditions, the *Agrostienion curtisii* communities adopt the form of densely populated grasslands, when growing on deep soils capable of preserving some amount of moisture even in summer months. However, shallow soils or soils lacking organic horizons tend to produce communities in transition towards the *Sedo-Scleranthetea* class, a fact already recorded by de Foucault (1993: 434). The *Agrostienion curtisii* communities on shallow soils tend to intertwine mosaically with shrublands belonging to the *Calluno-Ulicetea* class. If these shrublands are destroyed by fire, not only communities rich in *Agrostis curtisii* and *Pseudarrhenatherum longifolium* but also large-size, herb-like, slightly nitrophilous species belonging to the class *Epilobietea angustifolii* appear. We have recently described the association *Simethido mattiazzi-Asphodeletum ovoidei* (Izco *et al.*, 2001) of this kind of vegetation in the Galician-Portuguese sector.

## B. Dendrogram cluster analysis

To follow the classical phytosociological procedures, we propose a discriminating scheme based on a floristic criterion for the *Violion caninae* associations in the north of Spain and Portugal as opposed to the one studied here (Table V).

Also, according to the current procedures, we also performed a hierarchical cluster analysis of the relevés synthesized in Table IV, using the statistics package *SPSS* (2004), with nearest-neighbour linkage and squared Euclidean distance as the measure of similarity (Fig. 4). Braun-Blanquet indices of presence were transformed into numerical values by the method of Van der Maarel (1979). The cluster analysis is inspired in the same criterion as the one used in Table IV those species present in two columns or less were removed. This procedure produced a matrix of 96 species (rows). The dendrogram of Figure 4 illustrates the similarity relationships between the tables.

The original table of *Serratulo-Nardetum* (Tüxen & Oberdorfer, 1958), column 8, is clearly differentiated from the rest. This is probably due to wetter conditions than in the other cases, as the occurrence of *Carex pulicaris*, *Parnassia palustris* or *Carex lepidocarpa* and other species of *Molinietalia caeruleae* reveals. The tables of *Jasiono-Danthonietum* are perfectly arranged in branche G, except for column 2, which appears at a considerable distance. As previously explained, column 12 appears together with *Jasiono-Danthonietum* particularly in its more hygrophilous expression with *Nardus stricta*.

Branches B-F cannot clearly discriminate the different associations. Branch F (column 16), which corresponds to the original table of *Nardo-Caricetum*, with relevés made in Ireland (Braun-Blanquet & Tüxen, 1952), is clearly separate from the rest. This separation supports the idea that there are considerable differences between the original concept of

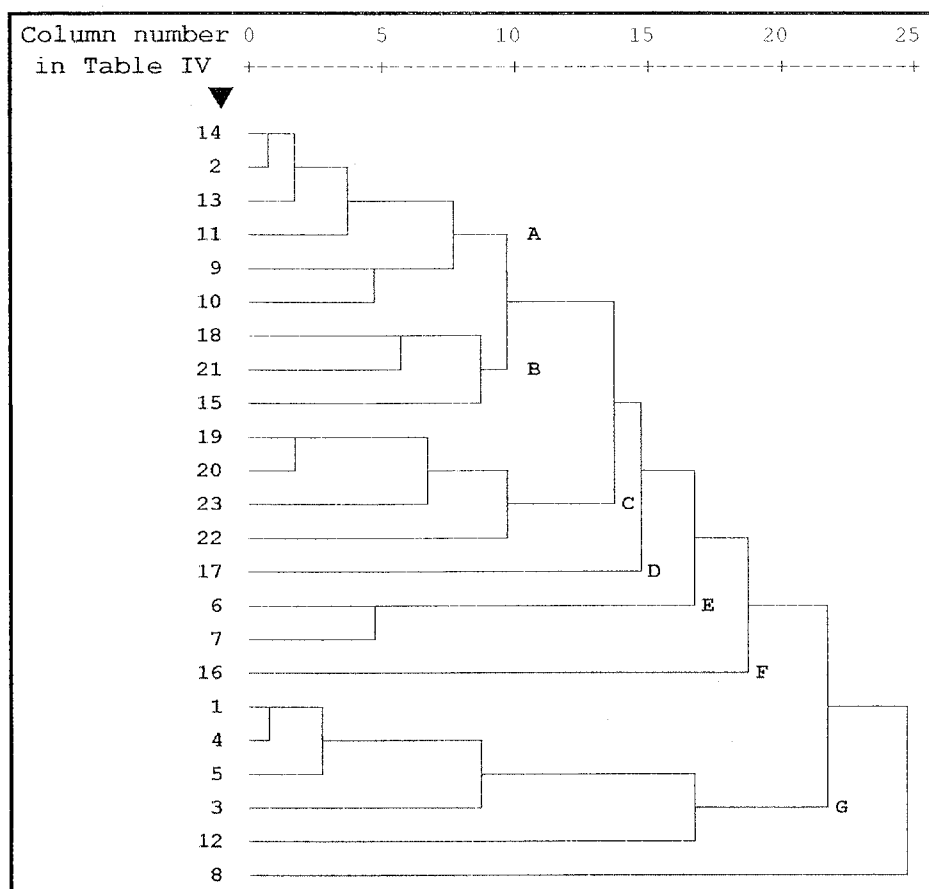


Fig. 4.- Resultant dendrogram from hierarchical clustering of *Violion caninae* associations and communities. Numeration agrees with Table IV.

Fig. 4.- Dendrograme dérivé de l'analyse hiérarchique des différents groupements et associations du *Violion caninae*.

*Nardo-Caricetum binervis* and the interpretation applied for the Spanish north-western territory (cols. 17 to 20, in Table IV). Branch E comprises the two tables with relevés of *Carici piluliferae-Agrostietum curtisii* (columns 6 and 7). Branches B-D encompass the group of associations growing on acid substrates in the eastern section of the territory: the tables of the community object of our study, those of *Nardo-Caricetum binervis* and those of *Agrostio hespericae-Nardetum* in the north of Portugal are included here. Some relevés ascribed to *Nardo-Caricetum binervis* can probably be included in the wettest expression of the community studied here, with *Juncus squarrosus*, *Carex panicea* and *Arnica montana* subsp. *atlantica*.

Branch A comprises tables belonging to *Serratulo-Nardetum* (columns 9, 10 and 11) and tables with few relevés made in similar neighbouring territories, probably related to this association (columns 13 and 14) and ascribed without any further precision to the *Violion caninae* alliance. The inclusion of a table of *Jasiono-Danthonietum* (column 2) in this group does not seem sufficiently justified. The location of branch D (column 16) linking branches A+B and C can explain why those relevés, ascribed by their author to *Nardo-Caricetum binervis* (Díaz, 1975), were later interpreted as being « presumably a particular variant of *Serratulo-Nardetum* » (Díaz & Fernández-Prieto, 1994).

#### IV. CONCLUSIONS

The cattle-grazed pastures of the Galician western ranges, extremely oceanic, with high rainfall rates and located in the Mesotemperate bioclimatic belt of the Galician-Portuguese Sector, belong to a new association.

Our study clearly reveals the occurrence of a *Violion caninae* community on the Atlantic rim of Galicia (NW of Spain), a territory with mostly granitic substrates and included in the Cantabrian-Atlantic subprovince, Galician-Portuguese Sector. The altitudinal distribution of the community is surprising: with occasional occurrences under 400 m a.s.l. and frequently recorded under 550 m a.s.l., the average altitude of all the relevés is 660 m. Climates exhibit high oceanicity and heavy rainfall. The community is dominated by *Agrostis capillaris*, *Agrostis curtisii*, *Danthonia decumbens* and *Avenula ludonensis*, which as soil-fixing gramineae are resistant to the trampling and grazing of livestock related to the main activity horse raising, and also other caespitose hemicryptophytes. Exceptionally *Nardus stricta* is also recorded in comparatively wetter pits and depressions.

The floristic composition of the community under study, based on *Agrostis capillaris*, *Agrostis curtisii*, *Avenula sulcata*, *Carex binervis*, *Carum verticillatum*, *Danthonia decumbens*, *Galium saxatile* var. *vivianum*, *Gentiana pneumonanthe*, *Potentilla erecta*, is shown in Tables II and III. Tables IV and V and Figure 4 (dendrogram) show the differences among *Violion caninae* communities occurring in the Cantabrian-Atlantic and Orocantabrian territory and the existence of a new association (*Galio viviani-Danthonietum decumbentis*) in the south-western end of the Eurosiberian Region.

Our study leads us to propose a new association: *Galio viviani-Danthonietum decumbentis* Izco, Amigo & Pulgar *ass. nova*, *Holotypus*: Table II, relevé 11 [defined here]. Two subassociations are recognized within the association subass. *danthonietosum decumbentis* Izco, Amigo & Pulgar *subass. nova* [subass. *typicum*], *Holotypus*: Table II, relevé 11, [defined here]; subass. *juncetosum squarrosi* Izco, Amigo & Pulgar *subass. nova*, *Holotypus*: Table III, relevé 5 [defined here].

With this addition the presence of *Violion caninae* in the Cantabrian-Atlantic and Orocantabric subprovinces increases to a total of 6 associations. The alliance is split into the suballiance *Violienion caninae* with three associations in the area (*Jasiono laevis-Danthonietum decumbentis*, *Nardo strictae-Caricetum binervis*, *Serratulo seoanei-Nardetum strictae*), and the *Agrostienion curtisii* (*Holotypus*: *Galio viviani-Danthonietum decumbentis*) [defined here], with three associations in the area (*Agrostio hespericae-Nardetum strictae*, *Carici piluliferae-Agrostietum curtisii*, *Galio viviani-Danthonietum decumbentis*) (Appendix I, Fig. 1).

The *Violion caninae* pastures are included in the group « Grass-like formations with *Nardus* », with numerous species growing on siliceous substrates in mountainous areas (and submountainous areas of continental Europe) (Code 6230 of the Habitats Directive 92/43). The pastures where *Nardus stricta* is absent, as has been presented here, should also be considered as belonging to the group.

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## Appendix 1: Phytosociological typology in the North and North-West Spain

NARDETEA STRICTAE Rivas Goday in Rivas Goday & Rivas-Martínez 1963

NARDETALIA STRICTAE Oberdorfer ex Preising 1949

*Nardion strictae* Br.-Bl. in Br.-Bl. & Jenny 1926 (not included in our study)

*Violion caninae* Schwickerath 1944 [holotypus: *Luzuletum multiflorae* Schwickerath 1944]

*Violenion caninae* Schwickerath 1944 [holotypus: *Luzuletum multiflorae* Schwickerath 1944]

[*Violion caninae* Schwickerath 1944 p.p. (Art. 24)]

- *Jasiono laevis*-*Danthonietum decumbentis* Loidi 1983

subass. *danthonietosum decumbentis* Loidi 1983 (in Rivas-Martínez *et al.* 1991)

subass. *nardetosum strictae* Rivas-Martínez *et al.* 1991

- *Nardo strictae*-*Caricetum binervis* Br.-Bl. & Tüxen 1952

- *Serratulo seoanei*-*Nardetum strictae* Tüxen in Tüxen & Oberdorfer 1958

*Agrostienion curtisii* (de Foucault 1986) Izco, Amigo & Pulgar *suball. nova*

holotypus: *Simethido mattiazzii*-*Pseudarrhenatheretum longifolii* Foucault 1986

[=*Agrostion curtisii* de Foucault 1986]

- *Agrostio hespericae*-*Nardetum strictae* Honrado *et al.* 2004

- *Carici piluliferae*-*Agrostietum curtisii* Darquistade *et al.* 2004

subass. *agrostietosum curtisii* Darquistade *et al.* 2004

subass. *nardetosum strictae* Darquistade *et al.* 2004

- *Galio viviani*-*Danthonietum decumbentis* Izco, Amigo & Pulgar *ass. nova*

subass. *danthonietosum decumbentis* Izco, Amigo & Pulgar *subass. nova*

subass. *juncetosum squarrosi* Izco, Amigo & Pulgar *subass. nova*

*Plantaginion nivalis* Quézel 1953 (not included in our study)

*Campanulo herminii*-*Nardion strictae* Rivas-Martínez 1964 (not included in our study)

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