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## Omphalodo nitidae-Coryletum avellanae, a new mesophytic woodland community of the northwest Iberian Peninsula

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### Abstract

Amigo J., Giménez J., and Romero I. 1994. *Omphalodo nitidae-Coryletum avellanae*, a new mesophytic woodland community of the northwest Iberian Peninsula. *Bot. Helv.* 104: 103–122.

We describe a new woodland association, *Omphalodo nitidae-Coryletum avellanae*, of which we present a series of relevés. On the basis of floristic composition, the new association is assigned to the European mesophytic woodland alliance *Carpinion* Issler em. Mayer 1937. We detail the floristic differences between the new association and its vicariants, presenting a synoptic table which summarizes the characteristics of the associations of *Carpinion* described to date in the northwest Iberian Peninsula. We also provide information on biogeographical, ecological and dynamic aspects of the new association.

*Key words:* Phytosociology, deciduous woodland, *Carpinion*, Galicia (NW Spain).

### Introduction

The meso- to hygrophytic, neutro- to moderately acidophile deciduous woodlands of the Atlantic and Central European hill belt are generally included in the alliance *Carpinion* Issler 1931 em. Mayer 1937 (Rivas-Martínez et al. 1991). In the Iberian Peninsula, Tüxen et al. (1958) were the first authors to assign an association (“*Corylo-Fraxinetum cantabricum*”, from valley bottoms in central Asturias) to *Carpinion*; since that time, a number of Spanish authors have described Iberian woodland communities of this alliance (see for example Rivas-Martínez 1964, Navarro 1974, Rivas-Martínez et al. 1984, Rivas-Martínez et al. 1985, Fernández-Prieto et al. 1987).

Tüxen et al. (1958) chose *Corylus avellana* and *Fraxinus excelsior* as name-giving taxa for their association in view of the constant presence of these species in their relevés, despite the fact that hazel usually forms part of the shrub, rather than the tree, layer.

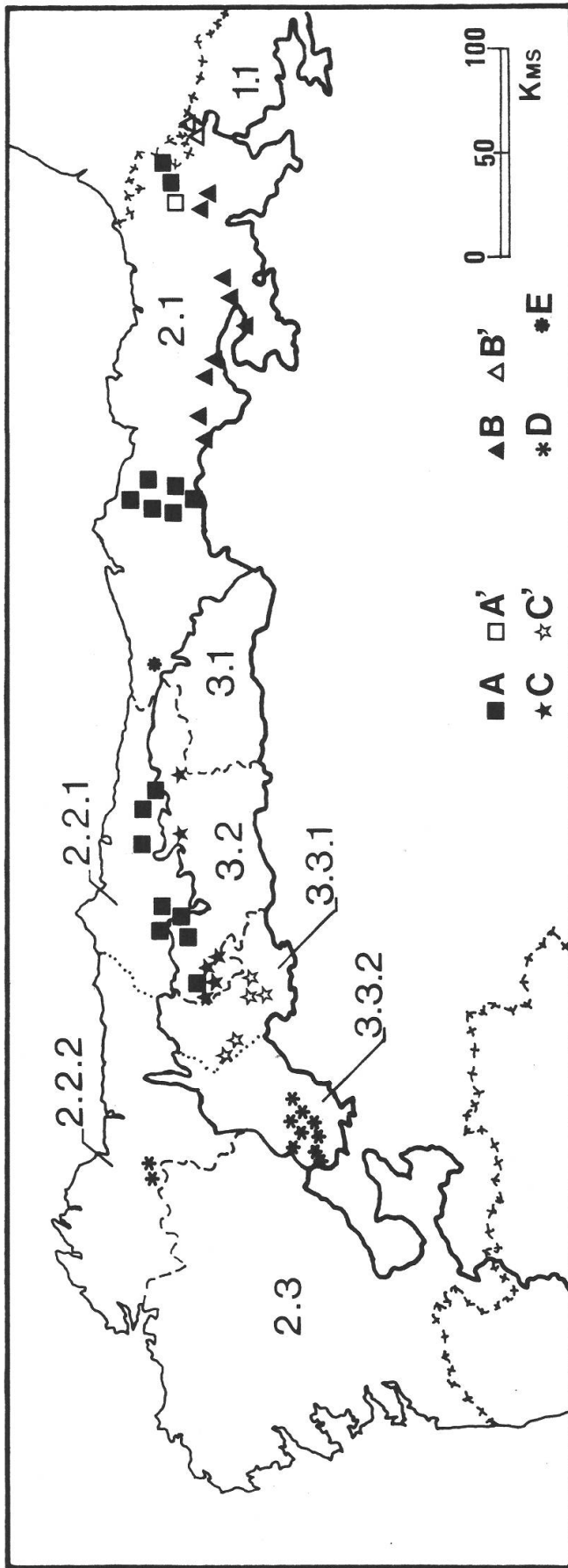


Fig. 1. Map showing the major biogeographical subdivisions of the Eurosiberian Region in northern Iberia.

Pirenaica Province: Pirenaico Central Sector (1.1).  
 Cántabro-Atlántica Province: Cántabro-euskaldún Sector (2.1). Galaico-asturiano Sector (2.2), divided in Ovetense Subsector (2.2.1) and Galaico-asturiano septentrional Subsector (2.2.2). Galaico-portugués Sector (2.3).  
 Orocantábrica Province: Campurriano-carrionés Sector (3.1). Ubiñense-picoeuropeano Sector (3.2). Laciano-ancarensis Sector (3.3), divided in Laciano-narceense Subsector (3.3.1) and Naviano-ancarensis Subsector (3.3.2).  
 Dashed lines (- - -) indicate boundaries between sectors, and dotted lines (· · ·) boundaries between subsectors. Crosses (+ + +) indicate national boundaries between Spain, France and Portugal.

Location of sites of published Carpinion woodland relevés (see Tab. 1):

- A: *Polysticho setiferi-Fraxinetum excelsioris*. A': *Polysticho-Fraxinetum* subsp. *carpinetosum betuli*.
- B: *Crataego laevigatae-Quercetum roboris*. B': *Crataego-Quercetum* subsp. *quercetosum petraeae*.
- C: *Mercurialidi perennis-Fraxinetum excelsioris*. C': *Mercurialidi-Fraxinetum* subsp. *omphalodetosum nitidae*.
- D: *Omphalodo nitidae-Coryletum avellanae*. E: *Pulmonario longifoliae-Fagetum sylvaticae*.

These woodlands have been subject to intense human pressure for centuries. The total wooded area has been greatly reduced as a result of clear-felling to obtain agricultural land, while selective felling of large trees for timber has greatly altered the composition of what woodland remains (in particular, increasing the abundance of hazel at the expense of that of oak and, in some cases, of beech). This perhaps explains why various authors have viewed "Corylo-Fraxinetum" as a type of mixed woodland (of ash, oak, sycamore, elm, hazel, etc.), rather than as a woodland community which, at maturity might be described as "oakwood" or "oakwood with ash" (Rivas-Martínez 1987, Díaz et al. 1992).

In the Cantabro-euskaldún Sector of the Cántabro-Atlántica Province of northern Iberia (see Fig. 1), there is still a reasonable diversity of Carpinion woodland types whose mature phases are dominated by a large forest species. For example, in addition to the mixed oakwoods of *Polysticho setiferi-Fraxinetum excelsioris* (= *Corylo-Fraxinetum cantabricum*, nom. ileg.), *Quercus robur* oakwoods (*Crataego laevigatae-Quercetum roboris*), *Quercus petraea* oakwoods with beech (*Crataego-Quercetum subass. quercetosum petraeae*), hornbeam woods (*Polysticho-Fraxinetum subass. carpinetosum betuli*) and even beechwoods (*Pulmonario longifoliae-Fagetum sylvaticae*) are all present.

In the western part of the northern Iberian Peninsula, however, there is less diversity of Carpinion woodlands, and the composition of such woodland as is present tends to be more heavily modified as a result of human pressure. In the northwest Spanish region of Galicia, this reduced diversity is reflected in the fact that there has been no unequivocal published confirmation of the presence of woodlands of this alliance. Bellot (1968) cites the presence in Galicia of the alliance "Fraxinio-Carpinion Tx. 1936", and Castroviejo (1973) cites the alliance in a description of vegetation along a vertical transect in the Sierra de Ancares (in eastern Galicia); to date, however, not even a single inventory demonstrating the presence of Carpinion in this region has been published.

In the course of an extensive study of the vegetation of limestone areas of Galicia (Giménez de Azcárate 1993), we have compiled a series of relevés which constitute proof of the presence of Carpinion woodlands in this region.

## Results

The characteristics of the principal Carpinion woodland formations of the Cántabro-Atlántica and Orocantábrica Provinces are summarized in Table 1, a synoptic table based on inventories published by various authors. Apart from these communities and that described by us in this study, no other Carpinion communities have been reported from the territories to the west of the Pyrenees.

In Table 2 we present 18 relevés which exemplify the floristic composition of the new association, for which we have selected the name *Omphalodo nitidae-Coryletum avelanae* ass. nova (syntype: relevé 12). The basic ecological and biogeographical characteristics of the new association are as follows:

– *Omphalodo-Coryletum* is a woodland community characterized by high tree species diversity and very high nemoral herb species richness (mean number of species per inventory = 34).

– It is currently restricted to streamside sites and steeply sloping valley sides, generally (though not necessarily) over limestone.

– It typically occurs on deep soils (generally well-humified Cambisols), even when on steep slopes, although it has occasionally been recorded from less favourable sites: in a



Tab. 1. Synoptic table summarizing the floral characteristics of the principal Carpinion woodland formations of the Cantabro-Atlántica and Orocantábrica Provinces

Column number	1	2	3	4	5	6	7	8	9	10	11	12	13	14
Highest altitude (×10)	70	.	80	28	17	75	50	42	41	50	65	75	95	129
Lowest altitude (×10)	50	.	75	6	16	4	30	24	29	23	50	50	68	100
Species/relevé (mean)	27	.	31	38	34	36	.	28	37	23	33	32	29	38
Number of relevés	15	5	6	2	3	27	3	2	4	16	3	10	5	4
Tree level														
<i>Corylus avellana</i>	IV	V	III	2	3	V	3	2	4	V	3	V	V	4
<i>Fraxinus excelsior</i>	II	.	I	2	3	III	.	2	4	V	3	V	II	4
<i>Ulmus glabra</i>	I	.	.	.	2	II	3	.	1	I	2	II	IV	3
<i>Ilex aquifolium</i>	III	III	.	1	1	III	2	.	3	.	.	I	I	4
<i>Castanea sativa</i>	I	III	IV	1	3	IV	.	.	1	II	1	III	.	.
<i>Fagus sylvatica</i>	II	.	V	.	.	II	3	1	1	I	1	II	IV	.
<i>Acer pseudoplatanus</i>	I	.	.	1	.	+	.	.	3	IV	1	II	V	.
<i>Quercus robur</i>	V	V	.	2	1	V	.	1	1	IV	1	.	.	.
<i>Prunus avium</i>	I	.	.	.	2	III	.	1	1	I	.	I	.	3
<i>Acer campestre</i>	IV	.	V	.	3	IV	2	.	.	.	.	.	.	.
<i>Salix atrocinerea</i>	.	II	.	.	.	+	.	.	.	II	.	.	II	.
<i>Tilia platyphyllos</i>	.	.	.	.	.	I	.	.	4	.	1	III	.	.
<i>Sorbus aucuparia</i>	.	.	II	.	.	.	.	.	.	.	.	.	I	3
<i>Quercus petraea</i>	.	.	V	.	.	.	.	.	.	.	.	II	II	.
<i>Tilia cordata</i>	.	.	.	.	1	.	.	.	1	.	.	I	.	.
<i>Salix caprea</i>	.	.	.	.	.	.	.	.	.	.	.	I	.	2
<i>Crataegus laevigata</i>	IV	V	.	.	.	.	.	.	.	.	.	.	.	.
<i>Quercus pyrenaica</i>	.	.	.	.	1	+	.	.	.	.	.	.	.	.
Characteristic spp. All. & Or.														
<i>Helleborus viridis</i> spp. <i>occidentalis</i>	I	III	II	1	3	III	2	2	4	III	2	IV	III	1
<i>Sanicula europaea</i>	I	II	I	.	.	III	3	.	3	III	1	II	III	3
<i>Polystichum setiferum</i>	.	.	.	2	3	V	1	2	4	V	3	V	V	4
<i>Mercurialis perennis</i>	I	.	.	1	2	I	.	.	4	IV	3	V	V	4
<i>Melica uniflora</i>	.	.	IV	1	1	I	.	.	1	I	2	III	IV	3
<i>Carex sylvatica</i>	I	.	I	.	1	III	3	2	2	.	1	IV	III	.
<i>Pulmonaria longifolia</i>	IV	III	V	1	1	III	3	1	3	I	.	.	.	.
<i>Hypericum androsaemum</i>	I	.	.	2	3	IV	3	.	3	V	2	II	.	.
<i>Primula vulgaris</i>	.	.	.	.	1	II	3	2	4	V	2	IV	II	.
<i>Phyllitis scolopendrium</i>	.	.	.	1	1	II	.	2	3	V	3	II	.	.
<i>Circaea lutetiana</i>	I	III	.	1	.	.	3	1	2	I	.	.	I	.
<i>Lamiastrum galeobdolon</i>	I	.	.	1	1	II	2	1	3	I	.	.	.	.
<i>Daphne laureola</i>	.	III	.	.	2	+	2	.	.	I	1	I	.	.
<i>Potentilla sterilis</i>	II	.	I	2	.	II	3	.	2	I	.	.	.	.
<i>Lilium martagon</i>	.	.	.	.	.	.	.	.	1	II	1	I	I	2
<i>Milium effusum</i>	I	.	.	.	.	.	2	.	1	.	1	I	IV	.
<i>Stachys sylvatica</i>	I	.	.	1	1	+	.	.	.	.	.	I	.	2
<i>Bromus ramosus</i>	I	.	.	.	.	II	.	1	1	.	.	III	II	.
<i>Galium odoratum</i>	.	.	.	.	.	.	3	.	.	.	2	II	III	1
<i>Cardamine impatiens</i>	.	.	.	.	2	.	.	.	.	.	1	I	I	1
<i>Symphytum tuberosum</i>	.	.	I	.	.	I	.	.	1	II	.	.	.	2
<i>Festuca gigantea</i>	.	.	.	.	.	+	2	.	2	.	.	II	III	.
<i>Allium ursinum</i>	.	.	.	.	.	.	.	.	2	I	1	I	.	.
<i>Polygonatum multiflorum</i>	I	.	.	.	.	.	.	.	1	II	.	I	.	.
<i>Carex remota</i>	.	.	.	.	.	.	1	1	.	.	1	I	.	.



Tab. 1 (continued)

Column number	1	2	3	4	5	6	7	8	9	10	11	12	13	14
Highest altitude ( $\times 10$ )	70	.	80	28	17	75	50	42	41	50	65	75	95	129
Lowest altitude ( $\times 10$ )	50	.	75	6	16	4	30	24	29	23	50	50	68	100
Species/relevé (mean)	27	.	31	38	34	36	.	28	37	23	33	32	29	38
Number of relevés	15	5	6	2	3	27	3	2	4	16	3	10	5	4
<i>Euonymus europaeus</i>	I	.	.	1	.	I	.	.	2	.	.	.	.	.
<i>Vaccinium myrtillus</i>	.	V	.	.	.	+	1	.	.	.	.	.	.	1
<i>Anemone nemorosa</i>	.	.	.	.	.	+	.	1	.	I	.	.	.	2
<i>Carex pendula</i>	.	.	.	.	.	+	.	.	.	I	2	I	.	.
<i>Melampyrum pratense</i>	I	IV	V	.	.	.	.	.	.	.	.	.	.	.
<i>Ligustrum vulgare</i>	III	.	.	.	1	II	.	.	.	.	.	.	.	.
<i>Rosa canina</i>	I	III	.	.	.	.	.	.	.	.	1	.	.	.
<i>Dryopteris dilatata</i>	.	.	.	.	.	+	.	.	.	III	.	.	.	1
<i>Lathyrus niger</i>	.	.	V	.	.	+	.	.	.	.	.	.	.	1
<i>Cardamine flexuosa</i>	.	.	.	.	.	+	.	1	.	.	.	.	II	.
<i>Polygonatum verticillatum</i>	.	.	.	.	.	.	.	.	2	I	.	.	.	1
<i>Helleborus foetidus</i>	.	.	II	.	.	.	.	.	.	.	.	I	.	.
<i>Festuca heterophylla</i>	.	IV	II	.	.	.	.	.	.	.	.	.	.	.
<i>Hieracium umbellatum</i>	.	I	II	.	.	.	.	.	.	.	.	.	.	.
<i>Buxus sempervirens</i>	.	.	I	1	.	.	.	.	.	.	.	.	.	.
<i>Sorbus torminalis</i>	I	.	.	.	.	I	.	.	.	.	.	.	.	.
<i>Rosa sempervirens</i>	.	.	.	.	1	III	.	.	.	.	.	.	.	.
<i>Holcus mollis</i>	II	.	.	.	.	II	.	.	.	.	.	.	.	.
<i>Lonicera xylosteum</i>	II	.	.	.	.	.	.	.	.	.	.	.	.	1
<i>Sorbus aria</i>	.	.	II	.	.	+	.	.	.	.	.	.	.	.
<i>Viburnum lantana</i>	II	.	.	.	.	+	.	.	.	.	.	.	.	.
<i>Buglossoides purpureocaerulea</i>	.	.	.	.	.	II	.	.	.	.	.	I	.	.
<i>Luzula forsteri</i>	.	.	.	.	.	I	.	.	.	.	.	I	.	.
<i>Hyacinthoides non-scripta</i>	.	.	.	.	.	.	.	.	.	I	.	.	.	2
<i>Omphalodes nitida</i>	.	.	.	.	.	.	.	.	.	.	.	.	IV	2
<i>Saxifraga spathularis</i>	.	.	.	.	.	.	.	.	.	.	.	.	III	1
Other species														
<i>Geranium robertianum</i>	II	.	.	1	3	III	2	1	3	I	3	III	IV	3
<i>Rubus</i> sp.	V	III	III	1	2	I	.	1	2	I	3	III	III	.
<i>Fragaria vesca</i>	I	I	IV	1	.	II	.	.	.	.	1	II	.	1
<i>Pteridium aquilinum</i>	III	III	V	2	2	IV	1	.	.	.	.	.	.	2
<i>Geum urbanum</i>	.	.	I	.	1	I	.	1	2	I	2	II	.	.
<i>Ajuga reptans</i>	.	II	II	1	.	I	.	1	1	I	.	I	.	.
<i>Polypodium vulgare</i>	.	III	.	.	.	+	.	.	.	I	.	III	III	2
<i>Veronica chamaedrys</i>	.	I	III	.	.	II	.	.	.	.	1	I	.	1
<i>Urtica dioica</i>	I	.	.	1	.	.	.	1	1	.	.	I	II	.
<i>Silene dioica</i>	.	.	.	1	.	.	.	.	.	II	1	I	I	.
<i>Iris foetidissima</i>	.	.	.	.	1	I	.	.	.	I	2	I	.	.
<i>Stachys officinalis</i>	II	I	II	.	.	II	.	.	.	I	.	.	.	.
<i>Arum italicum</i>	I	.	.	2	3	II	.	.	.	.	.	I	.	.
<i>Brachypodium pinnatum</i>														
<i>ssp. rupestre</i>	III	.	II	1	1	I	.	.	.	.	.	.	.	.
<i>Dactylis glomerata</i>	I	.	IV	.	.	I	.	.	.	.	1	I	.	.
<i>Angelica sylvestris</i>	I	.	.	1	.	I	.	1	.	II	.	.	.	.
<i>Deschampsia flexuosa</i>	I	IV	V	.	.	.	3	.	.	.	.	.	.	.
<i>Solidago virgaurea</i>	.	I	IV	.	.	I	.	.	.	.	.	I	.	.

Tab. 1 (continued)

Column number	1	2	3	4	5	6	7	8	9	10	11	12	13	14
Highest altitude ( $\times 10$ )	70	.	80	28	17	75	50	42	41	50	65	75	95	129
Lowest altitude ( $\times 10$ )	50	.	75	6	16	4	30	24	29	23	50	50	68	100
Species/relevé (mean)	27	.	31	38	34	36	.	28	37	23	33	32	29	38
Number of relevés	15	5	6	2	3	27	3	2	4	16	3	10	5	4
<i>Agrostis capillaris</i>	II	III	I	1	.	.	.	.	.	.	.	.	.	.
<i>Cytisus scoparius</i>	.	I	III	1	.	.	.	.	.	.	1	.	.	.
<i>Asphodelus albus</i>	I	III	II	.	.	+	.	.	.	.	.	.	.	.

## Additional species present in a single column only

Tree level (usually  $> 3$  m): *Acer opalus*: III en 3; *Betula alba*: 2 en 14; *Carpinus betulus*: 3 en 5; *Populus nigra*: 3 en 14.

Characteristic spp. of All. & Or.: *Actaea spicata*: 1 in 14; *Ornithogalum pyrenaicum*: 1 in 14; *Paris quadrifolia*: 1 in 14; *Poa chaixii*: 2 in 14; *Ranunculus platanifolius*: 1 in 14; *Stellaria nemorum*: 3 in 14.

Characteristic spp. of Class: *Campanula latifolia*: 2 in 14; *Euphorbia hyberna*: 4 in 14; *Polygonatum odoratum*: 4 in 14; *Prunella hastifolia*: V in 3.

Companion species present in three or less columns are not included since we consider such species to be unimportant for the purposes of this study.

Table 1. Each column summarizes a series of relevés (see below); frequency of occurrence of each species is indicated with Roman numerals for sets of five or more relevés or with Arabic numerals for sets of less than five relevés (+ = present in less than 10%; I = present in up to 20% of relevés; II = present in 21–40% of relevés; III = present in 41–60% of relevés; IV = present in 61–80% of relevés; V = present in more than 80% of relevés).

## Data from:

Column 1: *Crataego laevigatae-Quercetum roboris*. Rivas-Martínez et al. (1988).

Column 2: *Crataego laevigatae-Quercetum roboris*. Bascones (1978), Table 19, invts. 1, 2, 5 y 7.

Column 3: *Crataego laevigatae-Quercetum roboris subass. quercetosum petraeae*. Rivas-Martínez et al. (1991), Tabla 21, cols. 4 a 9.

Column 4: *Polysticho setiferi-Fraxinetum excelsioris*. Rivas-Martínez et al. (1985). Tabla 3, invts. 1 y 2.

Column 5: *Polysticho setiferi-Fraxinetum excelsioris subass. carpinetosum betuli*. Rivas-Martínez et al. (1985). Tabla 3, invts. 3–5.

Column 6: *Polysticho setiferi-Fraxinetum excelsioris*. Herrera (1988). Tabla 67.

Column 7: *Pulmonario longifoliae-Fagetum sylvaticae*. Rivas-Martínez (1968).

Column 8: *Polysticho setiferi-Fraxinetum excelsioris* ("Corylo-Fraxinetum cantabricum subass. typicum"). Tüxen et al. (1958). Tabla 87, grupo A.

Column 9: *Polysticho setiferi-Fraxinetum excelsioris* ("Corylo-Fraxinetum cantabricum subass. tilietosum platyphylli"). Tüxen et al. (1958). Table 87, grupo B.

Column 10: *Polysticho setiferi-Fraxinetum excelsioris* ("Corylo-Fraxinetum cantabricum"). Navarro (1974). Table 26.

Column 11: *Polysticho setiferi-Fraxinetum excelsioris* ("Corylo-Fraxinetum cantabricum"). Fernández-Prieto (1981).

Column 12: *Mercurialidi perennis-Fraxinetum excelsioris*. Fernández-Prieto et al. (1987). Table 5, invts. 1 a 10.

Column 13: *Mercurialidi perennis-Fraxinetum excelsioris subass. omphalodetosum nitidae*. Fernández-Prieto et al. (1987). Table 5, invts. 11 a 15.

Column 14: *Mercurialidi perennis-Fraxinetum excelsioris subass. omphalodetosum nitidae*. Puente (1988). Table 73.

Tab. 2. *Omphalodo nitidae* – *Coryletum avellanae* ass. nova

Relevé number	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	
Altitude (× 10)	65	62	80	72	68	75	80	78	85	80	76	82	93	90	85	40	97	.	
Slope (°)	10	40	45	40	35	10	60	35	60	45	60	30	25	30	20	40	30	.	
Aspect	SE	E	W	W	NW	S	SE	NE	NW	NW	N	N	NE	N	NE	NW	N	.	
Tree layer cover (%)	100	95	90	100	100	100	100	100	100	100	100	100	95	100	100	100	100	.	
Sample area (m <sup>2</sup> )	70	120	300	250	200	200	150	300	200	110	300	300	150	130	150	200	100	.	
Number of species	29	41	50	41	28	29	37	39	26	32	26	44	35	27	41	26	40	29.8	
Tree layer (> 3 m)																			
<i>Corylus avellana</i>	4.4	4.4	4.4	5.5	4.4	5.5	5.4	4.3	4.4	4.4	5.4	4.4	+	4.4	4.4	5.5	.	IV	
<i>Acer pseudoplatanus</i>	.	+2	1.1	1.1	2.2	+	.	.	1.1	1.1	+	2.2	2.2	.	1.1	.	+	V	
<i>Ilex aquifolium</i>	.	.	+	.	.	.	2.2	.	.	.	.	1.2	+	2.2	1.1	.	+2	I	
<i>Fraxinus excelsior</i>	1.1	1.1	+	.	.	.	.	.	.	.	.	1.1	1.1	.	+	.	r	III	
<i>Quercus robur</i>	.	.	1.1	.	.	+	+	.	.	.	.	4.4	2.2	3.3	.	1.1	2.2	I	
<i>Castanea sativa</i>	.	.	.	1.1	.	.	.	.	.	.	.	1.1	2.2	.	1.1	.	2.2	III	
<i>Quercus pyrenaica</i>	1.1	r	.	.	.	.	.	.	1.1	.	r	.	.	.	5.5	.	.	I	
<i>Betula celtiberica</i>	.	.	.	.	.	.	.	.	1.1	.	.	2.2	2.2	.	.	.	3.3	II	
<i>Prunus avium</i>	.	.	.	.	.	.	.	.	.	.	.	+	+	.	.	.	r	I	
<i>Sorbus aucuparia</i>	.	.	+	.	.	.	.	.	.	.	.	.	+	.	.	.	.	2.2	.
Characteristic spp. Ass., All. & Or.																			
<i>Polystichum setiferum</i>	2.2	2.2	1.2	4.2	2.2	1.2	1.2	1.2	+2	2.2	3.3	1.2	+	2.2	+	2.2	1.1	V	
<i>Primula vulgaris</i>	1.1	+2	1.1	1.1	1.1	1.1	1.1	1.1	1.1	+2	+	2.2	1.1	1.1	1.1	1.1	+	IV	
<i>Mercurialis perennis</i>	.	1.2	1.2	1.2	2.2	2.2	2.1	1.2	1.1	1.1	2.1	2.2	.	.	2.2	4.4	2.3	III	
<i>Melica uniflora</i>	.	2.1	1.1	2.1	1.1	1.1	1.2	2.2	.	1.1	1.1	1.1	.	1.2	.	.	+	III	
<i>Daphne laureola</i>	.	1.1	1.2	+2	+	1.1	1.1	+2	.	.	.	2.2	1.1	1.1	1.2	.	1.2	.	
<i>Omphalodes nitida</i>	.	+	+	+	.	.	+	.	+	.	+	1.1	.	1.1	+	.	1.1	III	
<i>Lilium martagon</i>	.	.	+	1.1	.	.	+	1.1	1.1	+	.	1.1	.	+	.	+	.	.	
<i>Phyllitis scolopendrium</i>	1.2	1.1	.	1.2	1.2	1.1	.	.	.	1.2	.	.	.	.	.	+2	.	III	
<i>Potentilla sterilis</i>	+2	+	+2	+	.	.	+	+2	.	.	.	.	.	.	1.1	.	.	.	
<i>Sanicula europaea</i>	.	.	.	1.1	.	.	1.1	.	.	.	+	1.2	+2	.	1.1	.	.	.	
<i>Ornithogalum pyrenaicum</i>	r	+2	r	r	.	.	.	.	.	.	.	.	.	+	.	.	.	.	
<i>Mycelis muralis</i>	r	+	.	+	.	.	.	1.1	.	.	.	.	.	.	.	.	r	.	
<i>Saxifraga spathularis</i>	.	.	.	+	+2	.	.	+	.	1.2	1.1	.	.	.	.	.	.	.	
<i>Circaea lutetiana</i>	.	.	.	+	.	.	.	.	.	+	+	.	.	.	.	.	.	II	
<i>Allium ursinum</i>	.	+2	.	+2	.	.	.	.	.	.	.	1.2	.	+	.	.	.	II	



Tab. 2. (continued)

Relevé number	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	
Altitude (×10)	65	62	80	72	68	75	80	78	85	80	76	82	93	90	85	40	97	.	
Slope (°)	10	40	45	40	35	10	60	35	60	45	60	30	25	30	20	40	30	.	
Aspect	SE	E	W	W	NW	S	SE	NE	NW	NW	N	N	NE	N	NE	NW	N	.	
Tree layer cover (%)	100	95	90	100	100	100	100	100	100	100	100	100	95	100	100	100	100	.	
Sample area (m <sup>2</sup> )	70	120	300	250	200	200	150	300	200	110	300	300	150	130	150	200	100	.	
Number of species	29	41	50	41	28	29	37	39	26	32	26	44	35	27	41	26	40	29.8	
Other species																			
<i>Rubus</i> sp.	1.2	1.1	+2	1.2	+	+	1.1	.	1.1	+	1.2	+2	3.3	1.1	3.3	+	1.1	V	
<i>Geranium robertianum</i>	r	+	+	+	+	+	+	5.4	.	1.1	.	+	.	.	.	1.1	.	.	
<i>Pteridium aquilinum</i>	.	+	+	.	.	+	.	+	+	.	.	+	1.1	.	1.1	.	1.1	I	
<i>Brachypodium pinnatum</i>																			
<i>ssp. rupestre</i>	.	.	.	.	.	.	.	.	.	.	+	1.1	3.3	+2	3.3	1.2	.	I	
<i>Fragaria vesca</i>	.	.	.	.	.	+	.	.	.	.	.	+	1.1	.	1.1	.	+	.	
<i>Epilobium parviflorum</i>	.	+	+	.	.	.	.	1.1	.	+	.	.	.	.	.	.	.	.	
<i>Polypodium vulgare</i>	.	.	.	.	.	.	+	.	+	.	.	1.2	.	.	1.1	.	1.1	.	
<i>Heracleum sphondylium</i>	.	.	.	.	.	.	+	.	.	+	.	.	+	.	.	.	.	III	
<i>Geum urbanum</i>	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	I	
<i>Ajuga reptans</i>	.	+	+	.	.	.	.	.	.	.	.	.	.	+	.	.	.	III	
<i>Rumex acetosella</i>	.	.	+	.	.	.	.	r	.	.	.	.	.	.	.	.	.	I	
<i>Urtica dioica</i>	.	.	.	.	1.1	+	.	+	.	.	.	.	.	.	.	+.2	.	.	
<i>Galium aparine</i>	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	1.1	.	I	
<i>Erica arborea</i>	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	
<i>Lamium maculatum</i>	+	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	
<i>Hieracium grex murorum</i>	.	.	+	.	.	.	.	.	.	r	.	.	+	.	.	.	.	.	



## Species present in 1 or 2 relevés

## Characteristic species of Alliance, Order or Class:

*Alnus glutinosa*: I in 18; *Arum italicum*: + in 8, 1.1 in 16; *Athyrium filix-femina*: III in 18; *Blechnum spicant*: II in 18; *Cardamine impatiens*: + in 1; *Carex pendula*: I in 18; *Dryopteris affinis*: + in 12, IV in 18; *Helleborus viridis* subsp. *occidentalis*: + in 16; *Hypericum androsaemum*: III in 18; *Hypericum pulchrum*: + in 15; *Juglans regia*: + in 2; *Melampyrum pratense*: + in 15, + in 17; *Physospermum cornubiense*: +.2 in 13, + in 15; *Pimpinella major*: + in 7, + in 14; *Quercus x andegavensis*: + in 5; *Quercus rubra*: I in 18; *Salix atrocinerea*: 1.2 in 1; *Stellaria nemorum*: r in 2, 2.2 in 8; *Ulmus glabra*: +.2 in 12, I in 18; *Vaccinium myrtillus*: r in 9, +.2 in 17.

## Companion species:

*Angelica sylvestris*: + in 10; *Arrhenatherum elatius* subsp. *bulbosum*: r in 3; *Asplenium trichomanes*: +.2 in 16, II in 18; *Centranthus calcitrapa*: + in 16; *Chrysosplenium oppositifolium*: I in 18; *Conopodium majus*: + in 8, + in 13; *Cruciata laevipes*: + in 15; *Cuscuta epithymum*: +.2 in 6; *Doronicum carpetanum*: + in 3; *Epipactis* sp.: + in 2; *Festuca gr. rubra*: 1.3 in 3, 1.1 in 11; *Geranium sanguineum*: + in 3; *Lapsana communis*: 1.1 in 8; *Laserpitium nestleri*: 1.1 in 3; *Lastrea limbosperma*: I in 18; *Laurus nobilis*: I in 18; *Myosotis* sp.: I in 18; *Silene vulgaris*: + in 17, I in 18; *Stellaria neglecta*: I in 18; *Umbilicus rupestris*: 1.2 in 16; *Valeriana pyrenaica*: 1.1 in 10; *Veronica chamaedrys*: + in 15.

## Relevé locations (in all cases in Lugo Province).

1: Caurel, Ponte de Esperante. 2: Caurel, Camín Rial, between Seoane and Moreda. 3 & 4: Caurel, between Moreda and Devesa de Rogueira. 5 & 6: Caurel, near to the confluence of the Romeor and the Lor river. 7: As Nogais, Alence. 8: Caurel, between Moreda and Rogueira. 9: Caurel, Parada. 10: Caurel, between Romeor and Mostad. 11: Caurel, between Mostad and Pacios. 12: Triacastela, Cancele. 13: As Nogais, Nullán. 14: As Nogais, between Nullán and Alence. 15: Cervantes, between O Portelo and Doiras. 16: Abadín, Samordás on the boundary with the Municipio of Mondoñedo. 17: Triacastela: between Filloval and Fonfria. 18: 5 relevés from O Incio (Romero, 1993).

plot close to our relevé 16, described by Giménez de Azcárate (1993), soil depth was only 55 cm.

– As regards altitude, it occurs most commonly in the upper hill belt (i.e. over the range 600–900 m in the study area), although it is occasionally found at lower altitudes (400 m or lower).

– Precipitation regime in areas where the association occurs is oceanic and generally hyperhumid (>1400 mm per annum), though occasionally at the upper end of humid (for example, 1345 mm per annum in Mondoñedo; Carballeira et al. 1983). Summers tend to be somewhat drier than in the regions where the more easterly Iberian Carpinion formations occur, and this is reflected in the fact that *Omphalodo-Coryleta* generally occurs at sites with low insolation.

– It generally occurs in areas of mild temperature regime, at sites with annual mean temperature between 9,5° and 13°. Although winters may be quite cold, active growth probably takes place for at least 9 months of the year (cf. Pav index sensu Rivas-Martínez 1987); this contrasts with the much shorter active growth period (Pav) of the *Fagetalia sylvaticae* beechwoods which occur in the montane belt in Galicia.

– As regards biogeography, most of the 18 relevés presented here are from the Laciano-ancarense Sector of the Orocantábrica Province, and only a few of them from the Galaico-asturiano Sector of the Cántabro-Atlántica Province. Galicia can thus be taken to represent the extreme southwestern limit of the distribution of the alliance Carpinion in Europe.

## Discussion

### *Syntaxonomic aspects*

Although there are fewer species typical of Carpinion in *Omphalodo-Coryletum* than in the various vicariant communities whose characteristics are summarized in Table 1, the presence of a number of such species in the relevés presented in Table 2 – for example, *Polystichum setiferum*, *Primula vulgaris*, *Potentilla sterilis*, *Phyllitis scolopendrium*, *Neottia nidus-avis*, *Prunus avium* and *Fraxinus excelsior* – provides adequate support for the assignation of the new association to Carpinion. Some of the herb species in our relevés also occur in *Fagion sylvaticae* woodlands (such as *Mercurialis perennis*, *Daphne laureola*, *Milium effusum* and *Carex sylvatica*) or even in Alno-Ulmion (*Circaea lutetiana*, *Allium ursinum*); this provides further confirmation that it belongs to the order *Fagetalia sylvaticae*.

The floristic composition of the new association differs from that of the formations summarized in Table 1 in a number of respects, as detailed herein.

– Certain species present in communities of the Cántabro-euskaldún Sector of the Cántabro-Atlántica Province (Table 1, columns 1–7) are entirely absent from the Carpinion woodlands of the Galaico-asturiano Sector of that province and from the Orocantábrica Province (Table 1, columns 8–14). These species include *Crataegus laevigata*, *Acer campestre*, *Festuca heterophylla* and *Carpinus betulus*; as is to be expected, none of these species is present in any of the *Omphalodo-Coryletum* relevés (Table 2). In addition, some species – particularly shrubs characteristic of the woodland fringe, such as *Ligustrum vulgare*, *Rosa arvensis* and *Cornus sanguinea* – appear to be more frequent in the Cántabro-euskaldún Sector than in more westerly parts of northern Iberia; *Ligustrum*

Tab. 3. Summary of the principal biogeographical and dynamic characteristics of the Carpinion woodland communities present in northwestern Iberia. Species useful for discriminating between the different syntaxa are also listed. The letters designating each syntaxon (A, B and C) correspond to those used on the map of the study area (Fig. 1).

	A	C	D
	Polysticho – Fraxinetum excelsioris	Mercurialidi – Fraxinetum excelsioris subass. omphalodetosum nitidae: C'	Omphalodo – Coryletum avellanae
1	Cantabro-eusk. (2.1) + Ovetense (2.2.1) Ubiñense-piceuropeano (3.2) (rare)	Ubiñense-piceuropeano (3.2) Laciano-narceense (3.3.1) (C' only)	Galaico-asturiano-septentr. (2.2.2) Naviano-ancareense (3.3.2)
2	Hill (Middle to Upper)	Upper Hill + Motane (C': Montane)	Hill (Middle to Upper)
3	Versus D Lam. galeobdolon Pulmonaria longif. Scilla lilio-hyac. Tilia platyphyllos Symphytum tuberosum	Versus D Quercus petraea Tilia platyph. Fagus sylvatica Hepatica nobilis Carex caudata Bromus ramosus	Versus C+C' Pontentilla steril. Asplenium onopt. Versus C' Phyllitis scolopendrium Tamus communis Neottia nidus-avis
4	Rubo ulmifolii – Tametum communis subass. rosetosum sempervirentis subass. loniceretosum periclymeni	Berberidion Rubo ulmifolii – Tametum communis subass. rosetosum villosae (with C')	Rubo ulmifolii – Tametum communis subass. organetosum virentis
5	Genistion occidentalis + Ulicion minoris	Genistion occidentalis	Ulicion minoris

Level 1: Biogeographic sector/subsector (see Fig. 1)

Level 2: Bioclimatic belt

Level 3: Discriminant species (present in one ass. and absent from the other)

Level 4: Fringe communities

Level 5: Replacing communities following major degradation

*vulgare* and *Rosa arvensis* are only exceptionally present in Galicia (Romero et al. 1989, 1992).

– A number of species frequently present in Polysticho-Fraxinetum excelsioris of areas to the west of the Cántabro-euskaldún Sector (such as the Ubiñense-picoeuropeano Sector and the Ovetense Subsector of the Galaico-asturiano Sector; Table 1, columns 8–13) are absent from Omphalodo-Coryletum, namely *Lamiastrum galeobdolon*, *Pulmonaria longifolia*, *Symphytum tuberosum*, *Scilla lilio-hyacinthus* and *Tilia platyphyllos*.

– The association described as Mercurialidi-Fraxinetum excelsioris, occurring characteristically in the upper sub-belt of the hill belt and even in the montane belt, frequently contains species (such as *Carex caudata*, *Festuca altissima*, *Hepatica nobilis* and *Quercus petraea*) which are never present in Omphalodo-Coryletum. Similarly, *Festuca gigantea*, *Fagus sylvatica*, *Stachys sylvatica*, *Bromus ramosus* and *Galium odoratum* – all of which may be present in Fagion sylvaticae beechwoods in the montane belt of the Laciano-ancarense Sector (Izco et al. 1986) – are never present in Omphalodo-Coryletum, although a number of these species may occur at lower altitudes in hygrophytic Alno-Ulmion woodland (Amigo et al. 1987).

– Both *Helleborus viridis* subsp. *occidentalis* and *Saxifraga hirsuta* are almost entirely absent from Omphalodo-Coryletum. Although very frequently present in the vicariant formations summarized in Table 1, both species are very rare in Galicia and absent from Portugal (Franco 1971).

– Of the species which constitute the characteristic combination of the new association, of particular interest are *Omphalodes nitida* and *Saxifraga spathularis*, both endemic to the west/northwest Iberian Peninsula and both useful for differentiating Omphalodo-Coryletum from Polysticho-Fraxinetum excelsioris and Mercurialidi-Fraxinetum excelsioris. Note that we consider the subassociation omphalodetosum nitidae of this latter association to represent a transition towards Omphalodo-Coryletum. *Quercus pyrenaica* similarly has discriminant value; it is not uncommon in Omphalodo-Coryletum from upper hill-belt sites, but entirely absent from Polysticho-Fraxinetum excelsioris and Mercurialidi-Fraxinetum excelsioris.

– In the Laciano-ancarense Sector, Omphalodo-Coryletum (occurring in the hill belt) may adjoin beechwoods in the adjacent montane belt. The new association can be distinguished from these beechwood formations by the presence of thermophilous species such as *Fraxinus excelsior* or the herbs *Phyllitis scolopendrium*, *Potentilla sterilis*, *Neottia nidus-avis*, *Ruscus aculeatus*, *Tamus communis* and *Asplenium onopteris*. Except for *Fraxinus*, these species also serve to differentiate Omphalodo-Coryletum avellanae from Mercurialidi-Fraxinetum excelsioris subass. omphalodetosum nitidae, reported from higher altitudes in the Orocantábrica Province and with a floristic composition which, in our opinion, is closer to Fagion sylvaticae than to Carpinion (see Puente 1988, Table 73).

– It is of interest that hazel is the dominant tree-layer species in the majority of the relevés in Table 2, while a number of climbing species are present, most notably *Hedera helix* which often attains very high cover values. In northwest Iberia at least, the high presence of *Hedera helix* often clearly discriminates between hill-belt Carpinion communities and adjoining montane-belt Fagion sylvaticae communities.

In conclusion, then, Omphalodo-Coryletum typically contains a high proportion of species of Fagitalia sylvaticae. Unlike in Fagion communities, thermophilous species are present. A number of the humicolous species occurring in the more easterly Iberian Carpinion communities are absent. On the other hand, Omphalodo-Coryletum is characterized by the presence of various species not found in other Carpinion communities

(including several species endemic to the west Iberian Peninsula). In Table 3 (level 3) we summarize the characteristics by which Omphalodo-Coryletum can be distinguished from its vicariant syntaxa.

### *Biogeographical aspects*

The majority of the relevés assigned to the new association are from the Naviano-ancarense Subsector of the Laciano-ancarense Sector of the Orocantábrica Province (see Fig. 1). However, the association was also found at two sites in the Galaico-asturiano septentrional Subsector of the Galaico-asturiano Sector, which is clearly attributable to the unusual topographic and edaphic conditions due to the limestone outcrops in that subsector. In our opinion, the presence of the association at these two sites indicates that, in the past, woodlands of this type were more widely distributed, at least in limestone areas of Galicia.

The westward migration of the characteristic species group of Fagetalia sylvaticae across the northern Iberian Peninsula came to a halt, for many species, in eastern Galicia (Izco et al. 1986). Furthermore, in the Galaico-asturiano septentrional Subsector, as a result of the scarcity of limestone substrates, the more nutrient-demanding species of Fagetalia become increasingly restricted to riparian woodland communities: as part of Alno-Ulmion in the case of genuinely alder-dominated woodland (see Bellot 1968), or as part of Blechno-Quercetum roboris subass. pulmonarietosum longifoliae at streamside sides where alder is not the dominant tree (Izco et al. 1990). In this connection, we consider that the relevé table presented by Díaz (1975) as Corylo-Fraxinetum cantabricum should be interpreted as belonging to Alno-Ulmion and not Carpinion; for this reason we have not included these data in our Table 1.

In conclusion, Omphalodo-Coryletum occurs within a specific territory in the westernmost part of the Orocantábrica Province. As can be seen from Figure 1 and Table 3 (level 1), its range does not overlap with those of the other Iberian Carpinion communities described to date.

### *Dynamic aspects*

Degradation of Omphalodo-Coryletum avellanae due to human pressure leads to the formation of characteristic shrub or herb communities, and these communities together form a vegetation series (i.e. a Sigmetum, sensu Géhu et al. 1981) presided by Omphalodo-Coryletum. The concept of vegetation series provides a further means by which the new association can be distinguished, on the basis of dynamic considerations, from its more easterly vicariants.

Moderate disturbance of Omphalodo-Coryletum leads to the appearance of a species-poor thornscrub of Rubo ulmifolii-Tametum communis, which is often present on the woodland fringe. This association is also typical on the fringe of Polysticho-Fraxinetum excelsioris woodland, though with certain differences in species composition (as expected given the more westerly distribution of Omphalodo-Coryletum): for example, *Euonymus europaeus*, *Ligustrum vulgare*, *Rhamnus alaternus* and *Rosa sempervirens* are absent from Rubo-Tametum in the Omphalodo-Coryletum series, while *Origanum virens* and *Ulex europaeus* (absent from or very rare in Rubo-Tametum in the Polysticho-Fraxinetum series; Arnáiz et al. 1983) are present. These differences indicate a need to consid-



er Rubo-Tametum in the Omphalodo-Coryletum series as a distinct subassociation, though it will not be possible to determine an appropriate name for this subassociation until the association Rubo-Tametum communis is correctly typified. Herrera (1988), in an unpublished doctoral thesis, suggests that relevé "Tx 184" from Tüxen et al. (1958) should be taken as the syntype of the typical subassociation (subass. *loniceretosum periclymeni*, without thermophilous species), thus validating the name of this syntaxon and exemplifying the ways in which it differs from the low-altitude subassociation *rosetosum sempervirentis*. We consider this proposal to be useful, and it would facilitate the definition of a new western subassociation, corresponding to the fringe community of the Omphalodo-Coryletum series, which might be called subass. *origanetosum virentis*.

The upper-hill and montane belt communities which develop following disturbance of *Mercurialidi-Fraxinetum* are similarly thornscrub formations. However, these formations occur at higher altitude, and generally in areas of more continental climate, than Rubo-Tametum in the Omphalodo-Coryletum series, and either constitute a clearly montane variant of Rubo-Tametum (subass. *rosetosum villosae*; see Puente 1988) or belong to a different alliance altogether (i.e. *Berberidion*; see Díaz et al. 1992).

Following more severe disturbance of Omphalodo-Coryletum, several different communities may arise. The characteristics of these communities depend on traditional land-use practices and other ecological factors. Frequently, woodland areas are clear-felled in order to convert the land to agricultural use. On valley bottoms and slope bottoms, for example, especially in limestone areas, Omphalodo-Coryletum woodland has often been replaced by *Arrhenatherion elatioris* grassland communities (such as *Trifolio-Malvetum moschatae*; Izco et al. 1982). On steeply sloping or slope-top sites, on the other hand, the replacing community is often a natural *Bromion erecti* grassland, such as *Helianthemo-Brometum erecti* (Gutián et al. 1988).

Extreme degradation of Omphalodo-Coryletum, with associated reductions in soil depth, generally leads to the appearance of scrub communities of *Ulicion minoris*, dominated by *Ulex europaeus* or, in colder areas, by *Erica australis* and *Erica arborea*. Unlike in the vegetation series of *Polysticho-Fraxinetum* and *Mercurialidi-Fraxinetum*, spiny chamaephyte communities of *Genistion occidentalis* never occur in the Omphalodo-Coryletum series. Likewise, the *Ulicion minoris* scrub communities which may form part of the Omphalodo-Coryletum series never contain *Ulex cantabricus* or *Erica vagans*.

To characterize the fire- and grazing-resistant vegetation which often replaces Omphalodo-Coryletum, we have described a community which might be defined as a "gorse grassland". This is a hill-belt community restricted to limestone substrates, denominated *Helianthemo cantabrici-Brometum erecti* subass. *ulicetosum europaei* (Amigo et al. 1994).

In addition to the above communities which arise in response to differing degrees of disturbance of Omphalodo-Coryletum, it should be pointed out that, in the absence of disturbance, this association may possibly progress towards a more mature woodland type. Although the name chosen for the association may seem to imply hazel woodland, *Corylus* is considerably shorter than several of the tree species characteristically present, and in fact Omphalodo-Coryletum, when reasonably mature, has a multispecies upper canopy layer. Like Tüxen et al. (1958) and the name "*Corylo-Fraxinetum cantabricum*", we have chosen to use *Corylus* as a name-giving taxon in view of the constancy and abundance of hazel in these formations. The abundance of hazel, which may on occasions form a dense canopy of about 8–10 m in height, guarantees the maintenance of a

nemoral environment even when the wood is subject to a certain amount of felling. We are unable to confirm whether Omphalodo-Coryletum will eventually give way to oakwood (as appears to be the case with Polysticho-Fraxinetum), since we do not know of any examples of this formation of sufficient age. In one of our best examples of Omphalodo-Coryletum – that selected as syntype (Table 2, relevé 12) – *Quercus robur* is present with very high cover in the canopy layer. On the other hand, we have also found examples, within the same biogeographical subsector, in which the dominant tree species is *Quercus pyrenaica* (e.g. Table 2, relevé 16). We therefore consider it inappropriate to use “Quercetum” in the name of the new association.

Were these woodlands to enjoy adequate legal protection, we would perhaps be able to observe their progression towards a more mature stage (probably mixed oakwood). However, in view of the coppicing pressure to which these formations are invariably subject in Galicia, the name “Coryletum” – reflecting the most evident physiognomic feature of the syntaxon – seems more appropriate than a *Quercus*-derived name. Patterns of disturbance of the tree layer similar to those often affecting Omphalodo-Coryletum formations have been described in detail for English *Fraxinus excelsior*-*Acer campestre*-*Mercurialis perennis* woodland (Rodwell et al. 1991). This is probably the most similar British community to the Carpinion communities of northwest Iberia.

In conclusion, there are characteristic differences between the dynamics (as between the ecology and biogeography) of Omphalodo-Coryletum avellanae and its more easterly vicariants. In Table 3 (levels 4 and 5), we summarize the characteristics of most important of the woody formations typically arising following disturbance of the different Iberian Carpinion communities.

## Conclusions

The Atlantic and Central European mesophytic deciduous woodlands of the alliance Carpinion Issler 1931 em. Mayer 1937 reach the southwestern limit of their distribution in Galicia (northwest Iberian Peninsula).

A study of the Carpinion woodlands of Galicia and of more easterly parts of the northern Iberian Peninsula has indicated the presence of a new association: Omphalodo nitidae-Coryletum avellanae. This association can be distinguished from its more easterly vicariants by the absence of certain species and the presence of others.

The vegetation series presided by Omphalodo-Coryletum (Omphalodo-Coryleto-sigmatum) comprises formations including Pruno-Rubion ulmifolii thornscrub (characteristically occurring on the woodland fringe), heaths/gorse scrubs of Ulicion minoris and Arrhenaterion or Bromion erecti grasslands. The new association occurs in the hill belt at low to medium altitude.

The characteristic development of deep fertile soils beneath Omphalodo-Coryletum has motivated widespread clear-felling of this formation, for conversion of the land to agricultural use. In view of this situation, the few remaining examples of this vegetation type should be the object of special conservation measures.

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## Nomenclature

The biogeographical and bioclimatic terminology used follows that of Rivas-Martínez (1973, 1984), updated by Rivas-Martínez et al. (1984, 1991), Rivas-Martínez (1987) and Diaz et al. (1992). Names of provinces, sectors and subsectors are given in the original Spanish, since no standard translation to English exists. Taxonomic nomenclature follows that of Castroviejo et al. (1986–1993), or of Tutin et al. (1964–1980) for taxa not included in the work of Castroviejo et al. Syntaxonomic nomenclature follows that of Rivas-Martínez et al. (1991); authorities for syntaxa not included in that work are listed in the following appendix.

## Appendix

Complete name and correspondent superior syntaxa of associations and subassociations cited in the text but not included in Rivas-Martínez et al. (1991).

Ass. *Pulmonario longifoliae-Fagetum sylvaticae* Riv.-Mart. 1964 (Carpinion, *Fagetalia sylvaticae*, *Querco-Fagetea*).

Ass. *Mercurialidi perennis-Fraxinetum excelsioris* Fdez.-Prieto & Vázquez 1987 (Carpinion, *Fagetalia sylvaticae*, *Querco-Fagetea*)

subass. *fraxinetosum excelsioris*

subass. *omphalodetosum nitidae* Fdez.-Prieto & Vázquez 1987

Ass. *Omphalodo nitidae-Coryletum avellanae* ass. nova (Carpinion, *Fagetalia sylvaticae*, *Querco-Fagetea*).

Ass. *Blechno spicantis-Quercetum roboris* R.Tx. & Oberd. 1958 (*Quercion robori-pyrenaicae*, *Quercetalia roboris*, *Querco-Fagetea*)

subass. *pulmonarietosum longifoliae* Izco, Amigo & Guitián 1990

Ass. *Rubo ulmifolii-Tametum communis* R.Tx. & Oberd. 1958 (*Pruno-Rubion ulmifolii*, *Prunetalia spinosae*, *Querco-Fagetea*)

subass. *loniceretosum periclymeni* R.Tx. & Oberd. 1958

subass. *rosetosum sempervirentis* Arnáiz & Loidi 1982

subass. rosetosum villosae Puente 1987

subass. organetosum virentis nova prov.

Ass. Trifolio dubii-Malvetum moschatae Izco & Guitián 1982 (Arrhenatherion, Arrhenatheretalia, Molinio-Arrhenatheretea).

Ass. Helianthemo cantabrigi-Brometum erecti Guitián, Izco & Amigo 1988

subass. brometosum erecti

subass. ulicetosum europaei Amigo & Giménez de Azcárate 1994