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12-VI-98

Fragm. Flor. Geobot. 42(1): 95-129, 1997

Contribution to the phytocoenological knowledge of Pyrenean forests

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CARRERAS, J., CARRILLO, E., NINOT, J.-M. AND VIGO, J. 1997. Contribution to the phytocoenological knowledge of Pyrenean forests. *Fragmenta Floristica et Geobotanica* 42(1): 95-129. Kraków. PL ISSN 0015-931x.

ABSTRACT: Following some ongoing projects on phytocoenology and vegetation mapping in the central Pyrenees, we give phytocoenological descriptions of a number of communities. As a result we describe one new association, three new subassociations and five variants; the others, though described previously, were poorly known until now. For each one, species composition, ecology and distribution are discussed, and a relevé table is provided. The list, in decreasing order of dryness of habitat, is:

- *Quercetum rotundifoliae asplenietosum adiantinigrum*, subass. nova; holm oak forest growing on dry, rocky slopes, mainly of slate, in the basal (rarely sub-montane) belt of the inner, drier part of the Pyrenees.

- *Pteridio-Quercetum pubescentis*; in its typical form this is a meso-xerophilous deciduous oak forest, also found on non-calcareous substrata, in the sub-montane belt, preferring cooler slopes than the former association. It includes several variants and subassociations: *pteridietosum* (=typicum), *betuletosum pendulae* and *pinetosum sylvestris*, novae.

- *Lathyro linifolii-Quercetum petraeae*; deciduous oak or birch forest of the montane belt, growing on meso-xeric, acid slopes at the heads of valleys.

- *Veronico-Betuletum pendulae*; deciduous mixed woodland typical of poor, acid soils, on moister aspects at the heads of valleys.

- *Roso pendulinae-Aceretum platanoidis*, ass. nova; mixed, very diverse thicket confined to rock deposits in moist, snowy habitats, in the upper part of the montane belt of Val d'Aran which experiences a mountain Atlantic climate.

KEY WORDS: Pyrenees, vegetation, forests, phytocoenology, *Quercetea ilicis*, *Querceto-Fagetea*, *Vaccinio-Piceetea*.

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INTRODUCTION

In the course of several research projects on geobotany and vegetation mapping, carried out in the Pyrenean mountains from Alt Urgell to Val d'Aran, we have acquired a more thorough knowledge of that area's forest communities, which are especially interesting both as potential vegetation units and as sensitive communities associated with different habitats. In this paper we discuss the communities involving syntaxonomic novelties and also those which, although already described, were poorly known until now. As a whole,

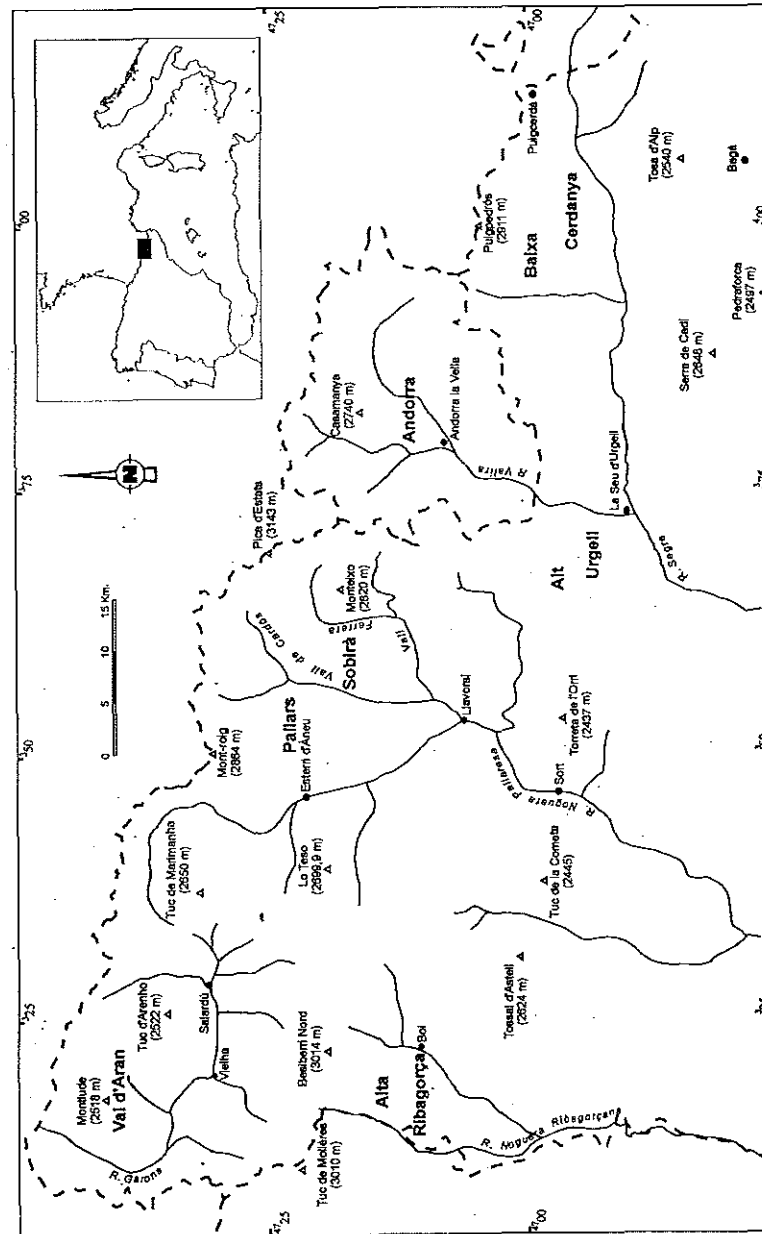


Fig. 1. Map of the study area and location within southwestern Europe.

these are mainly broad-leaved forests conspicuous within a landscape clearly dominated by coniferous woodland.

The area studied (Fig. 1) contains several valleys on the south facing side of the Pyrenees, which have a fairly continental, dry climate, and also Val d'Aran, a north facing valley with a partly sub-oceanic climate. In the south facing area the mean annual rainfall is about 800 mm at 1000 m a.s.l. and about 1100 mm at 1500 m; however, mainly in the sub-montane belt, summer can involve up to 2 months of water deficit. Mean monthly temperatures in the sub-montane belt range from 1 to 3°C in January and reach about 20°C in July. In Val d'Aran moisture conditions are more favourable, at least in its lowest, sub-Atlantic part. Over the whole area the main substrata are slate, generally devoid of carbonates. From the phytogeographical aspect, we consider the following forest vegetation belts:

- sub-montane, which shows a sub-Mediterranean character in the south facing valleys of the chain (the dominant plant cover is meso-xerophilous, deciduous oak woods and even holm oak woods in the driest parts); however, in the north facing basins it is clearly Atlantic in character (with Atlantic mixed woodland);
- montane, with *Pinus sylvestris* forests (*Deschampsio-Pinion sylvestris*) as the most extensive woodland on the Iberian side and extensive silver fir woodland (*Goodyero-Abietetum*) in Val d'Aran;
- sub-Alpine, with *Pinus mugo* subsp. *uncinata* (*Vaccinio-Piceetalia*) throughout the whole area.

This study is based on some 100 phytocoenological relevés, from which 83 have been selected for publication here. After an initial manual distribution into syntaxonomic units, they were analyzed, selected and tabulated by means of XTRINAU computer programs (Font 1990).

In this paper we describe and discuss the floristic, chorologic, ecological and syntaxonomic aspects of the communities considered. These are based on tables compiled for each community and consisting of representative relevés. In the tables, the sorting of taxa into syntaxonomic categories has been carried out by a combination of deduction and consultation of the literature. The relevés are arranged by syntaxonomical gradation. Their locations are defined by 1 x 1 km UTM square coordinates and are confined to the 31T Zone. Sampling data are included.

For the nomenclature of higher plants we follow *Flora Manual dels Països Catalans* (Boldòs *et al.* 1993), including valid synonyms; and for bryophytes, the checklist by Casas (1991).

RESULTS AND DISCUSSION

General aspects

In the rather dry landscapes of Pallars Sobirà and Alt Urgell, holm oak sclerophyllous forests cover significant area at the lowest altitudes, entering the sub-montane belt on

south facing slopes. Their frequently quite good state of conservation allowed us to analyze and individualize a new syntaxonomic unit within the association *Quercetum rotundifoliae*, which includes *Quercus ilex* subsp. *ballota* (= *Q. rotundifolia*) forests developing in base poor soils.

In the sub-montane and montane belts of the same area, acidophilous forests of deciduous *Quercus petraea*, *Q. cerruoides* and *Q. humilis* are rather common, both on south and north facing slopes; however, they have not been adequately investigated until now. Their study led us to classify most of them into the meso-xerophilous *Pteridio-Quercetum pubescentis* or the still less xerophilous *Lathyro montani-Quercetum petraeae* (= *Teucrio-Quercetum*, nom. illeg.). Long-term exploitation of these oak woods and of other forests has resulted in the expansion of birch (*Betula pendula*) woodland. In this area these fast growing communities exhibit one of the highest levels of presence within the Pyrenees, covering extensive slopes which clearly correspond to different potential domains. From a successional standpoint they mainly represent secondary vegetation phases following drastic disturbance, such as felling, fires or avalanches, though in some cases these forests do seem to be rather stabilized. From the phytocoenological point of view, some of the birch woods correspond to pasture communities (*Nardion*, *Chamaespartio-Agrostidenion*) with a thin covering of *Betula pendula*; these therefore, are not considered in this paper. In other cases, birch woods or mixed birch-oak woods contain an understorey which relates them mainly to acidophilous oak woodland (*Quercion roburi-petraeae*, *Luzulo-Fagenion*, *Quercion pubescenti-petraeae*), and also with *Pinus sylvestris* communities (*Deschampsio-Pinion*) or even to *Pinus uncinata* communities (*Rhododendro-Vaccinion* and *Juniperion nanae*).

In Val d'Aran and neighbouring areas, under quite different conditions, we sampled some species rich, mixed forest (with *Fraxinus excelsior*, *Acer* sp.pl., etc.) growing in special places located below cliffs or on unstable slopes. They are noteworthy within Pyrenean vegetation as representing a new association of the alliance *Tilio-Acerion*, here described as *Roso-Aceretum platanoidis*.

Quercetum rotundifoliae Br.-Bl. & Bolòs in Vives 1956 *asplenietosum adiantinigrum*,
subass. nova (Table 1)

[=*Buxo-Quercetum rotundifoliae* Gruber 1974 p.p., *Helleboro-Quercetum rotundifoliae* (Gruber) Rivas-Mart. 1982 p.p.]

HOLOTYPE: Table 1, rel. 9.

This is a holm oak forest peculiar to some inner Pyrenean valleys (Alt Urgell, Andorra and Pallars Sobirà), occurring mainly on slate substrata. It avoids the bottom of valleys which are cold and wet, and covers the warmer slopes, generally those with a southern aspect, though at lower altitudes it is also found on north facing ones. Sometimes this forest occurs as permanent vegetation on rocky slopes or in thin soils, but it is always related to fissured rocks, where the dominant tree can root deeply. At present this holm oak forest appears in the form of young coppice or open woodland, because of the intense exploitation for charcoal and wood suffered by the dominant, hard wooded *Quercus ilex* subsp. *ballota* until a few decades ago, and to extensive pasturing.

Table 1. *Quercetum rotundifoliae* Br.-Bl. & Bolòs in Vives 1956 *asplenietosum adiantinigrum*, subass. nova (HOLOTYPE: rel. 9). [*Quercion ilex*, *Quercetalia ilex*, *Quercetia ilex*].

Relièu number	1	2	3	4	5	6	7	8	9	10	11	12	13
Altitude (dam a.s.l.)	77	105	110	124	86	110	94	95	94	90	110	100	115
Aspect	ESE	SSW	SSW	SE	E	S	SW	W	SSE	SW	W	SE	SSW
Angle of slope (°)	20	17	15	25	25	30	20	25	8	35	15	20	25
Cover of tree layer (%)	90	85	97	95	95	90	100	85	90	85	95	80	90
Cover of shrub layer (%)	15	15	10	10	8	30	-	8	10	10	20	20	5
Cover of herb layer (%)	15	10	15	10	15	7	25	15	30	15	35	40	20
Height of tree layer (m)	4-5	4-6	4-7	3-5	5-7	6-10	5-6	5-7	4-7	4-6	7-10	6-10	2-5
Height of shrub layer (m)	1	1-2	<2	-	-	<3	-	0.5	<2	<2	2	1-2	1-2
Sample area (m ²)	100	120	100	100	100	150	-	100	150	100	100	120	100
Character- and differential-taxa of the association and higher syntaxa													
<i>Quercus ilex</i> subsp. <i>ballota</i>	5.4	4.3	5.4	5.4	5.5	5.4	5.5	5.4	5.4	5.4	5.5	5.4	5.4
<i>Quercus ilex</i> subsp. <i>ballota</i> (sapl.)	.	.	1.2	1.2	.	.	.	.	1.2	.	1.1	+	.
<i>Quercus ilex</i> subsp. <i>ballota</i> (seedl.)	+2	+2	+	1.2	1.2	+	1.2	+	1.2	.	1.2	1.2	1.2
<i>Teucrium chamaedrys</i>	2.2	2.2	1.2	.	2.1	.	2.1	2.2	1.1	+	2.2	1.2	.
<i>Rubia perigrina</i>	1.2	.	+	.	+	.	1.1	+	.	+	1.1	2.2	+
<i>Lonicera etrusca</i>	1.2	+	.	.	+	2.2	.	.	1.1	.	.	+	.
<i>Fistacia terebinthus</i>	.	.	.	.	.	.	1.1	.	.	.	.	.	.
<i>Vincetoxicum nigrum</i>	+	.	+	.	.	1.1	.	.	.	.	.	.	.
<i>Euphorbia characias</i>	.	.	.	.	.	.	.	.	.	.	.	.	.
<i>Juniperus phoenicea</i>	.	.	.	.	.	.	.	.	.	.	.	.	.
<i>Juniperus oxycedrus</i>	.	.	.	.	.	.	.	.	.	.	.	.	.
<i>Osyris alba</i>	.	.	.	.	.	.	.	.	.	.	.	.	.
<i>Asparagus acutifolius</i>	.	.	.	.	.	.	.	.	.	.	.	.	.
<i>Jasminum fruticans</i>	.	.	.	.	.	.	.	.	.	.	.	.	.
<i>Limodorum abortivum</i>	.	.	.	.	.	.	.	.	.	.	.	.	.
Differential-taxa of the subassociation <i>asplenietosum adiantinigrum</i>													
<i>Asplenium adiantum-nigrum</i>	1.2	+	+	+	1.2	+	+	+2	1.2	1.1	2.1	1.2	1.2
subsp. <i>adiantum-nigrum</i>	+2	+2	.	1.2	.	(+)	1.1	1.2	2.2	1.2	2.2	1.2	+2
<i>Galium maritimum</i>	+	.	.	+	.	.	+	.	.	+	+2	.	.
<i>Hieracium glaucinum</i> gr.	.	.	.	.	.	.	.	.	.	.	.	.	.
<i>Hieracium sabaudum</i>	.	.	.	.	.	.	.	.	.	1.1	.	.	+

(cont.)

Table 1. Continued.

Relevé number	1	2	3	4	5	6	7	8	9	10	11	12	13
<i>Taxa from Quercus-Fagetea</i>													
<i>Prunus spinosa</i>	.	1.2	.	.	.	+	+	+	+	+	.	+	+
<i>Quercus cerrioides</i>	+	3.1	+	.	+	.	+	.	.	+	+	.	.
<i>Quercus cerrioides</i> (sapling)	+	.	+	+	+	+	.	+	.
<i>Amelanchier ovalis</i>	.	+	.	.	+	+	+	.	+	+	.	+	.
<i>Acer monspessulanum</i>	.	.	2.2	.	+	+	1.1	.	.	.	+	+	.
<i>Acer monspessulanum</i> (sapling)	+	+	+	+	.
<i>Clematis vitalba</i>	.	.	.	+	+	.	.	+	.	+	+	.	.
<i>Prunus mahaleb</i>	.	+	+	+	+2	.	.
<i>Brachypodium sylvaticum</i>	+	+	+	.	.	.	+	.
<i>Crataegus monogyna</i>	+	.	.	+
<i>Cornus sanguinea</i>	.	.	.	+	.	.	.	+
<i>Epipactis helleborine</i>	.	.	+	+	+	.
<i>Rosa micrantha</i>	.	+	.	+
<i>Helleborus foetidus</i>	.	.	+	+	.	.	.	+
<i>Prunus avium</i> (sapling)	+	+	.	+2	+2	.	.
<i>Poa nemoralis</i>	+	.	.	1.1	.	.
<i>Arabis turrata</i>
<i>Rosa canina</i>	.	+	.	+
<i>Rubus ulmifolius</i>	.	+	.	+	+	1.1	.
<i>Rosa sicula</i>	+2	.	+2	.
<i>Teucrium scorodonia</i>	+	.	.	.	+	.	.
<i>Fraxinus excelsior</i> (sapling)	+
<i>Ligustrum vulgare</i>
<i>Pinus nigra</i> subsp. <i>salmianii</i>	.	+	+
<i>Primula veris</i> subsp. <i>columnnae</i>	+
<i>Rosa agrestis</i>	+	.	.	.
<i>Viola sylvestris</i>
<i>Main companions</i>													
<i>Carex halleriana</i>	.	+	.	+	1.2	.	+2	.	1.2	1.2	2.2	1.2	.
<i>Dactylis glomerata</i>	+2	1.2	.	.	.	.	+2	+2	+	+	+2	+	.
<i>Festuca ovina</i> gr.	.	.	.	+2	+2	.	+2	+	1.2	2.2	1.2	.	+2

<i>Silene nutans</i>	.	+	.	.	.	.	+2	+	1.2	1.2	1.2	.	.
<i>Juniperus communis</i> subsp. <i>communis</i>	.	.	.	1.1	.	.	.	.	+	.	+	+	+2
<i>Saponaria ocymoides</i>	.	.	.	.	.	.	.	2.2	1.2	.	+	1.1	1.2
<i>Celtis australis</i>	+	.	.	.	.	+	.	.	.	.	.	.	.
<i>Celtis australis</i> (sapling)	.	.	.	.	+	+	.	.	.	.	.	.	.
<i>Celtis australis</i> (seedl.)	.	.	.	.	1.1	+	.	.	.	.	.	.	.
<i>Genista scorpius</i>	+	+	.	.	.	.	.	+	.	+	.	.	.
<i>Inula conyza</i>	.	.	.	.	.	.	+	+	.	.	.	+	+
<i>Sedum album</i>	.	.	.	.	.	.	.	+2	+	+	+3	.	.
<i>Brachypodium retusum</i>	.	+2	.	.	+	+	.	.	.	.	.	.	.
<i>Sedum rupestre</i> subsp. <i>reflexum</i>	+	.	.	.	+2	.	.	.	.	+2	.	.	+2
<i>Psoralea bituminosa</i>	.	+	.	.	.	.	.	1.1	+	.	.	.	.
<i>Asplenium trichomanes</i>	.	.	.	.	+2	.	+	.	.	.	+	.	.
<i>Galium lucidum</i>	.	.	.	.	.	.	.	+	.	.	+	.	+
<i>Galium pumilum</i> s.l.	.	.	.	.	.	.	.	.	+	+	+	+	.
<i>Carex humilis</i>	.	.	+2	+2	+2	.	.	.	.	.	.	.	.
<i>Origanum vulgare</i>	.	.	.	.	.	.	.	1.2	.	+	.	+2	.
<i>Pinus sylvestris</i>	.	+	.	.	.	.	.	.	+	+	.	.	.
<i>Rosa</i> sp.	.	.	.	.	+	+	+	.	.	.	.	.	.
<i>Sedum telephium</i> subsp. <i>maximum</i>	.	.	+	.	.	+	.	.	.	.	.	.	+

Companions occurring in one or two relevés – *Alliaria petiolata* 7, *Alyssum abyssoides* 6 and 12, *Arabis thaliana* 12, *Arabis hirsuta* 9, *Arenaria serpyllifolia* 9 (1.1), *Arrhenatherum elatius* 7 and 11, *Brachypodium phoenicoides* 6, *Bryonia cretica* subsp. *dioica* 12, *Calluna vulgaris* 10, *Campanula hispanica* subsp. *catalanica* 1, *Campanula rotundifolia* 5, *Carex muricata* 8, *Cephalanthera longifolia* 4 and 8, *Ceterach officinarum* 6, *Clinopodium vulgare* 9, *Dianthus carthusianorum* 11, *Epipactis microphylla* 5 and 10, *Erysimum grandiflorum* 2, *Fragaria vesca* 8, *Galium aparine* 3 and 12, *Genistella sagittalis* 7, *Geranium columbinum* 3, *Geranium rotundifolium* 12, *Hedera helix* 3 (1.1) and 12, *Hieracium pilosella* 2, *Hieracium* sp. 5, *Hippocrepis comosa* 8, *Hypericum perforatum* 2, *Knautia dipsacifolia* subsp. *catalaunica* 4, *Lactuca virosa* 11, *Lavandula angustifolia* subsp. *pyrenaica* 2, *Lens nigricans* 10, *Melica ciliata* subsp. *ciliata* 9 and 12 (1.2), *Monotropa hypopitys* 5, *Myosotis arvensis* 3, *Odontides lanceolata* 8, *Odontides* sp. 5, *Odontides viscosa* 10 and 13, *Ononis spinosa* 10, *Phleum phleoides* 2 (1.2), *Pinus pinaster* 1, *Polypodium vulgare* 3 and 13, *Pteridium aquilinum* 10 (1.2), *Rosa* cf. *pouzinii* 8, *Rubus* sp. 8, *Sedum sediforme* 2 (1.2), *Seseli montanum* 10, *Silene latifolia* 12 (1.1), *Solidago virgaurea* 3 and 13, *Stachys recta* 8 and 12, *Stellaria media* 7, *Taraxacum officinale* 7, *Thymus vulgaris* 2 and 13, *Trifolium arvense* 9, *Umbilicus rupestris* 1 and 7, *Verbascum chaixii* 2, *Verbascum lychnitis* 2, *Verbascum* sp. 11, *Veronica arvensis* 12, *Veronica officinalis* 10, *Vicia cracca* gr. 2, *Vicia hirsuta* 9, *Vicia sativa* subsp. *nigra* 3, *Vicia tetrasperma* subsp. *gracilis* 10, *Vincetoxicum hirundinaria* subsp. *intermedium* 13, *Viola hirta* 3 (1.1) and 4, *Viola rupestris* 10.

Locations of relevés – 1 (B560): above Seu d'Urgell; Alt Urgell; CG7391, 15/10/94. 2 (B269): above el Pont de Bar, to Aristot; Alt Urgell; CG8592, 7/6/92. 3 (B580): below Estac, to Escós, young coppice; Pallars Sobirà; CG4193, 27/6/95. 4 (B579): above Estac, small holm oak stands on rocky slope; Pallars Sobirà; CG4194, 27/6/95. 5 (B582): road from Sort to Enviny; Pallars Sobirà; CG4595, 2/7/95. 6 (B561): between Rialb and Surp; Pallars Sobirà; CH4501, 10/9/94. 7 (B559): Llavorsí; Pallars Sobirà; CH5306, 31/10/94. 8 (B589): road to Estaron; Pallars Sobirà; CH5011, 12/9/95. 9 (B571): Can Escalles, between Vall Ferrera and Vall de Cardós; Pallars Sobirà; CH15509, 5/6/95. 10 (B572): between Arnós and Tirvia, left side of the river (Vall Ferrera); Pallars Sobirà; CH5609, 5/6/95. 11 (B588): above Tirvia, road to Virós (Vall Ferrera); Pallars Sobirà; CH15609, 11/7/95. 12 (B570): south facing slope of Pic dels Malls, Vall de Cardós; Pallars Sobirà; CH15409, 5/6/95. 13 (B585): above Bonestarré (Vall de Cardós); Pallars Sobirà; CH15415, 4/7/95.

Among the dominant holm oaks, some meso-xerophilous deciduous trees, mainly *Acer monspessulanum* and *Quercus cerrroides*, occur thinly. The shrub and herb layers are rather poor and open. They include several taxa of *Quercetea ilicis*, some of which are quite constant (*Rubia peregrina*, *Pistacia terebinthus*, *Teucrium chamaedrys*, *Lonicera etrusca*) while others are more occasional (*Euphorbia characias*, *Asparagus acutifolius*, *Jasminum fruticans*). Diverse *Quercus-Fagetea* taxa, chiefly related to *Quercetalia pubescenti-petraeae* or to *Prunetalia spinosae*, are more or less constant, though always thinly scattered. As rather unusual taxa in comparison with other known subassociations of *Quercetum rotundifoliae* we mention *Asplenium adiantum-nigrum* subsp. *adiantum-nigrum*, *Galium maritimum*, *Hieracium sabaudum* and *Hieracium praecox* gr. The occurrence of these differential-taxa, and also the lack or low incidence of calcicolous plants (e.g. *Buxus sempervirens* and *Coronilla emerus*) provide the basis for proposing a new subassociation of the Pyrenean range, parallel to the subassociation *buxetosum* Vives 1964, though related to non-calcareous substrata and in general to more continental climates.

In several earlier papers some of the relevés identified as subassociation *buxetosum* (= *Buxo-Quercetum rotundifoliae* Gruber 1974) are actually best classified into the new subassociation *asplenietosum*, according to our scheme. These include papers published by Gruber (1974: Table 2, rel. 1, 2, 9, 10, 12 & 15), Carreras (1993: Table 69, rel. 1-10; rel. 11-13 are transitional to subassociation *buxetosum*) and Carrillo & Ninot (1992: Table 90, rel. 2 & 3).

Moreover, we are conscious that the floristic differences between the Pyrenean subassociations (*buxetosum* and *asplenietosum*) and the *Quercetum rotundifoliae* occurring in the lowlands of the Ebro depression and of the inner Catalan basins (*typicum*) are insufficient for separating them into different associations. The character-taxa of *Quercetea ilicis* inhabiting Pyrenean holm oak forests are also common in typical *Quercetum rotundifoliae* (Vives 1956; Braun-Blanquet & Bolòs 1957). The occurrence of sub-Mediterranean or central European taxa, related to *Quercus-Fagetea*, distinguishes only at subassociation level the two mountain communities (subassociations *buxetosum* and *asplenietosum adiantinigrum*) from the subassociation *typicum*, while these are differentiated from each other by the presence or absence of some calcicolous and calcifuge taxa.

Pteridio-Quercetum pubescentis (Suspl.) Bolòs 1983

(Tables 2 & 3)

[= *Buxo-Quercetum pubescentis* Br.-Bl. (1915) 1932 subass. à *Teucrium scorodonia* et *Peridium aquilinum* Suspl. 1942]

subass. *pteridietosum* (= *typicum*; Tables 2 & 3: rel. 1 & 2)

subass. *betuletosum pendulae*, subass. *nova* (Table 3, rel. 3-6; HOLOTYPE: rel. 6)

subass. *pinetosum sylvestris*, subass. *nova* (Table 3, rel. 7-9; HOLOTYPE: rel. 8)

This is a meso-xerophilous deciduous oak wood typical of non-calcareous substrata, and vicariant of the calcicolous *Buxo-Quercetum pubescentis* Br.-Bl. (1915) 1932. It was formerly described from Vallespir (Susplugas 1942) as an acidophilous subassociation of *Buxo-Quercetum*, and was later classified as an association in its own right by Bolòs

Table 2. *Pteridio-Quercetum pubescentis* (Suspl.) Bolòs 1983 *pteridietosum* (= *typicum*); 1 - var. of *Quercus cerrroides* (rel. 1-11); 2 - var. of *Quercus humilis* (= *typicum*; rel. 12-18). [*Quercus pubescenti-petraeae*, *Quercetalia pubescenti-petraeae*, *Quercus-Fagetea*].

Relevé number	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	
Altitude (dam a.s.l.)	118	118	106	110	100	100	105	100	101	100	116	115	90	140	105	115	115	104	
Aspect	N	NE	NE	SSW	E	NNW	E	W	SE	NNE	NE	WNW	W	S	ESE	W	SE	ENE	
Angle of slope (°)	25	30	20	20	30	15	30	30	17	30	35	25	30	25	25	27	30	30	
Cover of tree layer (%)	100	85	85	90	90	95	85	85	90	85	100	85	90	90	90	100	90	80	
Cover of shrub layer (%)	10	10	20	15	35	40	15	10	20	20	20	15	15	10	60	30	40	15	
Cover of herb layer (%)	60	30	30	65	35	60	30	15	65	35	-	60	40	50	15	55	40	80	
Height of tree layer (m)	5-7	7-12	3-5	8-10	9-16	8-10	4-7	7-12	8-10	7-10	8-10	8-10	9-12	9-12	8	8-10	6	<15	
Height of shrub layer (m)	<2	1-2	1	1-3	1-3	1-5	1-2	<3	-	1-3	1-3	-	1-3	-	1-3	1-3	<2	1-3	
Sample area (m ²)	150	120	100	150	160	100	100	150	100	100	100	150	150	100	100	100	100	150	125
Character- and differential-taxa of the association and order	4.1	5.4	5.5	4.4	5.5	5.4	4.2	5.4	5.4	5.4	5.4	5.4	5.3	5.4	2.1	5.4	5.4	4.2	+
<i>Quercus cerrroides</i>	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+
<i>Quercus cerrroides</i> (sapling)																			
<i>Quercus humilis</i> (dom.) + <i>cerrroides</i>												5.4	5.5	5.4	2.1	5.4	5.4	4.2	+
<i>Quercus humilis</i> + <i>cerrroides</i> (sapl.)												1.1	1.1	+	+	+	+	+	+
<i>Amelanchier ovalis</i>												+	+	+	+	+	+	+	+
<i>Acer monspessulanum</i>												+	+	+	+	+	+	+	+
<i>Acer monspessulanum</i> (sapling)												+	+	+	+	+	+	+	+
<i>Helicoborus foetidus</i>												+	+	+	+	+	+	+	+
<i>Campanula persicifolia</i>												+	+	+	+	+	+	+	+
<i>Coronilla emerus</i>												+	+	+	+	+	+	+	+
<i>Quercus X strimii</i>												+	+	+	+	+	+	+	+
<i>Primula veris</i> subsp. <i>columnae</i>												+	+	+	+	+	+	+	+
<i>Viburnum lantana</i>												+	+	+	+	+	+	+	+
<i>Buxus sempervirens</i>												+	+	+	+	+	+	+	+
<i>Prunus mahaleb</i>												+	+	+	+	+	+	+	+
<i>Lathyrus niger</i>												+	+	+	+	+	+	+	+
<i>Pinus nigra</i> subsp. <i>satzmanii</i>												+	+	+	+	+	+	+	+
<i>Acer opalus</i>												+	+	+	+	+	+	+	+
<i>Acer opalus</i> (sapling)												+	+	+	+	+	+	+	+

(cont.)

Table 2. Continued.

Relevé number	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
<i>Differential-taxa of the association with respect to Buxo-Quercetum pubescentis</i>																		
<i>Stellaria holostea</i>	2.2	.	.	2.2	2.2	2.2	2.2	1.2	2.2	2.2	2.2	3.2	1.2	2.2	.	1.2	+	2.2
<i>Deschampsia flexuosa</i>	3.2	2.2	1.2	.	.	1.2	+2	+2	.	2.2	1.2	+2	1.2	.	.	.	.	+2
<i>Hieracium sabaudum</i>	+	.	+	(+)	1.1	.	1.1	+	.	1.1	1.1	.	.	.	.	1.2	+	1.1
<i>Solidago virgaurea</i>	+	1.2	+	.	1.2	.	.	.	.	+	+	.	+	1.2	.	.	1.2	.
<i>Teucrium scorodonia</i>	2.2	.	.	1.2	.	1.2	2.2	1.2	1.2	.	1.2	2.2	.	.	.	.	.	.
<i>Sedum rupestre</i> subsp. <i>reflexum</i>	+	.	.	.	.	.	.	+	.	+2	+2	.	.	.	.	.	+2	+
<i>Betula pendula</i>	+	1.2	1.2	.	.	.	2.2	+	.	.	+	.	.	.	.	.	.	.
<i>Stachys officinalis</i>	.	.	+	.	.	.	.	.	.	+	+	.	.	+2	.	+	.	.
<i>Polypodium vulgare</i> subsp. <i>vulgare</i>	.	.	.	.	.	+2	.	.	.	.	.	+	.	.	+2	.	.	+
<i>Calluna vulgaris</i>	.	1.1	+	.	.	.	+2	.	.	.	.	.	.	.	.	.	.	.
<i>Hylacomium splendens</i>	1.2	2.2	+2	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
<i>Quercus petraea</i>	.	1.1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1.1
<i>Quercus petraea</i> (sapling)	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	+
<i>Lathyrus linifolius</i>	.	+	.	.	.	1.2	.	.	.	.	.	.	.	.	.	.	.	.
<i>Genista pilosa</i>	.	.	+	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.
<i>Pteridium aquilinum</i>	.	.	.	.	.	.	.	+	.	.	.	.	.	+	.	.	.	.
<i>Xerophilous differential-taxa with respect to Lathyro-Quercetum petraeae</i>																		
<i>Asplenium adiantum-nigrum</i> subsp. <i>adiantum-nigrum</i>	+	+2	+2	+	.	+2	.	+	1.1	+	+2	1.2	+2	1.2	.	.	+	+
<i>Galium maritimum</i>	.	.	.	+	+2	.	1.2	1.2	+2	.	+	+	+	1.2	1.2	+2	1.2	.
<i>Lonicera etrusca</i>	.	.	.	+	2.2	.	+	+	.	.	.	1.1	1.1	.	.	+	.	+
<i>Teucrium chamaedrys</i>	.	.	+	.	.	.	.	.	+2	.	.	.	+	+2	+	1.2	1.2	.
<i>Quercus ilex</i> subsp. <i>ballota</i> (sapl.)	.	+	.	.	+2	+	1.2	.	.	+	.	.	.	.	.	.	.	.
<i>Saponaria ocymoides</i>	.	.	.	(+)	.	.	.	.	.	.	.	.	.	+2	+2	+2	.	.
<i>Viola alba</i>	.	.	.	.	.	.	.	.	.	.	.	.	+	+2	.	.	cf.+	cf.+
<i>Euphorbia characias</i>	.	.	.	.	.	.	.	.	+	.	.	.	+	.	.	.	.	.
<i>Pistacia terebinthus</i>	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.
<i>Character-taxa of the class</i>																		
<i>Poa nemoralis</i>	2.2	.	+2	+2	1.2	+2	+2	.	2.2	2.2	1.2	3.3	2.2	1.2	+2	1.2	1.2	3.2

<i>Rosa canina</i> gr.	+	+	+	.	+	+	.	.	+	1.2	+	+	.	+	+	+	+	+
<i>Brachypodium sylvaticum</i>	+2	.	+2	+2	.	1.2	1.2	1.2	2.2	+2	+	.	+2	.	.	1.2	1.2	1.2
<i>Campanula trachelium</i>	.	.	.	+	+	+2	+	+	1.1	.	+	+	+	.	1.1	1.2	+2	+
<i>Crataegus monogyna</i>	+	.	.	+	.	1.1	.	+	1.1	+	.	+	1.1	.	.	.	+	1.1
<i>Prunus spinosa</i>	+	.	.	.	.	+	.	+	+	+	.	.	+	1.1	+	+	.	+
<i>Prunus avium</i>	.	+	.	.	.	.	.	.	+	+	.	.	.	.	.	+	+	+
<i>Prunus avium</i> (sapling)	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.
<i>Prunus avium</i> (secdl.)	.	.	.	+	+	1.1	.	+	.	.	.	.	.	.	.	.	.	.
<i>Viola sylvestris</i>	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
<i>Hepatica nobilis</i>	+	.	.	+	.	+2	.	.	.	.	1.1	+	.	+2	.	+	+	+
<i>Fraxinus excelsior</i>	+2	+	+	.	.	2.2	.	.	.	.	2.2	2.2	.	.	.	1.2	1.2	+
<i>Fraxinus excelsior</i> (sapling)	.	.	.	.	.	+	.	.	.	.	+	.	.	.	.	.	.	.
<i>Fraxinus excelsior</i> (secdl.)	.	.	.	+	+	1.1	.	+	.	1.1	+	.	.	.	.	.	.	+
<i>Corylus avellana</i>	5.4	.	.	(+)	.	.	.	.	.	+	1.1	.	.	.	.	.	.	.
<i>Clematis vitalba</i>	.	.	.	.	.	+	.	.	.	.	.	.	.	+2	.	.	.	+
<i>Arabis turrita</i>	.	.	.	.	.	+	+2	+2	+2	.	.	.	.	.	.	.	.	+
<i>Lonicera xylosteum</i>	.	.	.	.	.	.	.	.	.	+	1.1	.	+	.	.	.	.	.
<i>Rubus ulmifolius</i>	.	.	.	.	+	.	.	.	.	.	.	.	+	.	.	.	.	.
<i>Ribes alpinum</i>	1.1	.	.	.	.	+	+	+	cf.+	.	.	.	.	.	.	.	.	.
<i>Rosa micrantha</i>	.	.	.	.	.	+	.	.	.	+	.	.	.	.	.	.	.	.
<i>Rosa rubiginosa</i>	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.
<i>Acer campestre</i>	.	+	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
<i>Dryopteris filix-mas</i>	(+)	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+
<i>Festuca heterophylla</i>	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.
<i>Moehringia trinervia</i>	+	.	.	.	.	.	.	.	.	.	.	.	.	2.2	.	1.2	.	.
<i>Tamus communis</i>	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
<i>Rosa sicula</i>	+	.	.	cf.+	.	.	.	.	1.1	.	.	.	.	.	.	.	.	+
<i>Cornus sanguinea</i>	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+
<i>Cotoneaster nebrodensis</i>	+	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.
<i>Euonymus europaeus</i>	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
<i>Hypericum montanum</i>	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.
<i>Polygonatum odoratum</i>	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+
<i>Pyrus malus</i> subsp. <i>mitis</i>	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	+	.	+

Table 2. Continued.

Relevé number	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
<i>Rhamnus saxatilis</i>	.	.	.	.	.	.	.	cf.+	.	.	.	.	.	.	+	.	.	.
<i>Rosa agrestis</i>	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+
<i>Sorbus aria</i> (sapling)	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.
<i>Phyteuma spicatum</i>	.	.	.	.	.	.	.	.	.	.	1.1	.	.	.	.	.	.	.
<i>Cardamine impatiens</i>	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Main companions																		
<i>Dactylis glomerata</i>	+	.	.	.	+	.	.	1.2	+2	+	.	+	1.2	1.2	+	+2	+	.
<i>Festuca ovina</i> gr.	.	.	2.2	.	1.2	.	1.2	1.2	3.2	+2	+	+2	.	.	1.2	.	2.2	.
<i>Juniperus communis</i> subsp. <i>communis</i>	.	+	+	+	+	.	+	+	.	+	1.1	.	.	.	+	.	.	+
<i>Galium aparine</i>	+	.	.	+	+	+	.	+2	1.2	.	+	.	.	+2	+	+2	+2	+
<i>Clinopodium vulgare</i>	(+)	.	.	+2	.	1.2	.	.	.	.	.	1.2	.	1.2	.	1.2	1.2	.
<i>Cruciata glabra</i>	.	1.1	1.2	.	.	2.2	.	.	.	.	.	.	.	.	+2	+	+	+
<i>Astragalus glycyphyllos</i>	.	.	+	.	+	.	.	.	.	1.2	+	.	+	+2	1.2	+2	+2	.
<i>Silene nutans</i>	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	1.2	.
<i>Galium pumilum</i> s.l.	+	+	.	(+)	.	.	1.2	+2	.	.	.	.	.	.	+	+2	1.2	.
<i>Hieracium glaucinum</i> gr.	.	.	+	+	.	.	.	+	.	+	.	.	.	.	+2	.	.	+
<i>Hieracium murorum</i> gr.	.	+	.	.	2.1	1.1	.	.	.	.	+	.	.	.	.	.	.	.
<i>Silene vulgaris</i>	+	.	.	.	+	.	+2	+	.	.	+	.	.	.	.	.	.	+
<i>Campanula patula</i>	(+)	.	.	.	.	.	.	.	+	.	.	.	.	+2	.	+2	.	.
<i>Carex</i> sp.	.	.	.	.	+2	+	.	.	.	.	.	.	.	.	cf.2.2	.	.	.
<i>Vicia cracca</i> subsp. <i>incana</i>	.	.	+2	+	+	.	.	.	.	.	.	.	.	.	.	.	.	.
<i>Vincetoxicum hirsutinaria</i> subsp. <i>intermedium</i>	.	.	.	(+)	.	+	+	.	.	.	+	.	.	.	.	.	.	1.2
<i>Fragaria vesca</i>	.	.	.	.	.	+	.	.	.	.	.	.	1.1	.	.	.	.	+
<i>Vicia sepium</i>	.	.	.	2.1	.	1.1	.	.	.	.	.	.	.	.	+2	.	+2	.
<i>Abietinella abietina</i>	+2	.	1.2	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+
<i>Arrhenatherum elatius</i>	+2	.	.	.	.	.	+	+	.	.	.	.	.	.	.	.	.	.
<i>Festuca nigrescens</i>	.	1.2	1.2	2.2	.	.	.	.	.	+	1.1	.	.	.	.	.	.	.
<i>Lapsana communis</i>	+	.	.	.	.	.	.	.	.	.	.	.	.	.	+2	.	.	+
<i>Sedum telephium</i> subsp. <i>maximum</i>	.	.	.	(+)	.	.	.	.	+2	.	.	.	.	.	.	.	.	.
<i>Verbascum chatxii</i>	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.

<i>Digitalis lutea</i>	+	+	+	
<i>Peucedanum oreoselinum</i>	+	+	+
<i>Asplenium trichomanes</i>	+	+2	+2	.	
<i>Carex caryophylla</i>	+2	.	.	.	2.2	cf.+	
<i>Conopodium majus</i>	.	.	.	+	.	.	.	.	.	.	.	+	1.2	.	.	.	.	.
<i>Phleum phleoides</i>	1.2	.	.	.	+2	+	
<i>Poa pratensis</i>	1.1	.	+	+2	.	.	.	
<i>Saxifraga granulata</i>	.	.	.	.	.	+	.	.	.	.	.	+	+2	.	.	.	.	.
<i>Vicia hirsuta</i>	.	.	.	.	.	.	.	+	.	1.3	.	+	.	.	.	.	.	.
<i>Stachys recta</i>	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	+
<i>Pinus sylvestris</i>	.	.	.	.	.	.	.	2.1	.	.	.	.	.	.	.	.	.	.
<i>Pinus sylvestris</i> (sapling)	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+

Companions occurring in one or two relevés – *Agrostis capillaris* 10, *Alliaria petiolata* 5 and 12, *Anthoxanthum odoratum* 10, *Arabis auriculata* 16, *Astragalus monspesulanus* 17, *Biscutella laevigata* 15 and 17, *Bupleurum cf. praealtum* 13, *Bupleurum falcatum* 3, *Carex cf. depressa* 15 (1.2), *Carex halleriana* 16 and 17 (1.2), *Cephalanthra longifolia* 18 (1.1), *Cystopteris fragilis* 1, *Dianthus hyssopifolius* 12, *Dicranum scoparium* 2, *Epipactis microphylla* 18, *Festuca gautieri* 1 (1.2) and 11, *Galium* sp. 12, *Genista scorpius* 15 and 17, *Genistella sagittalis* 12, *Geranium robertianum* 6 and 12, *Geum urbanum* 9 (1.1), *Hedera helix* 4 (2.2) and 16, *Hieracium* sp. 13 and 18, *Hippocrepis comosa* 17, *Homalothecium lutescens* 1 (1.2) and 15, *Hypericum perforatum* 10, *Hypnum cupressiforme* 2 and 17, *Inula conyza* 9 and 13, *Knautia dipsacifolia* s.l. 14, *Laserpitium latifolium* 16 and 17, *Lathyrus pratensis* 4, *Lathyrus sylvestris* subsp. *pyrenaicum* 7 (1.1), *Leucanthemum vulgare* 10, *Linaria repens* 10, *Lotus corniculatus* 8, *Luzula nivea* 2, *Medicago lupulina* 9, *Ononis spinosa* 14, *Origanum vulgare* 7, *Pimpinella saxifraga* 7 and 18, *Potentilla rupestris* 10, *Prunella grandiflora* subsp. *grandiflora* 14 (1.2) and 17, *Prunella grandiflora* subsp. *pyrenaica* 16, *Rhytidadelphus triquetrus* 2 and 3, *Rosa* sp. 13, *Rubus* sp. 14 (1.2) and 18, *Seseli montanum* 17, *Tanacetum corymbosum* 18 (1.1), *Taraxacum officinale* 9 and 18, *Torilis arvensis* 9, *Trifolium campestre* 8, *Trifolium medium* 6, *Trifolium pratense* 5, *Trifolium rubens* 15 and 18, *Vaccinium myrtillus* 2, *Valeriana officinalis* 6 and 11, *Veronica austriaca* subsp. *teucrium* 17, *Veronica chamaedrys* 18 (1.2), *Veronica officinalis* 3 and 12, *Vicia cracca* gr. 18 (1.1), *Vicia sativa* subsp. *nigra* 9 (1.1), *Vicia villosa* 6 (cf.) and 12, *Viola pyrenaica* 4, *Viola* sp. 9 (1.1).

Locations of relevés – I (B581): between Alins and Àreu, Fulleddo gully (Vall Ferrera); Pallars Sobirà; CH6213. 27/6/95. 2 (B584): above Ans (Vall de Cardós), young oak forest; Pallars Sobirà; CH5315. 4/7/95. 3 (B410): between Esterri d'Àneu and Isavarre (Vall d'Àneu); Pallars Sobirà; CH4521. 27/7/91. 4 (B568): Alins (Vall Ferrera), oak-wood among fields; Pallars Sobirà; CH6112. 4/6/95. 5 (B569): Ribera de Cardós, towards Surri (Vall de Cardós), rocky slope; Pallars Sobirà; CH5414. 4/6/95. 6 (B573): Araós, towards Virós forest (Vall Ferrera); Pallars Sobirà; CH5810. 26/6/95. 7 (B574): near Ribera de Cardós (Vall de Cardós), right side of river, rocky slope; Pallars Sobirà; CH5411. 26/6/95. 8 (B575): near Ribera de Cardós (Vall de Cardós), left side of river; Pallars Sobirà. CH5513. 26/6/95. 9 (B586): between Ainet de Besan and Alins (Vall Ferrera); Pallars Sobirà; CH6011. 10/7/95. 10 (B590): Ainet de Cardós (Vall de Cardós); Pallars Sobirà; CH5415. 13/9/95. 11 (B612): between Alins and Àreu (Vall Ferrera); Pallars Sobirà; CH6215. 1/6/95. 12 (B552): Ronf. between Rialb and LLavorsí; Pallars Sobirà; CH5002. 30/10/94. 13 (B563): near Beranf, road to Portainé; Pallars Sobirà; CH4801. 30/10/94. 14 (B276): above Músser, towards Arànsér, colluvial soil; Baixa Cerdanya; CG9093; 9/7/92. 15 (B267): Cassanet de Baix, Pont de Bar; Alt Urgell; CG89. 7/6/92. 16 & 17 (B274 & B275): road to Músser, above Senillers; Baixa Cerdanya; CG9191 & CG9093. 9/7/92. 18 (B591): below Albet (Vall de Castellbò); Alt Urgell; CG6295. 1/7/94.

Table 3. *Pteridio-Quercetum pubescentis* (Suspl.) Bolòs 1983: 1 – subass. *pteridietosum* (= *typicum*) var. of *Quercus petraea* (rel. 1 & 2); 2 – subass. *betuletosum pendulae* (rel. 3–6; HOLOTYPE: rel. 6); 3 – subass. *pinetosum sylvestris* (rel. 7–9; HOLOTYPE: rel. 8). [*Quercion pubescenti-petraeae*, *Quercetalia pubescenti-petraeae*, *Quercio-Fagetia*].

Relevé number	1	2	3	4	5	6	7	8	9
Altitude (dam a.s.l.)	116	120	144	158	120	115	102	96	98
Aspect	SE	NE	NE	NE	NNW	NW	NE	N	N
Angle of slope (°)	15	30	–	15	10	20	30	40	20
Cover of tree layer (%)	90	95	80	90	90	85	90	85	80
Cover of shrub layer (%)	5	15	70	–	–	30	15	10	50
Cover of herb layer (%)	50	65	60	–	80	75	90	85	75
Height of tree layer (m)	<14	8–10	8–10	<13	5–7	6–8	9–12	8–10	8
Height of shrub layer (m)	2–5	1–3	3–4	1–3	–	1–3	1–3	<2	1–4
Sample area (m ²)	125	150	–	150	100	100	200	150	120
<i>Differential-taxa of the variant and subassociations</i>									
<i>Quercus petraea</i>	5.3	5.5	1.1	1.1	+	–	–	–	–
<i>Quercus petraea</i> (sapling)	+	1.1	1.1	+	–	–	–	–	–
<i>Betula pendula</i>	–	–	4.3	5.4	5.5	4.3	–	–	–
<i>Betula pendula</i> (sapling)	–	–	–	1.1	–	–	–	+	+
<i>Ribes alpinum</i>	–	–	1.1	+	1.1	1.1	–	–	–
<i>Pinus sylvestris</i>	–	+	–	–	–	–	5.4	5.4	5.4
<i>Pinus sylvestris</i> (sapling)	–	–	–	–	–	–	–	+	+
<i>Dicranum scoparium</i>	–	–	–	–	–	–	1.2	1.2	2.2
<i>Rhytidium rugosum</i>	–	–	–	–	–	–	+2	1.2	1.2
<i>Pleurozium schreberi</i>	–	–	–	–	–	+2	4.3	4.3	–
<i>Viscum album</i> subsp. <i>austriacum</i>	–	–	–	–	–	–	+	+	–
<i>Character-taxa of the alliance and order</i>									
<i>Quercus cerrioides</i>	–	–	–	–	2.1	2.1	+	–	–
<i>Quercus cerrioides</i> (sapling)	–	–	–	–	–	1.1	2.1	1.1	1.1
<i>Quercus humilis</i>	+	–	–	–	–	–	–	–	–
<i>Amelanchier ovalis</i>	–	–	1.1	–	–	+	1.1	+	+
<i>Helleborus foetidus</i>	+	+	–	1.2	+	+	–	–	–
<i>Primula veris</i> subsp. <i>columnae</i>	–	+	+	+	–	–	–	–	–
<i>Acer monspessulanum</i>	–	+	–	+	–	–	–	–	–
<i>Acer monspessulanum</i> (sapling)	–	–	–	–	–	–	–	–	+
<i>Viburnum lantana</i>	–	–	1.1	–	+	–	–	–	–
<i>Prunus mahaleb</i>	–	–	–	–	+	–	–	–	–
<i>Quercus × streinii</i>	+	–	–	–	–	–	–	–	–
<i>Differential-taxa of the association with respect to Lathyro-Quercetum petraeae</i>									
<i>Quercus ilex</i> subsp. <i>ballota</i>	+	–	–	–	–	–	–	+	+
<i>Quercus ilex</i> subsp. <i>ballota</i> (sapling)	–	–	–	–	–	+	1.1	+	3.2
<i>Asplenium adiantum-nigrum</i> subsp. <i>adiantum-nigrum</i>	–	+	–	–	+	+2	–	–	+2
<i>Galium maritimum</i>	–	–	–	–	–	–	+	–	1.1
<i>Lonicera etrusca</i>	–	–	–	–	–	–	–	+	–
<i>Teucrium chamaedrys</i>	–	+	–	–	–	–	–	–	–
<i>Differential-taxa of the association with respect to Buxo-Quercetum pubescentis</i>									
<i>Deschampsia flexuosa</i>	+	–	2.2	–	3.2	3.2	3.2	2.2	3.2

(cont.)

Table 3. Continued.

Relevé number	1	2	3	4	5	6	7	8	9
<i>Stellaria holostea</i>	+	2.2	1.2	+	1.2	1.2	–	–	–
<i>Genista pilosa</i>	–	–	–	+	+	+	+	+	+
<i>Calluna vulgaris</i>	–	–	–	+	–	2.2	1.1	1.1	1.1
<i>Lathyrus linifolius</i>	–	–	+	1.2	+	2.1	2.1	–	1.1
<i>Hylocomium splendens</i>	–	–	–	–	–	2.2	3.3	3.3	3.2
<i>Hieracium sabaudum</i>	+	+	–	–	+	–	–	–	+
<i>Solidago virgaurea</i>	–	–	–	–	+	+	–	–	+
<i>Veronica officinalis</i>	–	–	–	–	+	+	–	–	+
<i>Polypodium vulgare</i> subsp. <i>vulgare</i>	–	–	–	–	–	+	–	–	+
<i>Sedum rupestre</i> subsp. <i>reflexum</i>	–	–	–	–	–	+	–	+2	–
<i>Peridium aquilinum</i>	2.3	–	–	–	–	–	–	+2	1.2
<i>Teucrium scorodonia</i>	–	–	–	–	–	1.2	–	–	–
<i>Holcus mollis</i>	–	+	–	–	–	–	–	–	–
<i>Luzula nivea</i>	–	–	–	+2	–	–	–	–	–
<i>Character-taxa of the class</i>									
<i>Brachypodium sylvaticum</i>	1.2	1.2	1.2	+2	2.2	1.2	–	–	+
<i>Viola sylvestris</i>	–	1.2	1.1	1.1	1.1	1.2	1.1	–	+
<i>Hepatica nobilis</i>	–	1.2	2.2	2.2	–	1.1	+2	–	+2
<i>Crataegus monogyna</i>	+	+	+	+	+	–	–	–	–
<i>Poa nemoralis</i>	2.2	2.2	1.2	–	+	1.2	–	–	–
<i>Lonicera xylosteum</i>	–	–	1.2	+	+	–	–	–	+
<i>Rosa canina</i>	+	+	+	–	+	–	–	–	–
<i>Prunus spinosa</i>	+	+	+	–	–	–	–	–	–
<i>Prunus avium</i>	+	+	–	+	–	–	–	–	–
<i>Fraxinus excelsior</i>	–	1.2	–	–	+	–	–	–	–
<i>Fraxinus excelsior</i> (sapling)	–	+	+	–	–	–	–	–	–
<i>Corylus avellana</i>	–	–	4.2	–	+	–	–	–	–
<i>Rosa rubiginosa</i>	–	–	1.1	1.1	–	–	–	–	–
<i>Campanula trachelium</i>	+	+	–	–	cf.+	–	–	–	–
<i>Clematis vitalba</i>	+	–	–	–	–	–	–	–	–
<i>Acer campestre</i>	–	+	–	–	–	–	–	–	–
<i>Acer campestre</i> (sapling)	–	+	–	–	–	–	–	–	–
<i>Ulmus minor</i>	+	–	–	–	–	–	–	–	–
<i>Rosa micrantha</i>	–	–	–	–	–	+	–	–	–
<i>Rosa agrestis</i>	–	–	–	–	–	+	–	–	–
<i>Dryopteris filix-mas</i>	–	–	–	–	–	–	–	–	–
<i>Moehringia trinervia</i>	–	–	–	–	–	–	–	–	–
<i>Rubus ulmifolius</i>	+	–	–	–	–	–	–	–	+2
<i>Main companions</i>									
<i>Juniperus communis</i> subsp. <i>communis</i>	–	+	1.2	3.1	+	1.1	+	+	+
<i>Festuca ovina</i> gr.	+	+	–	–	–	1.2	1.2	+2	1.2
<i>Cruciata glabra</i>	–	–	1.2	2.2	+	2.1	+2	–	–
<i>Fragaria vesca</i>	–	–	1.2	+	1.1	+	–	–	–
<i>Vicia sepium</i>	–	+	–	+	1.1	+	–	–	–
<i>Clinopodium vulgare</i>	+2	1.2	+	1.2	+	–	–	–	–
<i>Hieracium murorum</i> gr.	–	–	–	–	–	+	1.1	–	1.1
<i>Anthoxanthum odoratum</i>	+	–	–	–	1.2	+	–	–	–

(cont.)

Table 3. Continued.

Relevé number	1	2	3	4	5	6	7	8	9
<i>Arrhenatherum elatius</i>	+	+	.	.	.	+2	.	.	.
<i>Dactylis glomerata</i>	+	+	+2
<i>Laserpitium latifolium</i>	.	1.1	+	+	.	.	.	.	.
<i>Vincetoxicum hirundinaria</i> subsp. <i>intermedium</i>	.	.	+	.	+	+	.	.	.

Comparisons occurring in one or two relevés – *Achillea millefolium* 4, *Agrostis capillaris* 4 and 5 (1.2), *Asplenium trichomanes* 6, *Astragalus glycyphyllos* 1 and 4, *Campanula rapunculoides* 1, *Carex muricata* 1, *Cephalanthera longifolia* 1 and 2 (1.1), *Conopodium majus* 4 (2.2), *Dianthus carthusianorum* 1, *Dianthus hyssoptifolius* 5, *Digitalis lutea* 5 and 6, *Festuca gautieri* 3 (1.2) and 4 (3.3), *Festuca rubra* gr. 2, *Galium aparine* 1, *Galium pumilum* s.l. 6 (1.1) and 7, *Genista balansae* subsp. *europaea* 4, *Geranium robertianum* 6, *Hieracium glaucinum* gr. 7 (1.2) and 9, *Hieracium* sp. 2 (1.1), *Hypnum cupressiforme* 6 and 9 (3.2), *Hypochoeris maculata* 2, *Lactuca perennis* 1 and 2, *Luzula multiflora* 4, *Origanum vulgare* 5, *Ornithogalum umbellatum* 2, *Peucedanum oreoselinum* 1 and 2, *Phleum phleoides* 2, *Pimpinella saxifraga* 5, *Platanthera* sp. 4, *Poa pratensis* 4, *Polygala vulgaris* 4, *Potentilla micrantha* 2, *Potentilla neumanniana* 4, *Potentilla rupestris* 2, *Rhytidadelphus triquetrus* 6 and 9, *Rosa* sp. 2 and 9, *Rubus idaeus* 3 and 5, *Saxifraga granulata* 4, *Sedum brevifolium* 9, *Sedum telephium* subsp. *maximum* 2, *Silene nutans* 2 and 9 (1.2), *Silene vulgaris* 1, *Stachys officinalis* 9, *Thymus pulegioides* 6, *Trifolium montanum* 2, *Trifolium rubens* 2, *Valeriana officinalis* 2, *Veronica austriaca* subsp. *teucrium* 4, *Veronica chamaedrys* 2, *Vicia cracca* gr. 2 and 3, *Vicia hirsuta* 6, *Vicia sativa* subsp. *nigra* 1, *Viola hirta* 2.

Locations of relevés – 1 (B592): south-west of Seix (Vall de Castellbò); Alt Urgell; CG6197. 1/7/94. 2 (B593): between Santa Creu and Seix (Vall de Castellbò); Alt Urgell; CG6097. 1/7/94. 3 & 4 (B610 & B611): Lladrós, towards Pui de Tabaca (Vall de Cardós); Pallars Sobirà; CH5418 & CH5417. 1/6/95. 5 (B602): Alins, towards Norís (Vall Ferrera); Pallars Sobirà; CH6312. 1/8/94. 6 (B576): comunals gully, Ribera de Cardós (Vall de Cardós); Pallars Sobirà; CH5412. 26/6/95. 7 (B577): Araós, at Virós forest (Vall Ferrera); Pallars Sobirà; CH5810. 26/6/95. 8 (B583): near Araós, rocky slope (Vall Ferrera); Pallars Sobirà; CH5610. 4/7/95. 9 (B558): Llavorsí, rocky slope; Pallars Sobirà; CH5306. 31/10/94.

(1983). According to information in the literature (Braun-Blanquet & Susplugas 1937; Susplugas 1942; Bolòs 1960, 1983; Vigo 1996) it shows some variability, primarily in the tree layer, which typically consists of *Quercus humilis* but sometimes contains other oak species. Our new data, involving a wider range of data, leads to an increase in the scope of this association.

The form of *Pteridio-Quercetum pubescentis* dominated by *Quercus humilis* stretches mainly across the north-eastern part of Catalonia, and is fairly homogeneous from the Catalanidic mountains to the Ripollès basin (variant of *Quercus humilis*). Relevés 12–18 in Table 2, sampled in western Cerdanya, Alt Urgell and eastern Pallars Sobirà, are still referable to this variant although they normally contain some individuals of *Quercus cerrioides* among the dominant *Quercus humilis*. In the inner area of Pallars Sobirà, under a more continental and drier climate, this dominance becomes reversed and *Quercus cerrioides* forms the tree layer in the association, which otherwise retains a very similar floristic composition (variant of *Quercus cerrioides*; Table 2, rel. 1–11, and Bolòs 1960: 246, rel. from València d'Àneu). Moreover, from la Cerdanya westwards, some of the most Atlantic species (i.e. *Sarothamnus scoparius*, *Tamus communis*, *Sedum cepaea*) become absent or very rare in this variant, and no other plants peculiar to this area take their place.

Quercus petraea sometimes occurs in the *Pteridio-Quercetum humilis*, either among dominant *Q. cerrioides* or *Q. humilis*, or as a dominant itself (Susplugas 1942; Vigo

1996), especially in the neighbouring areas of *Lathyro-Quercetum petraeae* (variant of *Quercus petraea*; Table 3, rel. 1 & 2). Actually, *Pteridio-Quercetum* stands floristically close to *Lathyro-Quercetum petraeae*. As for the differences, the former is devoid of the character-taxa of *Quercetalia robori-petraeae*, or of acidophilous plants in general (e.g. *Deschampsia flexuosa*, *Teucrium scorodonia* and *Hieracium sabaudum*); also, *Stellaria holostea* and *Poa nemoralis* are much less abundant in its field layer. On the other hand, *Pteridio-Quercetum* contains several taxa which indicate quite warm, dry conditions (*Asplenium adiantum-nigrum* subsp. *adiantum-nigrum*, *Quercus ilex* subsp. *ballota*, *Lonicera etrusca* or *Teucrium chamaedrys*) and also some character-taxa of *Quercetalia pubescenti-petraeae* (*Cytisophyllum sessilifolium*, *Coronilla emerus*, *Viburnum lantana*, etc.). These plants, especially the most calcicolous, are never present in the understorey of *Lathyro-Quercetum*. The floristic differences between *Pteridio-Quercetum* and *Buxo-Quercetum* are related mainly to the substrata on which both of them develop.

From la Cerdanya to Pallars Sobirà, these oak woods appear chiefly in the form of isolated remnants, owing to heavy exploitation (extensive grazing and extraction of fuel) which took place until a few years ago. They occur mainly in the sub-montane belt, from about 900 to 1200 (1500) m, on slopes with intermediate aspects, though they may also inhabit both fertile south facing and sheltered north facing slopes. Therefore the neighbouring drier, steep south facing slopes are the domain of the holm oak community described above while the colder north facing ones support *Pinus sylvestris* forest. At the present time, these oak forests are largely replaced by xerophilous pastures (generally *Xerobromion*) or by diverse scrub communities.

In the area of Pallars Sobirà, owing to intense forest exploitation and the abundance of birch (*Betula pendula*), the pattern of neighbouring birch and oak stands, both referable to *Pteridio-Quercetum*, is rather common. Such birch forests are floristically very similar to typical *Pteridio-Quercetum*, although *Ribes alpinum* seems to prefer the birch community; also some herbaceous plants typical of forest clearings (such as *Fragaria vesca*, *Vincetoxicum hirundinaria* subsp. *intermedium* and *Anthoxanthum odoratum*) are more abundant in it. Therefore, we distinguish within the association *Pteridio-Quercetum* a new subassociation, *betuletosum pendulae*, which corresponds to a secondary form of the oak wood following fire or drastic felling.

We also include in *Pteridio-Quercetum* the Scots pine (*Pinus sylvestris*) forests occurring on some steep, north facing slopes at low altitude, involving rocky, poorly developed soils and unfavourable climate, relatively cold in winter and dry in summer. These pine communities are generally rather poor, the taxa of *Quercus-Fagetea* being very few. The shrub layer is made up of only sparse individuals of *Quercus cerrioides*, *Q. ilex* subsp. *ballota*, *Amelanchier ovalis* and *Lonicera etrusca*. In comparison with the above mentioned deciduous communities, the field layer consists of the most acidophilous and ubiquitous species: *Deschampsia flexuosa*, *Lathyrus linifolius*, *Genista pilosa*, *Calluna vulgaris*, *Festuca ovina* gr., *Sedum rupestre* subsp. *reflexum*, etc. This pine forest also maintains a well developed moss layer: *Hylocomium splendens* and *Pleurozium schreberi* are commonly dominant, and *Rhytidadelphus triquetrus*, *Rhytidium rugosum*, *Dicranum scoparium* and *Hypnum cupressiforme* quite frequent. These differen-

ces taken together define the subassociation *pinetosum sylvestris*, subass. nova. It is floristically related to the poorest pine forests of *Deschampsio-Pinion*, but its occurrence at low altitude, the presence in it of *Quercus ilex* subsp. *ballota* and *Lonicera etrusca*, and the absence of *Vaccinio-Piceetea* taxa are sufficient reasons to reject its inclusion in that class. The subassociation *pinetosum sylvestris* of *Pteridio-Quercetum* may be taken as a geographical vicariant of *Lonicero-Pinetum salzmanii* Gamisans & Gruber 1988 *hypnetosum cupressiformis* Carreras *et al.* 1996, which occurs in similar habitats in the more continental, drier Pyrenean areas.

Lathyro montani-Quercetum petraeae (Lapraz) Rivas-Mart. 1983 (Table 4)

[=*Teucrio scorodoniae-Quercetum petraeae* Lapraz 1966, em. Bolòs 1983, nom. illeg.; non *Teucrio scorodoniae-Quercetum petraeae* Chouard 1925]

LECTOTYPE: Table *Querceto-Teucrietum scorodoniae*, rel.7, Collect. Bot. 6: 590; designed in Bolòs 1983.

Lathyro-Quercetum is an association of a rather Atlantic character comprising oak woods of *Quercion robori-petraeae* in which the main tree is generally *Quercus petraea*. However, its tree layer is sometimes made up of other oak species (the mixture of *Quercus petraea* and *Q. robur* or *Q. humilis* occurs in places) or of various deciduous trees (including *Castanea sativa*, *Betula pendula* and *Corylus avellana*), and even of coniferous species, such as *Pinus sylvestris* (Bolòs 1988).

The relevés in Table 4 correspond to mainly immature and not very dense forest (75–90% cover), which contains a light shrubby layer and a herbaceous component of variable density (25–80%). Among that, acidophilous taxa predominate (*Teucrium scorodonia*, *Deschampsia flexuosa*, *Holcus mollis*, *Lathyrus linifolius*, *Stellaria holostea*, *Cynopodium majus*, etc.), while *Fagetalia* plants are almost absent. In comparison with relevés featured in previous publications, those in Table 4 are devoid of certain Atlantic taxa such as *Lonicera periclymenum*, *Sarothamnus scoparius* and *Serratula tinctoria* which do not occur in the study area. Relevés 8–10 of our table form a variant of *Betula pendula*, which must be the result of the former exploitation of oak forests belonging to this association.

In Catalonia *Lathyro-Quercetum* has been recorded from some northern massifs of the Catalanidic range (Bolòs 1983; Lapraz 1966), from Val d'Aran (Bolòs 1973, 1988; Rivas-Martínez 1968) and from the Ribes valley (Vigo 1984, 1996). As it appeared to be restricted to such temperate, wet areas, its presence in some valley heads of Pallars Sobirà is rather unexpected, particularly as it covers large areas, especially in the northern part of the Cardós and Ferrera valleys, being more occasional in the Santa Magdalena and Àneu valleys, and only sporadic in Alt Urgell (Castellbò only). *Lathyro-Quercetum* shows a marked preference for acidic conditions, and thrives on slate on south facing slopes of the montane belt. Our relevés were sampled at altitudes between 1000 and 1750 m; above that height *Lathyro-Quercetum* adjoins the sub-Alpine communities of *Pinus mugo* subsp. *uncinata* (*Vaccinio-Piceetea*). Its topographical situation is analogous to that of the *Deschampsio-Pinion* forests in the southern parts of the same valleys.

Within *Quercetalia robori-petraeae*, *Lathyro-Quercetum* shows a somewhat sub-Me-

Table 4. *Lathyro montani-Quercetum petraeae* (Lapraz) Rivas-Mart. 1983: 1 – var. of *Quercus petraea* (= *typicum*; rel. 1–7); 2 – var. of *Betula pendula* (rel. 8–10). [*Quercion robori-petraeae*, *Quercetalia robori-petraeae*, *Querceto-Fagetalia*].

Relevé number	1	2	3	4	5	6	7	8	9	10
Altitude (dam a.s.l.)	134	171	131	129	125	125	107	173	148	175
Aspect	SW	SSE	SE	S	W	SSW	NE	SW	S	E
Angle of slope (°)	35	20	20	20	27	20	20	15	17	20
Cover of tree layer (%)	80	100	90	90	90	95	95	70	–	75
Cover of shrub layer (%)	20	–	20	10	20	15	15	80	–	10
Cover of herb layer (%)	60	–	75	55	60	50	25	80	–	60
Height of tree layer (m)	12	5–7	9–12	8–10	6–8	12–15	5–8	7–9	8–10	8–10
Height of shrub layer (m)	1–3	1	2–3	1–5	1–2	1–4	1	2–3	2–4	1–3
Sample area (m ²)	150	150	150	150	100	125	120	100	90	100
<i>Species dominant in the tree layer, differential-taxa of the variants</i>										
<i>Quercus petraea</i>	5.2	3.3	5.4	5.4	5.4	5.4	5.5	.	+	.
<i>Quercus petraea</i> (sapling)	1.1	.	1.1	+	1.1	+	.	.	.	.
<i>Quercus petraea</i> (seedl.)	1.1	.	+	.	.	.	.	.	.	.
<i>Betula pendula</i>	.	2.2	.	+	+	.	1.2	4.3	5.4	4.3
<i>Betula pendula</i> (sapling)	.	.	.	.	.	.	.	+	+	1.1
<i>Character- and differential-taxa of the association, alliance and order</i>										
<i>Teucrium scorodonia</i>	.	2.1	2.1	2.1	1.1	.	+2	.	2.2	2.2
<i>Deschampsia flexuosa</i>	.	3.3	.	+2	3.2	.	2.2	1.2	.	+2
<i>Holcus mollis</i>	+	+	3.3	.	.	1.2	.	.	.	1.2
<i>Lathyrus linifolius</i>	1.2	.	.	2.1	+	+	.	.	.	.
<i>Stachys officinalis</i>	.	+	1.2	2.2	+	.	.	.	.	.
<i>Hieracium sabaudum</i>	.	.	.	1.2	.	+	+	.	.	.
<i>Luzula nivea</i>	.	.	.	.	+	.	+2	.	+	.
<i>Melampyrum pratense</i>	.	.	.	.	.	.	.	.	.	1.2
<i>Vaccinium myrtillus</i>	.	.	.	.	.	.	.	+	.	.
<i>Character-taxa of the class</i>										
<i>Viola sylvestris</i>	.	+	1.1	+	1.1	+	+	+	+	+
<i>Stellaria holostea</i>	1.1	1.2	2.2	+	.	1.1	.	1.1	1.2	+2
<i>Corylus avellana</i>	+	4.4	.	+	+	.	.	.	3.3	+
<i>Poa nemoralis</i>	1.2	.	3.3	+2	.	1.2	1.2	.	+2	.
<i>Fraxinus excelsior</i>	.	.	+	+	+	.	.	.	.	.
<i>Fraxinus excelsior</i> (sapling)	.	.	.	+	.	.	+	+	+	.
<i>Hepatica nobilis</i>	.	1.2	.	.	+	.	1.2	1.2	.	1.2
<i>Crataegus monogyna</i>	+	.	.	+	+	+	.	.	.	.
<i>Helleborus foetidus</i>	.	+	+	.	.	.	+	2.1	.	.
<i>Rosa canina</i>	+	.	.	+	.	+	+	.	.	.
<i>Festuca heterophylla</i>	.	.	+	2.2	+	.	.	.	.	.
<i>Acer campestre</i>	+	.	+	+	.	.	.	.	.	.
<i>Acer campestre</i> (sapling)	.	.	+	.	.	.	.	.	.	.
<i>Amelanchier ovalis</i>	+	.	.	.	+	.	+	.	.	.
<i>Rosa rubiginosa</i>	+	.	+	.	1.1	.	.	.	.	.
<i>Brachypodium sylvaticum</i>	.	.	.	+	1.2	.	.	.	.	.
<i>Prunus spinosa</i>	.	.	.	+	.	+	.	.	.	.

(cont.)

Table 4. Continued.

Relevé number	1	2	3	4	5	6	7	8	9	10
<i>Viburnum lantana</i>	.	.	+	.	.	.	+	.	.	.
<i>Campanula trachelium</i>	+	.	.	.	.	.	.	.	+	.
<i>Rosa cf. tomentosa</i>	.	+	.	.	.	.	.	.	.	.
<i>Primula veris</i> subsp. <i>columnae</i>	.	.	.	.	.	+	.	.	.	.
<i>Pyrus malus</i> subsp. <i>mitis</i>	.	.	.	.	.	1.1	.	.	.	.
<i>Tamus communis</i>	.	.	.	.	.	.	.	.	.	.
<i>Acer monspessulanum</i>	+	.	.	.	.	.	.	.	.	.
<i>Acer platanoides</i>	.	.	+	.	.	.	.	.	.	.
<i>Campanula persicifolia</i>	.	.	.	.	+	.	.	.	+	.
<i>Dryopteris filix-mas</i>	.	.	.	.	.	.	.	.	.	+
<i>Moehringia trinervia</i>	.	.	.	.	.	.	.	1.1	.	.
<i>Mycelis muralis</i>	.	.	.	.	.	.	.	.	.	.
<i>Tilia platyphyllos</i>	+	.	.	.	.	.	+	.	.	.
<i>Cornus sanguinea</i>	.	.	.	.	.	.	.	.	+	.
<i>Ilex aquifolium</i>	.	.	.	.	.	.	.	.	.	.
<i>Lathyrus niger</i>	2.2	.	.	.	.	.	.	.	.	.
<i>Rubus ulmifolius</i>	.	.	.	.	.	+	.	.	.	.
Main companions	.	.	.	.	.	.	.	.	.	.
<i>Cruciata glabra</i>	.	1.1	+	1.2	+	.	1.2	+	+	+
<i>Peridium aquilinum</i>	.	+	+	2.3	+	+	1.2	.	.	3.3
<i>Galium pumilum</i> s.l.	.	+	+	+	+	.	.	1.1	+	+
<i>Conopodium majus</i>	.	+	+	.	+	.	.	2.2	1.2	+
<i>Anthoxanthum odoratum</i>	.	+	.	+	+	+	.	3.3	.	1.1
<i>Juniperus communis</i> subsp. <i>communis</i>	.	1.1	+	.	1.1	.	+	+	.	.
<i>Silene nutans</i>	+	+2	1.2	+2	+	.	+	.	+	.
<i>Clinopodium vulgare</i>	.	+	+	+	.	.	.	2.3	.	+
<i>Genista balansae</i> subsp. <i>europaea</i>	1.1	1.2	+	.	.	+	.	+	.	.
<i>Hieracium murorum</i> gr.	+	.	.	.	.	.	.	.	.	+
<i>Abies alba</i>	.	.	.	.	.	.	.	.	+	+
<i>Abies alba</i> (sapling)	.	.	+	.	.	.	.	.	+	+
<i>Agrostis capillaris</i>	.	3.3	1.2	1.2	.	.	.	1.2	.	.
<i>Festuca ovina</i> gr.	1.2	.	+2	.	.	.	.	.	+	.
<i>Achillea millefolium</i>	.	+	+	+	.	.	.	.	+	.
<i>Dactylis glomerata</i>	+	+	+	+	.	.	.	.	+	.
<i>Hypericum perforatum</i>	.	+	.	.	+	.	.	.	+	2.2
<i>Veronica officinalis</i>	.	.	.	.	.	+	.	.	1.2	+2
<i>Festuca rubra</i> gr.	.	.	.	.	+	.	.	.	2.3	+
<i>Rubus</i> sp.	.	.	.	.	+	.	.	.	+	.
<i>Sedum rupestre</i> subsp. <i>reflexum</i>	.	.	+	.	+	.	.	1.2	+	.
<i>Veronica chamaedrys</i>	.	.	.	.	.	1.1	.	.	.	.
<i>Fragaria vesca</i>	.	+	+	.	.	.	.	.	.	.
<i>Galium maritimum</i>	+2	.	.	.	+	.	.	.	.	.
<i>Trifolium medium</i>	1.2	.	+	.	.	.	+	.	.	.
<i>Vincetoxicum hirundinaria</i> subsp. <i>intermedium</i>	.	.	+	+	+	.	.	.	.	.

(cont.)

Table 4. Continued.

Companions occurring in one or two relevés – *Arrhenatherum elatius* 1 (1.2) and 6, *Asphodelus albus* 2, *Asplenium adiantum-nigrum* subsp. *adiantum-nigrum* 5 and 9, *Astragalus glycyphyllos* 7, *Bupleurum cf. falcatum* 5, *Calluna vulgaris* 7, *Campanula glomerata* 2, *Campanula rapunculoides* 1, *Campanula rotundifolia* 2 and 7, *Carex muricata* 9, *Carex ornithopoda* 7 (1.2), *Carex* sp. 2 and 5, *Centaurea nigra* 3 and 9, *Dianthus hyssopifolius* 2 and 7, *Euphorbia cyparissias* 2 and 3, *Festuca gautieri* 3 and 5 (1.2), *Festuca nigrescens* 8 (1.2), *Galium aparine* 3, *Genistella sagittalis* 4, *Geranium robertianum* 9, *Hieracium glaucinum* gr. 6 and 10, *Laserpitium latifolium* 6, *Lathyrus pratensis* 6, *Linaria striata* 10, *Myosotis arvensis* 8, *Peucedanum oreoselinum* 6, *Picris hieracioides* 9, *Pimpinella saxifraga* 4 and 7, *Pinus mugo* subsp. *uncinata* 8 and 10, *Pinus sylvestris* 6, *Pinus sylvestris* (shrubby) 7, *Platanthera* sp. 9, *Poa pratensis* 4, *Polygonatum odoratum* 3, *Polystichum* sp. 9, *Potentilla micrantha* 10, *Potentilla neumanniana* 2 and 4, *Potentilla rupestris* 1 and 6, *Ranunculus bulbosus* 9 and 10, *Ranunculus montanus* s.l. 8, *Ranunculus* sp. 5, *Rubus idaeus* 9, *Rumex acetosella* 10, *Saponaria ocyroides* 1 and 3, *Saxifraga granulata* 8, *Silene rupestris* 10, *Silene vulgaris* 9, *Solidago virgaurea* 4 and 5, *Sorbus aucuparia* 10, *Sorbus aucuparia* (seedl.) 8, *Tanacetum corymbosum* 1 (1.1) and 6 (1.1), *Thlaspi brachypetalum* 10, *Thymus pulegioides* 9, *Trifolium pratense* 8, *Trifolium rubens* 6, *Vicia cracca* gr. 1 and 6, *Vicia sepium* 3 and 6.

Locations of relevés – 1 (B597): sunny slope at Planell del Roi, Montenartró (Santa Magdalena valley); Pallars Sobirà; CH5301. 4/8/94. 2 (B603): Tavascan, forest track to Certascan, near Closell gully (Vall de Cardós); Pallars Sobirà; CH6026. 26/7/95. 3 (B604): between Morioto bridge and Artamon site (Vall de Cardós); Pallars Sobirà; CH6025. 26/7/95. 4 (B607): Tavascan, towards Noarre (Vall de Cardós), rocky substrate; Pallars Sobirà; CH5623. 25/7/95. 5 (B613): above Tavascan, towards Boldós (Vall de Cardós); Pallars Sobirà; CH5622. 29/6/95. 6 (B595): between Sant Andreu and Santa Creu (Vall de Castellbò); Alt Urgell; CG6096. 1/7/94. 7 (B411): Guingueta reservoir, on left side, young wood; Pallars Sobirà; CH4716. 26/7/91. 8 (B320): La Molina gully, above Arròs (Vall de Cardós); Pallars Sobirà; CH5915. 25/6/93. 9 (B324): sunny slope above Pla de Boavi (Vall de Cardós); Pallars Sobirà; CH6327. 23/7/93. 10 (B325): below Collada de Estallo, towards Boavi (Vall de Cardós); Pallars Sobirà; CH6126. 14/7/93.

diterranean tendency. Therefore, if the scheme of Pallas (1996) is followed, it would be related to the alliance *Hieracio lachenalii-Quercion petraeae*.

Veronico urticifoliae-Betuletum pendulae Vigo 1984

(Table 5)

Veronico-Betuletum is generally a mixed deciduous forest which contains some pioneer trees (such as *Betula pendula*, *Populus tremula* or *Salix caprea*) which are related to open habitats and forest regenerating following clearing. *Quercus petraea* frequently shares the upper layer with them, and is even very dominant in some places (rel. 8). Maybe the ancient exploitation of former oak woods has led to such diversity in the composition of the tree layer. As for its floristic composition, *Veronico-Betuletum* is well characterized by a group of nemoral species of the *Luzulo-Fagenion* and *Fagetalia* in general (*Phyteuma spicatum*, *Dryopteris filix-mas*, *Anemone nemorosa*, *Helleborus viridis* subsp. *occidentalis*, etc.) and also by another group related to acidophilous oak forests of *Quercion robori-petraeae* (including *Vaccinium myrtillus*, *Melampyrum pratense* and *Lathyrus linifolius*).

This association was only known from Ripollès (Vigo 1984; Carreras et al. 1987) and from the area linking Pallars Sobirà with Alt Urgell (Santa Magdalena and Castellbò valleys; Carreras 1993). As shown in Table 5, it also occurs in the northern valleys of Pallars Sobirà, where it can achieve some prominence (Àneu, Unarre, Cardós, etc.), between Alt Urgell and Andorra (Os de Civís) and even in Capcir (rel. 6).

The habitat of *Veronico-Betuletum* ranges in the montane belt from 1000 to 1700 (1880) m, on steep, north facing slopes with very acid soils. As with the former associ-

Table 5. *Veronica urticifoliae*-*Betuletum pendulae* Vigo 1984. [*Luzulo-Fagenion*, *Fagion*, *Fagetalia*, *Quercu-Fagetea*].

Relevé number	1	2	3	4	5	6	7	8	9	10	11	12	13	14
Altitude (dam a.s.l.)	170	160	170	152	188	147	150	127	135	151	156	120	128	135
Aspect	NNE	NNE	NE	NNE	NE	N	N	N	ENE	SW	NE	NW	N	NNE
Angle of slope (°)	20	25	20	20	30	10	15	25	40	17	20	30	35	25
Cover of tree layer (%)	80	70	75	80	65	90	70	95	80	80	70	100	85	95
Cover of shrub layer (%)	15	20	20	15	15	90	50	10	20	-	85	50	95	20
Cover of herb layer (%)	100	95	60	80	90	90	80	80	70	-	-	85	95	90
Height of tree layer (m)	5-10	3-7	6-9	3-6	5-8	8-12	8-12	<18	8-11	<16	<14	8-10	<12	<10
Height of shrub layer (m)	1-2	<2.5	<1.5	<1	<1.5	3-5	1-3	2-4	2-3	2-6	3-6	1-5	3-5	1-4
Sample area (m ²)	100	90	120	110	100	125	120	125	125	125	125	120	150	150
<i>Species dominant in the tree layer</i>														
<i>Betula pendula</i>	5.4	4.3	5.3	5.3	4.2	4.2	4.2	.	.	2.1	4.1	3.2	5.4	1.1
<i>Betula pendula</i> (sapling)	+	1.1	+	.	1.2	.	1.1	.	.	.	.	.	.	.
<i>Quercus petraea</i>	.	.	.	+	.	.	.	2.1	5.3	4.2	1.1	3.2	2.1	5.4
<i>Quercus petraea</i> (sapling)	.	.	.	.	.	.	.	+	.	1.1	.	+	+	.
<i>Populus tremula</i>	.	.	.	.	.	2.2	1.1	5.3	.	.	.	.	.	.
<i>Populus tremula</i> (sapling)	.	.	.	.	.	.	3.2	+	.	.	.	.	.	.
<i>Differential-taxa of the suballiance</i>														
<i>Deschampsia flexuosa</i>	+2	3.3	2.2	1.2	2.2	3.2	3.2	2.2	2.2	.	+	3.2	4.3	2.2
<i>Vaccinium myrtillus</i>	+	+2	1.2	3.3	4.3	3.4	2.2	.	.	.	3.3	.	+	3.3
<i>Luzula nivea</i>	.	.	.	1.2	.	+	1.2	+	2.2	+	2.2	.	2.2	2.2
<i>Melampyrum pratense</i>	+	+	1.2	3.3	2.2	1.1	.	.	.	.	.	.	2.1	2.1
<i>Lathyrus linifolius</i>	.	.	.	2.2	.	.	1.1	1.2	1.2	.	+	+2	2.1	2.2
<i>Calluna vulgaris</i>	.	1.2	1.2	.	1.2	.	.	.	1.2	.	.	.	.	+
<i>Calamagrostis arundinacea</i>	.	.	.	+	+2	.	.	.	.	.	+2	.	.	1.2
<i>Prenanthes purpurea</i>	.	.	.	+	.	.	.	.	.	.	+	.	.	+
<i>Hieracium sabaudum</i>	.	.	.	+	.	.	.	+	.	.	.	.	.	.
<i>Serratula tinctoria</i>	.	.	.	.	.	2.1	.	.	.	.	.	.	.	.
<i>Teucrium scorodonia</i>	.	.	.	.	.	.	.	.	1.1	.	.	.	.	.
<i>Character-taxa of the alliance and order</i>														
<i>Stellaria holostea</i>	.	.	.	1.2	1.2	+	1.2	+	1.2	1.2	2.2	.	.	1.1
<i>Phyteuma spicatum</i>	.	.	.	+	.	.	.	1.2	+	.	+	.	+	+
<i>Dryopteris filix-mas</i>	.	.	+	.	.	.	+	.	+	.	+	+	.	.
<i>Fraxinus excelsior</i>	+	.	.	.	.	.	.	.	+	+	+	1.1	.	.

<i>Helleborus viridis</i>	2.2	.	.	+	+	.	.	1.2	.	+	2.1	.	.	.
subsp. <i>occidentalis</i>	.	.	.	.	.	.	.	.	.	.	.	.	.	.
<i>Ranunculus serpens</i> subsp. <i>nemorosus</i>	+	.	.	.	.	+	2.1	+	.	.	2.1	.	+2	.
<i>Anemone nemorosa</i>	.	+	.	+	1.2	2.1	.	.	.	.	.	.	.	.
<i>Festuca heterophylla</i>	.	.	.	.	.	.	.	.	.	.	.	.	.	.
<i>Acer platanoides</i>	.	.	.	.	.	.	.	.	.	.	+2	+	+2	+
<i>Polystichum aculeatum</i>	2.3	+	.	.	.	.	.	.	.	1.1	+	.	.	.
<i>Aquilegia vulgaris</i>	.	.	.	.	.	.	.	.	.	.	+2	.	.	.
<i>Melica uniflora</i>	.	.	.	.	.	.	1.1	+	.	.	.	.	.	.
<i>Moehringia trinervia</i>	.	.	.	.	.	.	.	.	1.2	+	.	.	.	.
<i>Mycelis muralis</i>	.	.	.	.	.	+	+	.	.	.	.	.	.	.
<i>Prunus avium</i>	.	.	.	.	.	.	.	.	.	+	.	.	.	.
<i>Athyrium filix-femina</i>	+2	.	.	.	.	.	.	.	.	1.1	.	+	.	.
<i>Galium odoratum</i>	.	.	.	.	.	.	.	.	.	.	.	.	.	.
<i>Campanula trachelium</i>	.	.	.	.	.	.	.	.	.	.	.	+2	.	.
<i>Cardamine impatiens</i>	.	.	.	.	.	.	.	.	.	+	.	.	.	.
<i>Fraxinus excelsior</i> (sapling)	.	.	.	.	.	.	.	.	.	.	+	.	.	.
<i>Luzula sylvatica</i>	.	.	.	.	.	.	.	+	.	.	.	.	.	.
<i>Pulmonaria affinis</i>	.	.	.	.	.	.	.	.	.	.	.	.	+	.
<i>Fagus sylvatica</i>	.	.	.	.	.	.	.	.	.	.	+	.	.	.
<i>Polygonatum verticillatum</i>	.	.	.	.	.	1.2	.	.	.	.	.	.	.	.
<i>Daphne mezereum</i>	.	.	.	.	.	+	.	.	.	.	.	.	.	.
Character-taxa of the class	.	.	.	.	.	1.1	.	.	.	.	.	.	.	.
<i>Viola sylvestris</i>	+	2.2	2.2	1.1	1.2	2.1	1.1	1.2	+	1.1	1.2	2.1	1.1	+
<i>Hepatica nobilis</i>	1.1	2.2	.	1.2	+	3.2	.	1.2	1.2	1.2	1.2	2.2	1.2	1.2
<i>Corylus avellana</i>	.	.	.	3.3	.	5.4	.	+	1.2	2.3	5.2	3.3	5.4	2.2
<i>Poa nemoralis</i>	.	.	.	2.2	.	1.2	+	1.2	2.2	1.2	.	+2	.	.
<i>Rosa canina</i>	.	.	.	.	.	.	.	.	.	.	.	.	.	.
<i>Brachypodium sylvaticum</i>	.	.	.	.	.	.	1.1	+	+	+	.	.	.	+
<i>Lonicera xylosteum</i>	.	.	.	.	.	.	.	.	.	.	.	2.2	+	.
<i>Sorbus aria</i>	.	.	.	.	.	.	.	.	.	+	.	+	.	+
<i>Campanula persicifolia</i>	.	.	.	.	.	.	.	.	.	.	+	+	.	+
<i>Helleborus foetidus</i>	.	.	.	.	.	.	.	.	.	.	.	.	.	+
<i>Rosa rubiginosa</i>	.	.	.	.	.	.	.	+	.	+	.	.	.	+
<i>Acer campestre</i>	.	.	+	+	+	.	.	.	.	.	.	1.1	.	.
<i>Crataegus monogyna</i>	.	.	.	.	.	.	.	.	.	.	.	.	.	.
<i>Primula veris</i> subsp. <i>columnae</i>	.	.	.	.	.	.	.	+	+	.	.	.	.	.

(cont.)

Table 5. Continued.

Relevé number	1	2	3	4	5	6	7	8	9	10	11	12	13	14
<i>Acer opalus</i>	.	.	.	.	.	.	.	.	1.1	.	.	.	.	.
<i>Amelanchier ovalis</i>	.	.	.	.	.	.	.	.	1.1	.	.	.	.	.
<i>Arabis turrita</i>	.	.	.	.	.	.	.	.	+	.	.	.	.	.
<i>Carex digitata</i>	.	.	.	cf.+	.	.	.	.	.	.	.	.	.	.
<i>Prunus spinosa</i>	.	.	.	.	.	.	.	.	.	.	.	.	.	.
<i>Pyrus malus</i> subsp. <i>mitis</i>	.	.	.	.	.	.	.	+	.	.	.	.	.	.
<i>Quercus humilis</i>	.	.	.	.	.	.	.	+	.	.	.	.	.	.
<i>Rosa pimpinellifolia</i> subsp. <i>pimpinellifolia</i>	.	.	.	.	.	.	.	.	.	.	.	.	.	2.2
<i>Rosa rubiginosa</i>	.	.	.	.	.	.	.	.	.	.	.	+	.	.
<i>Rosa tomentosa</i>	.	.	.	.	.	.	.	+	.	.	.	.	.	.
Main companions														
<i>Juniperus communis</i> subsp. <i>communis</i>	1.1	2.3	2.2	1.2	.	+	2.2	+	+	.	+	2.1	+	+
<i>Cruciata glabra</i>	.	+2	.	1.2	+	1.1	+	+	+	.	+	1.1	2.2	1.2
<i>Conopodium majus</i>	.	.	.	+	+	.	1.1	+	+	1.1	1.1	1.1	.	.
<i>Agrostis capillaris</i>	4.4	+	3.2	+	+	.	.	.	.	1.2	2.2	.	+	.
<i>Epilobium montanum</i>	+	+	1.2	+	+	.	+	.	.	.	.	.	.	.
<i>Solidago virgaurea</i>	.	.	.	.	.	1.1	.	1.2	+	.	.	+	.	.
<i>Hylocomium splendens</i>	+	3.3	.	2.2	.	.	.	+2	.	.	.	.	3.3	+2
<i>Hieracium murorum</i> gr.	.	.	.	+	.	.	+	+	.	+	+	.	.	.
<i>Clinopodium vulgare</i>	.	.	.	.	.	.	+	+	1.1	+	+	+	.	.
<i>Veronica chamaedrys</i>	1.1	+2	1.2	.	.	.	1.2	.	.	.	+	.	.	.
<i>Anthoxanthum odoratum</i>	.	.	1.2	+	.	.	+	.	+	.	.	1.2	.	.
<i>Veronica officinalis</i>	+	1.1	+	.	+	.	.	.	+	.	1.2	1.2	+	.
<i>Vicia sepium</i>	.	.	.	.	.	.	+	.	+	.	1.2	1.2	.	.
<i>Campanula precatorea</i>	.	.	.	+	1.2	.	.	.	.	1.1	1.2	.	.	.
<i>Sedum rupestre</i> subsp. <i>reflexum</i>	+	+	+	.	.	.	.	.	+	.	.	.	.	.
<i>Carex</i> sp.	+	+	.	.	.	.	+	+	.	.	.	.	.	.
<i>Dianthus hyssopifolius</i>	+	+	+2	.	.	.	.	.	.	.	.	.	.	.
<i>Fragaria vesca</i>	.	.	.	.	.	+	2.2	.	+	.	1.2	.	.	.
<i>Laserpitium latifolium</i>	.	.	.	.	.	+	.	2.2	.	1.1	.	.	.	1.1
<i>Pimpinella saxifraga</i>	+	+	.	+	.	.	.	.	.	.	.	.	.	+
<i>Polypodium vulgare</i> subsp. <i>vulgare</i>	.	.	.	+2	.	.	+	.	+	.	.	.	.	+
<i>Rhytidadelphus triquetrus</i>	.	3.3	.	1.2	.	.	.	.	.	.	.	.	2.3	+

<i>Genista balansae</i> subsp. <i>europaea</i>	+	.	1.2	+	+2	.	.	.	.	.	.	.	.	.
<i>Campanula rotundifolia</i>	+	+	.	+	.	.	.	.	.	.	.	.	.	.
<i>Euphorbia cyparissias</i>	+	+	.	.	.	.	+	.	.	.	.	.	.	.
<i>Galium pumilum</i> subsp. <i>pinetorum</i>	+	1.1	.	+	.	.	.	.	.	.	.	.	.	.
<i>Galium verum</i>	+	.	+	.	+2	.	.	.	.	.	.	.	.	.
<i>Linaria repens</i>	.	.	1.2	.	+2	.	.	.	.	.	.	.	.	.
<i>Oxalis acetosella</i>	2.3	.	.	1.2	.	.	+	.	.	.	.	.	.	.
<i>Pinus sylvestris</i>	.	+	.	+	.	.	.	+	.	.	.	.	.	.
<i>Poa chaixii</i>	.	.	+2	.	+	.	+2	.	.	.	.	.	.	.
<i>Potentilla erecta</i>	1.1	+	.	.	.	+	.	.	.	.	.	.	.	.
<i>Sorbus aucuparia</i>	.	.	.	.	+2	.	+	.	.	.	.	+	.	.
<i>Sorbus aucuparia</i> (sapling)	.	.	.	+	.	.	.	.	.	.	.	.	.	.
<i>Valeriana officinalis</i>	+	.	.	.	+	.	.	+	.	.	.	.	.	.
<i>Abies alba</i>	.	.	.	.	.	.	.	.	.	.	+	.	.	.
<i>Abies alba</i> (sapling)	.	.	.	+	.	.	.	.	.	.	.	1.1	.	.
<i>Abies alba</i> (seedl.)	.	.	.	.	.	.	.	+	.	.	.	.	.	.

Companions occurring in one or two relevés – *Achillea millefolium* 5 and 14, *Acinos alpinus* 3, *Ajuga pyramidalis* 1, *Alchemilla hybrida* gr. 1, *Arabis brassica* 9 (1.2), *Arrhenatherum elatius* 8, *Asplenium adiantum-nigrum* subsp. *adiantum-nigrum* 8, *Astrantia major* 7 (2.2) and 9 (1.1), *Bupleurum falcatum* 11, *Campanula glomerata* 9, *Centaurea nigra* 9, *Cerastium fontanum* 5, *Chaerophyllum aureum* 7, *Cotoneaster integerrimus* 5 (2.2), *Crepis* cf. *lampsanoides* 9 (1.1), *Cystopteris fragilis* 11, *Dactylis glomerata* 6 and 10, *Dactylorhiza maculata* 5, *Dicranum scoparium* 8 (1.2), *Digitalis purpurea* 3, *Erythronium dens-canis* 6, *Festuca eskia* 3 and 14 (2.2), *Festuca rubra* gr. 5 (1.2), *Galium aparine* 11, *Genista pilosa* 13, *Gentiana* cf. *lutea* 6, *Geranium robertianum* 9 and 10, *Geum urbanum* 1 (1.1), *Hieracium glaucinum* gr. 7, *Hieracium* sp. 2 and 7, *Hypericum* cf. *perforatum* 3, *Hypericum maculatum* 1 and 5, *Hypnum cupressiforme* 1 and 2, *Knautia dipsacifolia* subsp. *arvernensis* (1.1), *Lathyrus pratensis* 5 (1.1), *Listera ovata* 5, *Lotus corniculatus* 1, *Mnium* sp. 1 (1.1), *Myosotis arvensis* 5, *Platanthera chlorantha* 8, *Platanthera* sp. 3, *Poa pratensis* 1 and 5 (2.2), *Polygonatum odoratum* 8, *Polystichum lonchitis* 10, *Potentilla* cf. *micrantha* 6, *Potentilla rupestris* 7, *Prunella grandiflora* subsp. *pyrenaica* 5, *Prunella vulgaris* 6, *Pteridium aquilinum* 9 (4.3), *Ranunculus auricomus* 5, *Rhinanthus mediterraneus* 4, *Rhododendron ferrugineum* 4 and 12, *Rosa pendulina* 6 (1.2), *Rosa* sp. 11, *Rubus idaeus* 8 and 9, *Rumex acetosa* 1 and 5, *Saxifraga granulata* 5 (1.1) and 11, *Senecio adonidifolius* 14, *Silene nutans* 4 and 11, *Silene vulgaris* 11, *Stachys officinalis* 6 and 11 (2.2), *Stellaria graminea* 5, *Succisa pratensis* 2, *Tanacetum corymbosum* 8 and 9, *Teucrium chamaedrys* 8, *Thesium pyrenaicum* 5, *Thymus pulegioides* 3, *Trifolium medium* 5, *Trifolium ochroleucon* 7, *Trifolium pratense* 1, *Urtica dioica* 1, *Veronica fruticulosa* 3, *Vicia orobus* 9 (1.1), *Viola canina* 2.

Locations of relevés – 1 & 2 (B400 & B401): Serra Obaga de Cerbi (Vall d'Unarre); Pallars Sobirà; CH4724, 14/8/93, 3 (B312): Obaga de Cerbi (Vall d'Unarre); Pallars Sobirà; CH4723, 24/7/91, 4 (B313): Obaga d'Àreu (Vall d'Àneu); Pallars Sobirà; CH4124, 24/7/91, 5 (B311): Obaga de Cerbi (Vall d'Unarre); Pallars Sobirà; CH4624, 24/7/91, 6 (B323): between Puigbaladó and Quèrigut, glade in a beech-wood; Capcir-Ariège; DH22, 4/6/85, 7 (B321): Obaga d'Esterrí de Cardós (Vall de Cardós); Pallars Sobirà; CH5715, 25/6/93, 8 (B594): between Sant Andreu and Santa Creu (Vall de Castellbò); Alt Urgell; CG6096, 1/7/94, 9 (B596): Bixessarri, towards Os de Civís; Andorra; CH7206, 9/7/94, 10 (B599): Noarre (Vall de Cardós); Pallars Sobirà; CH5527, 11/8/94, 11 (B600): Quanca, above Portells site (Vall de Cardós); Pallars Sobirà; CH5426, 11/8/94, 12 (B614): above Tavascan, towards Boldís (Vall de Cardós); Pallars Sobirà; CH5722, 29/6/95, 13 (B605): Bordes de Guidal, above Tavascan (Vall de Cardós); Pallars Sobirà; CH5924, 26/7/95, 14 (B608): above Estaon, near Borda de Gorf (Vall de Cardós); Pallars Sobirà; CH5318, 1/6/95.

ation, under the somewhat Atlantic influence of high Pallars, *Veronico-Betuletum* replaces the *Pinus sylvestris* forests (*Hylocomio-Pinetum catalaunicae* Vigo 1968), which are so dominant in the more continental areas of the same valleys.

Table 6. *Hylocomio-Pinetum catalaunicae* Vigo 1968 *lathyretosum montani* (= *typicum*): 1 – var. of *Populus tremula* (rel. 1); 2 – var. of *Betula pendula* (rel. 2–7). [*Deschampsio-Pinion sylvestris*, *Pinetalia sylvestris*, *Vaccinio-Piceetea*].

Relevé number	1	2	3	4	5	6	7
Altitude (dam a.s.l.)	161	167	175	175	182	162	155
Aspect	NNW	N	NE	N	ENE	ESE	NNE
Angle of slope (°)	25	10	15	25	15	20	15
Cover of tree layer (%)	90	85	85	65	60	85	75
Cover of shrub layer (%)	40	30	–	7	10	15	40
Cover of herb-moss layer (%)	75	75	–	90	100	50	70
Height of tree layer (m)	9–14	5–8	10–14	8–10	8–10	7–12	5–8
Height of shrub layer (m)	1–2	1–2	1–3	1–2	<1,5	1–2	1–3
Sample area (m ²)	180	100	150	100	100	70	150
<i>Species dominant in the tree layer</i>							
<i>Betula pendula</i>	+	5.3	4.2	4.3	4.4	4.3	4.3
<i>Betula pendula</i> (sapling)	.	1.1	.	.	+	.	1.2
<i>Populus tremula</i>	5.4	.	.	.	.	.	.
<i>Populus tremula</i> (sapling)	2.1	.	.	.	.	.	.
<i>Character- and differential-taxa of the association and higher syntaxa</i>							
<i>Pinus sylvestris</i>	1.1	.	1.1	+	.	2.1	1.1
<i>Pinus sylvestris</i> (sapling)	+	.	.	+	.	.	1.1
<i>Hylocomium splendens</i>	2.2	2.2	+2	4.4	2.2	1.2	1.2
<i>Rhytidadelphus triquetrus</i>	3.3	2.2	.	1.2	+2	.	.
<i>Rhododendron ferrugineum</i>	1.2	.	.	+	.	.	+
<i>Melampyrum pratense</i> subsp. <i>alpestre</i>	.	1.2	.	.	.	+	1.2
<i>Pinus mugo</i> subsp. <i>uncinata</i>	.	.	.	+	+	.	.
<i>Pinus mugo</i> subsp. <i>uncinata</i> (sapling)	.	.	.	+	+	.	.
<i>Pyrola secunda</i>	.	1.2	+	.	.	.	.
<i>Pyrola minor</i>	.	1.2	2.3	.	.	.	.
<i>Pinus x rhaetica</i>	.	+	.	.	.	.	.
<i>Pinus x rhaetica</i> (sapling)	.	+	.	.	.	.	.
<i>Pyrola uniflora</i>	.	.	+	.	.	.	.
<i>Rosa pendulina</i>	+2	.	.	.	.	.	.
<i>Sorbus aucuparia</i>	1.2	.	.	.	.	.	.
<i>Sorbus aucuparia</i> (sapling)	1.1	.	.	.	.	.	.
<i>Sorbus aucuparia</i> (seedl.)	.	.	.	+	.	.	.
<i>Main companions</i>							
<i>Juniperus communis</i> subsp. <i>communis</i>	+	2.2	2.1	3.3	1.1	1.1	2.2
<i>Gallium pumilum</i> s.l.	.	+	.	+	1.1	+	1.1
<i>Anthoxanthum odoratum</i>	.	.	1.2	+2	1.1	1.2	+
<i>Cruciata glabra</i>	1.2	2.2	+	.	+3	1.2	2.2
<i>Viola sylvestris</i>	.	1.1	+	1.2	+2	1.2	+

(cont.)

Table 6. Continued.

Relevé number	1	2	3	4	5	6	7
<i>Fragaria vesca</i>	+	+2	.	+2	+	.	1.2
<i>Viola canina</i>	.	1.1	.	1.2	1.2	.	2.1
<i>Veronica officinalis</i>	.	+	.	+	1.1	.	+
<i>Dicranum scoparium</i>	+2	.	+	+2	+2	+2	.
<i>Euphorbia cyparissias</i>	.	.	.	+	+2	+	+
<i>Veronica chamaedrys</i>	.	.	1.2	+	2.2	1.2	2.2
<i>Achillea millefolium</i>	.	+	.	+	.	.	+
<i>Hepatica nobilis</i>	+2	.	.	.	.	1.1	1.2
<i>Leontodon hispidus</i>	.	+	+	.	+	.	+
<i>Trifolium pratense</i>	.	1.1	1.1	+	+	.	.
<i>Abies alba</i>	.	.	+	.	.	.	.
<i>Abies alba</i> (sapling)	+	+	.	+	.	.	.
<i>Abies alba</i> (seedl.)	+	.	.	.	.	.	.
<i>Quercus petraea</i>	+	+	.	.	.	.	.
<i>Quercus petraea</i> (sapling)	.	.	.	.	.	1.1	.
<i>Quercus petraea</i> (seedl.)	.	.	+	.	.	.	.
<i>Agrostis capillaris</i>	.	+	2.3	.	2.2	.	.
<i>Luzula nivea</i>	.	.	1.2	.	+	.	+2
<i>Lathyrus linifolius</i>	2.2	.	.	.	.	+	+
<i>Carlina acaulis</i>	.	+	.	+	+	.	.
<i>Calluna vulgaris</i>	.	.	.	2.2	3.2	1.2	.
<i>Daphne cneorum</i>	.	+	.	+	+	.	.
<i>Festuca nigrescens</i>	.	1.2	.	.	.	2.2	1.2
<i>Ranunculus serpens</i> subsp. <i>nemorosus</i>	.	.	+	.	+	.	1.2
<i>Oxalis acetosella</i>	+	.	.	2.3	.	.	+
<i>Sedum rupestre</i> subsp. <i>reflexum</i>	.	+	.	+	.	+	.

Companions occurring in one or two relevés – *Acer platanoides* (sapling) 2, *Aconitum cf. napellus* 2, *Agrostis capillaris* 4 (1.1), *Ajuga pyramidalis* 7, *Anemone cf. nemorosa* 1, *Buxus sempervirens* 1 (3.2), *Campanula persicifolia* 3, *Campanula rotundifolia* 5, *Carex caryophylla* 2 and 4, *Carex* sp. 5, *Carlina acanthifolia* subsp. *cynara* 3 and 6, *Cerastium arvense* 4, *Cerastium fontanum* 7, *Conopodium majus* 7 (1.1), *Corylus avellana* 1, *Dianthus hyssopifolius* 2 and 3, *Epilobium montanum* 7, *Festuca gautieri* 1 (1.2), *Fraxinus excelsior* (sapling) 2, *Galium verum* 5 (1.2) and 7, *Genista pilosa* 2 (1.1) and 6, *Helianthemum nummularium* 5, *Helleborus foetidus* 7 (1.1), *Helleborus viridis* subsp. *occidentalis* 5 (2.2), *Hieracium murorum* gr. 3, *Hieracium lactucella* 5, *Lotus corniculatus* 2, *Luzula multiflora* 4 and 6, *Medicago suffruticosa* 5, *Melica nutans* 1, *Moehringia trinervia* 6, *Mycelis muralis* 3, *Myosotis arvensis* 5 and 7, *Pimpinella saxifraga* 2, *Plantago lanceolata* 5, *Platanthera chlorantha* 2 and 3, *Poa chaixii* 5 and 7, *Polygala vulgaris* 5, *Polypodium vulgare* subsp. *vulgare* 1, *Potentilla erecta* 4 and 5, *Prenanthes purpurea* 1, *Prunella vulgaris* 3 and 5 (1.2), *Ranunculus auricomus* 7 (1.1), *Ranunculus bulbosus* 5 and 6, *Rosa canina* 6, *Rosa mollis* 7, *Rosa pimpinellifolia* 2 and 6, *Rosa rubiginosa* 6 and 7, *Rosa* sp. 5, *Salix atrocinerea* 3, *Salix caprea* 2, *Saxifraga granulata* 7, *Silene vulgaris* 6 and 7, *Solidago virgaurea* 1 (1.1) and 2 (1.1), *Sorbus aria* (sapling) 4, *Stellaria graminea* 5 and 7, *Stellaria holostea* 6 (2.2), *Tanacetum corymbosum* 3, *Taraxacum officinale* 5, *Thymus pulegioides* 4 and 5, *Trifolium alpinum* 2 (1.2), *Trifolium medium* 7, *Trifolium montanum* 5, *Vaccaria officinalis* 7, *Vicia sepium* 6, *Vincetoxicum hirsutinaria* subsp. *intermedium* 4.

Locations of relevés – 1 (B458): Eriste, left slope of reservoir; Valle de Benasque; BH9616. 22/7/93. 2 (B460): Eriste, towards Serrao de las Comas; Valle de Benasque; BH9516. 22/7/93. 3 (B601): Sant Joan de l'Erm Vell (Santa Magdalena valley); Pallars Sobirà; CH5600. 4/8/94. 4 & 5 (B314 & B315): shady slope of Escart valley; below forest track; Pallars Sobirà; CH4509. 25/7/91. 6 (B317): shady slope near Nas (Vall de Cardós); Pallars Sobirà; CH5313. 25/6/93. 7 (B319): shady slope of Molina gully, above Esterrí de Cardós (Vall de Cardós); Pallars Sobirà; CH5715. 25/6/93.

Hylocomio-Pinetum catalaunicae Vigo 1968 *lathyretosum montani* Vigo 1979

(Table 6)

Within the areas of mossy *Pinus sylvestris* forest (*Hylocomio-Pinetum catalaunicae*), small, or occasionally rather extensive, stands of birch (*Betula pendula*) occur in places. They are found chiefly in the higher parts of the montane belt or at the beginning of the sub-Alpine belt. Such deciduous stands are frequently the result of extensive felling or of large uncontrolled fires. These serious disturbances were frequent during times of severe exploitation, the most recent of which occurred from the 50s to the early 60s. These secondary birch communities are rather extensive in the north facing woodlands of Pallars Sobirà (Bonaigua, Espot and Escart) and less so in other areas (Alt Urgell, Alta Ribagorça, etc.).

Floristically, these stands, dominated by *Betula pendula*, are very similar to the pine forests of *Hylocomio-Pinetum catalaunicae* which surround them. In the understorey, the replacement of pine by birch is evident only from the less extensive moss layer and by the higher frequency of some taxa of open habitats (*Anthoxanthum odoratum*, *Veronica chamaedrys*, *Fragaria vesca*, *Euphorbia cyparissias*, etc.). Therefore, it seems appropriate to us to include these birch forests in the same *Hylocomio-Pinetum sylvestris*, but differentiated at variant level (var. of *Betula pendula*). The same may be said of some secondary forests dominated by *Populus tremula*, which are much less common; we consider them to be a parallel variant of the same association (*Hylocomio-Pinetum* var. of *Populus tremula*; Table 6, rel. 1).

Secondary birch forests of the sub-Alpine belt

In the sub-Alpine belt, in the woodlands of *Pinus mugo* subsp. *uncinata* and silver fir, birch (*Betula pendula*) forests are much less common than in the montane belt. However, they occur in places in medium sized groups, the result of great disturbance in the former forests.

The following three relevés are good examples. The first was situated at Vall de Baiasca, on a north facing slope at 1800 m, and may be included in *Saxifrago-Rhododendretum* Br.-Bl. 1948 *abietetosum albae* (Rivas-Mart.) Vigo 1979; the second, also from a north facing aspect, comes from Vall de Cardós, 1710 m, and corresponds to the same association, *Saxifrago-Rhododendretum*, though to subassociation *pinetosum uncinatae* Br.-Bl. 1948; and the last, from Noarre (Vall Ferrera), was sampled on a south facing slope, at 1900 m, and may be referred to *Veronico-Pinetum sylvestris* Rivas-Mart. 1968 *pinetosum uncinatae* Rivas-Mart. 1968.

Relevé 1 (B316): Obaga de Baiasca; Pallars Sobirà; CH40. 28/7/91

Character taxa of association and higher syntaxa (*Rhododendro-Vaccinion*, *Vaccinio-Piceetalia*, *Vaccinio-Piceetea*): *Rhododendron ferrugineum* (3.3), *Pinus mugo* subsp. *uncinata* (3.1; sapling: +), *Pyrola secunda* (+.2), *Rhytidadelphus triquetrus* (+.2), *Abies alba* (sapling: +).

Companions: *Betula pendula* (5.4, sapling: +), *Calluna vulgaris* (2.2), *Viola sylvestris* (2.2), *Anemone nemorosa* (1.2), *Hepatica nobilis* (1.2), *Anthoxanthum odoratum* (1.2), *Luzula nivea* (1.2), *Veronica officinalis* (+.2), *Juniperus communis* (+), *Galium pumilum* gr. (+), *Fragaria vesca* (+), *Dicranum scoparium* (+.2), *Euphorbia cyparissias* (+), *Campanula rotundifolia* (+).

Relevé 2 (B357): Barranc de la Molina; Arròs; Pallars Sobirà; CH5915. 25/6/1993

Character taxa of association and higher syntaxa (*Rhododendro-Vaccinion*, *Vaccinio-Piceetalia*, *Vaccinio-Piceetea*): *Rhododendron ferrugineum* (5.4), *Pinus mugo* subsp. *uncinata* (3.1), *Vaccinium myrtillus* (2.2), *Rhytidadelphus triquetrus* (4.4), *Sorbus aucuparia* (sapling: +), *Abies alba* (sapling: +), *Pyrola secunda* (+), *Pyrola minor* (+).

Companions: *Betula pendula* (3.3), *Juniperus communis* subsp. *communis* (+), *Luzula nivea* (2.2), *Veronica chamaedrys* (2.2), *Cruciata glabra* (1.2), *Ranunculus montanus* s.l. (+), *Saxifraga granulata* (+), *Stellaria holostea* (2.1), *Hepatica nobilis* (1.1), *Oxalis acetosella* (2.1), *Viola sylvestris* (1.1), *Leontodon pyrenaicus* (+), *Deschampsia flexuosa* (2.2), *Epilobium montanum* (+), *Myosotis decumbens* subsp. *teresiana* (+), *Dryopteris filix-mas* (+), *Gymnocarpium dryopteris* (+), *Lathyrus linifolius* (+), *Ajuga pyramidalis* (+), *Anthoxanthum odoratum* (+), *Dryopteris carthusiana* cf. subsp. *assimilis* (+).

Relevé 3 (B615): Noarre; Pallars Sobirà; CH5628. 28/6/95

Character taxa of association and higher syntaxa (*Deschampsio-Pinion*, *Pinetalia sylvestris*, *Vaccinio-Piceetea*): *Pinus mugo* subsp. *uncinata* (1.1), *Sorbus aucuparia* (sapling: +), *Vaccinium myrtillus* (4.3), *Rosa pendulina* (1.1).

Companions: *Betula pendula* (4.4; sapling: 1.1), *Juniperus communis* (3.2), *Conopodium majus* (2.1), *Deschampsia flexuosa* (1.2), *Stellaria holostea* (1.1), *Asphodelus albus* (1.1), *Festuca eskia* (1.2), *Anthoxanthum odoratum* (1.2), *Viola sylvestris* (+), *Erythronium dens-canis* (+), *Calluna vulgaris* (+), *Campanula precatória* (+), *Polygala vulgaris* subsp. *alpestris* (+), *Poa chaixii* (+), *Potentilla micrantha* (+), *Meum athamanticum* (+), *Jasione montana* (+), *Helianthemum nummularium* (+), *Silene nutans* (+), *Cruciata glabra* (+), *Dactylis glomerata* (+), *Lotus corniculatus* (+), *Galium pumilum* s.l. (+), *Festuca ovina* gr. (+.2).

Roso pendulinae-Aceretum platanoidis, ass. nova

(Table 7)

HOLOTYPE: Table 7, rel. 1.

Roso-Aceretum platanoidis is a deciduous mixed wood made up of typical montane species together with some sub-Alpine ones. Its floristic composition relates it to *Campanulo-Fraxinetum*, described from One valley (Nègre 1972), but it is sufficiently different to be considered a new association.

The tree layer is a mixture with some character taxa from *Tilio-Acerion*, such as *Acer platanoides*, *Ulmus scabra*, *Prunus padus*, some from *Carpinion* (*Fraxinus excelsior*) and others common in *Quercu-Fagetalia* communities; *Sorbus aucuparia* is also nearly always present. In the shrub layer some species (*Lonicera nigra*, *Lonicera alpigena*, *Ribes petraeum*, *Rosa pendulina*), which generally occur in silver fir woods and their glades are prominent. Other special taxa in the field layer are *Lathyrus laevigatus* subsp. *occidentalis*, *Convallaria majalis*, *Rubus saxatilis* and *Calamagrostis arundinacea*, as well as many characteristic *Fagetalia* species. *Polygonatum verticillatum*, *Polystichum aculeatum*, *Aruncus dioicus* and *Campanula latifolia* (taxa typical of *Tilio-Acerion*) are also frequent. In contrast with *Campanulo-Fraxinetum excelsioris*, *Alnus glutinosa*, *Rubus caesius*, *Acer campestre*, *Cornus sanguinea*, *Clematis vitalba*, *Mercurialis perennis*, *Stachys alpina*, *Filipendula ulmaria*, etc. are rare or absent in this new association; also, some montane species of soil rich in nitrates and general at lower altitudes give way to sub-Alpine ones (*Geranium sylvaticum*, *Molopospermum peloponnesiacum*, *Angelica razulii*, etc.). In spite of its location, from 1500 to 1750 m in altitude, this community contains some relatively thermophilous plants such as *Corylus avellana*, *Lonicera xylos-*

Table 7. *Roso pendulinae-Aceretum platanoidis*, ass. nova (HOLOTYPE: rel. 1). [*Tilio-Acerion*, *Fagetalia sylvaticae*, *Quercu-Fagetalia*].

Relevé number	1	2	3	4	5	6	7	8	9
Altitude (dam a.s.l.)	160	162	155	150	175	164	169	168	160
Aspect	NNE	WNW	E	NW	SE	ENE	N	NE	N
Angle of slope (°)	25	20	20	25	25	30	-	35	25
Cover of tree layer (%)	85	95	100	80	90	90	75	80	85
Cover of shrub layer (%)	-	-	20	-	-	-	-	20	45
Cover of herb layer (%)	90	85	90	40	50	-	100	70	90
Height of tree layer (m)	8	3-6	3-5	2-5	5-7	3-5	1-5	4-8	<10
Height of shrub layer (m)	-	-	1-2	-	-	-	-	1-3	1-2
Sample area (m ²)	120	80	120	100	80	100	100	100	70
<i>Character- and differential-taxa of the association and the alliance</i>									
<i>Acer platanoides</i>	3.2	3.2	2.1	+	2.1	.	+	2.2	+
<i>Prunus padus</i>	2.2	3.2	.	.	+	1.1	4.1	+	+
<i>Ribes alpinum</i>	.	+	2.1	1.1	+	+	.	.	1.1
<i>Ulmus scabra</i>	1.1	2.2	1.1	2.1	.	.	.	2.1	+
<i>Polygonatum verticillatum</i>	1.2	1.2	+	.	.	.	+	.	+
<i>Polystichum aculeatum</i>	1.2	.	.	.	.	1.2	.	2.2	+
<i>Aruncus dioicus</i>	1.2	+	.	.	.	.	4.2	.	.
<i>Campanula latifolia</i>	+2	.	.	.	.	.	+	+	.
<i>Hesperis matronalis</i>	.	.	+	.	.	.	.	.	.
<i>Differential-taxa with respect to other associations from the alliance</i>									
<i>Lathyrus laevigatus</i> subsp. <i>occidentalis</i>	1.2	+	1.1	+	+2	1.2	4.1	+	1.1
<i>Rosa pendulina</i>	1.2	1.2	+	1.2	1.2	1.1	+	1.2	2.1
<i>Sorbus aucuparia</i>	2.2	2.2	3.2	.	.	3.1	2.1	3.2	3.1
<i>Sorbus aucuparia</i> (seedl.)	.	.	.	+	.	.	.	.	1.1
<i>Rubus saxatilis</i>	+2	+	1.2	+	1.2	1.3	+	.	.
<i>Calamagrostis arundinacea</i>	.	+	+2	+2	2.2	1.2	+	.	.
<i>Lonicera nigra</i>	+	1.2	2.1	1.2	+	.	+	.	.
<i>Lonicera alpigena</i>	1.2	.	.	.	1.1	.	3.2	+	2.1
<i>Vaccinium myrtillus</i>	.	1.2	+	.	.	1.3	+2	.	.
<i>Character-taxa of the order</i>									
<i>Dryopteris filix-mas</i>	3.2	3.2	3.2	3.2	+2	2.2	2.2	1.2	3.2
<i>Pulmonaria affinis</i>	1.1	1.1	+2	1.2	1.2	+2	+	1.1	2.2
<i>Lamium galeobdolon</i>	2.2	2.2	2.2	+	+	.	+	1.2	1.2
<i>Fraxinus excelsior</i>	2.2	.	2.1	3.2	3.2	1.1	+	2.2	3.1
<i>Fraxinus excelsior</i> (seedl.)	.	.	.	1.1	.	.	.	.	.
<i>Melica nutans</i>	+2	+	.	+2	1.2	1.2	+	1.2	1.1
<i>Ribes petraeum</i>	1.2	+	1.1	+	(+)	1.1	.	.	+
<i>Galium odoratum</i>	2.2	2.2	3.2	.	.	.	+	3.2	3.3
<i>Stellaria holostea</i>	.	+2	2.2	.	1.2	1.2	+	.	1.1
<i>Athyrium filix-femina</i>	1.2	1.2	.	+	.	+2	2.2	.	.
<i>Hordelymus europaeus</i>	.	.	.	.	+	+2	.	+2	1.1
<i>Actaea spicata</i>	1.2	+	.	.	.	.	.	+	+

(cont.)

Table 7. Continued.

Relevé number	1	2	3	4	5	6	7	8	9
<i>Paris quadrifolia</i>	1.2	1.1	.	.	.	+	+	.	.
<i>Fagus sylvatica</i>	1.1	2.1	2.2	.	.	.	+	.	.
<i>Scilla lilio-hyacinthus</i>	2.2	1.2	.	.	.	.	+	+2	.
<i>Ranunculus serpens</i> subsp. <i>nemorosus</i>	.	.	+	.	.	.	+	1.1	.
<i>Euphorbia hyberna</i>	1.2	+2	.	.	.	.	.	.	.
<i>Milium effusum</i>	.	.	.	.	.	.	.	+2	2.2
<i>Cardamine pentaphyllus</i>	.	.	.	.	.	.	.	2.2	2.2
<i>Ajuga reptans</i>	+	.	.	.	.	.	.	.	.
<i>Anemone nemorosa</i>	.	.	.	.	.	.	+	.	.
<i>Aquilegia vulgaris</i>	.	.	.	.	.	.	.	.	.
<i>Cardamine impatiens</i>	.	.	.	.	.	.	+	.	.
<i>Carex digitata</i>	.	.	.	.	.	.	.	.	+
<i>Carex sylvatica</i> subsp. <i>sylvatica</i>	.	+2	.	.	.	.	.	.	+
<i>Daphne mezereum</i>	.	.	.	.	.	.	.	.	.
<i>Helleborus viridis</i> subsp. <i>occidentalis</i>	+	.	.	.	.	.	.	.	.
<i>Lathyrus vernus</i>	.	.	.	.	.	.	.	.	.
<i>Lilium martagon</i>	.	.	.	.	+	.	.	.	1.1
<i>Myosotis sylvatica</i> subsp. <i>teresiana</i>	.	.	.	.	.	.	.	.	.
<i>Phyteuma spicatum</i>	.	+	.	.	.	.	.	.	.
<i>Prenanthes purpurea</i>	.	+	.	.	.	.	.	.	.
<i>Primula elatior</i> subsp. <i>elatior</i>	1.1	.	.	.	.	.	.	.	.
<i>Stellaria nemorum</i>	.	1.2	.	.	.	.	.	.	.
<i>Character-taxa of the class</i>									
<i>Hepatica nobilis</i>	1.2	+2	1.2	+2	+2	+2	.	1.1	2.2
<i>Lonicera xylosteuum</i>	+	+	1.1	2.1	+	+	.	+	2.2
<i>Poa nemoralis</i>	+2	.	2.2	+2	2.2	1.2	+	1.2	3.3
<i>Viola sylvestris</i>	.	+	1.2	.	+	+2	+	+	1.1
<i>Corylus avellana</i>	.	.	4.4	3.2	3.2	4.3	.	3.3	2.2
<i>Sorbus aria</i>	+	.	.	.	+	.	+	+	+
<i>Viburnum lantana</i>	.	.	.	.	+	.	.	+	.
<i>Festuca heterophylla</i>	.	.	.	.	.	+	.	.	.
<i>Primula veris</i> subsp. <i>columnae</i>	.	.	.	.	.	.	+	.	.
<i>Main companions</i>									
<i>Geranium sylvaticum</i>	1.1	+	+	+	2.2	1.1	2.1	.	+
<i>Fragaria vesca</i>	.	1.1	1.2	.	1.2	+2	+	1.1	2.2
<i>Abies alba</i>	+	+	.	+	2.1	+	.	.	+
<i>Abies alba</i> (sapling)	.	.	+	+	.	.	.	1.1	.
<i>Rubus idaeus</i>	.	+	+	1.2	+	.	+	.	+
<i>Salix caprea</i>	.	+	+	1.1	.	+	.	+	3.1
<i>Epilobium montanum</i>	+	1.1	+	1.2	.	.	+	.	+
<i>Convallaria majalis</i>	1.2	.	1.2	.	2.2	2.2	.	2.2	.
<i>Ranunculus aconitifolius</i> s.l.	+	.	1.1	+	.	1.1	.	+	.
<i>Betula pendula</i>	1.2	2.2	.	+	.	+	.	3.1	.
<i>Cruciata glabra</i>	.	.	+2	.	+2	+2	.	+	+
<i>Pimpinella major</i>	.	.	.	+	+	.	+	+	2.2

(cont.)

Table 7. Continued.

Relevé number	1	2	3	4	5	6	7	8	9
<i>Oxalis acetosella</i>	+2	1.2	.	.	.	.	+	.	1.1
<i>Galium pumilum</i> s.l.	.	.	+2	+	.	.	+	+	.
<i>Molopospermum peloponnesiacum</i>	.	.	.	+	+	+	+	.	.
<i>Cicerbita plumieri</i>	.	+	+	.	+	+	.	.	.
<i>Knautia dipsacifolia</i> subsp. <i>arvernensis</i>	.	.	.	+	+	.	2.2	.	1.1
<i>Laserpitium latifolium</i>	.	.	.	.	+	1.1	+	.	.
<i>Polystichum lonchitis</i>	.	.	.	.	+2	.	.	+	+
<i>Rhamnus alpina</i>	.	.	.	.	+	.	.	1.2	+
<i>Epilobium angustifolium</i>	.	.	.	+2	.	.	+	.	+
<i>Aconitum lamarckii</i>	+	.	.	.	.	+	+	.	.
<i>Myrrhis odorata</i>	+2	+	.	.	.	.	.	1.2	.
<i>Rhytidadelphus triquetrus</i>	.	.	.	+2	.	+2	.	.	+2
<i>Urtica dioica</i>	.	+	+	.	.	.	.	.	+
<i>Angelica razalii</i>	.	.	.	+	+	.	+	.	.
<i>Geranium robertianum</i>	.	.	.	1.2	.	1.2	.	1.2	.
<i>Geum urbanum</i>	+	.	.	.	.	+	.	.	+

Companions occurring in one or two relevés – *Adenostyles alliariae* 1 and 2, *Alliaria petiolata* 2, *Angelica sylvestris* 1 and 2, *Arabis alpina* 1, *Arabis brassica* 2 and 6, *Asplenium trichomanes* 4 (1.2), *Betula pubescens* 7, *Carex muricata* s.l. 9, *Chaerophyllum hirsutum* 2, *Chaerophyllum* cf. *temulum* 6, *Circaea alpina* 1 (1.2), *Clinopodium vulgare* 6, *Crepis lampanoides* 2 (1.2) and 7, *Cruciata laevipes* 7, *Cystopteris fragilis* 4, *Dactylis glomerata* 7 and 8, *Deschampsia flexuosa* 4, *Dianthus barbatus* 3 and 5, *Dicranum scoparium* 4, *Filipendula ulmaria* 1 (2.1) and 2, *Hieracium murorum* gr. 6, *Hylocomium splendens* 4 and 6, *Hypericum maculatum* 7 (2.2), *Hypericum richeri* subsp. *burseri* 7, *Juniperus communis* subsp. *communis* 6, *Knautia dipsacifolia* subsp. *fontqueri* 1, *Laserpitium nestleri* 8, *Lathyrus linifolius* 2 and 4, *Lathyrus pratensis* 4, *Peucedanum ostruthium* 7, *Poa chaixii* 3 and 6, *Polypodium vulgare* subsp. *vulgare* 6, *Rhododendron ferrugineum* 6, *Rosa glauca* 5, *Rumex arifolius* 7, *Sambucus racemosa* 4 and 9 (1.1), *Saxifraga umbrosa* 1 (2.2), *Scrophularia alpestris* 1 (1.2) and 2, *Sedum telephium* subsp. *fabaria* 4, *Silene vulgaris* 2 and 7 (2.2), *Solidago virgaurea* 3 and 5, *Stachys officinalis* 7, *Streptopus amplexifolius* 7, *Thalictrum aquilegifolium* 1 and 4, *Valeriana officinalis* 3 and 4, *Veronica chamaedrys* 3, *Vicia orobus* 6, *Vicia sepium* 1, *Vincetoxicum hirundinaria* subsp. *intermedium* 4.

Locations of relevés – 1 (B551): Pois gully (Artiga de Lin), stable chalk scree, below a shady cliff; Val d'Aran; CH1226. 5/8/94. 2 (B552): Es Neres (Artiga de Lin), edge of beech-wood near an avalanche corridor; Val d'Aran; CH1226. 5/8/94. 3 (B535): Homo (Val del Nere), rocky ground; Val d'Aran; CH1526. 29/8/93. 4 (B532): shady slope of Serra d'Homo (Val del Nere), avalanche corridor; Val d'Aran; CH1526. 29/8/93. 5 (B471): Pontet de Rius (Valarties), stable scree; Val d'Aran; CH2323. 17/8/93. 6 (B474): Ribera d'Aiguamòg, scree lodged by mixed wood; Val d'Aran; CH2926. 20/8/93. 7 (B616): shady slope at Salenques gully (Vall de Barravés), block scree; Alta Ribagorça; CH1418. 18/7/1986. 8 (B617): Gardar de Sorpe (Vall de la Bonaigua), chalk scree below a shady cliff; Pallars Sobirà; CH3822. 17/7/1994. 9 (B504): Gardar de Sorpe (Vall de la Bonaigua), stony clearing in a silver fir wood; Pallars Sobirà; CH3822. 23/8/93. (Rel. 8 & 9, published by Carrillo & Ninot, 1995).

teum and *Hepatica nobilis*. *Roso-Aceretum* is a luxuriant mixed wood with high diversity, as it contains on average 48 species per relevé.

This association usually grows on limestone, in substrata composed of large pieces of rock, where it roots in the humic, well drained, moist underlying soil. Topographically, it frequently occurs below cliffs, being a pioneer in the colonization of the upper slopes, where avalanches and rock falls are frequent. It adjoins *Scillo-Fagetum* or *Goodyero-Abietetum* woodland, and therefore may be interpreted as a permanent community maintained by these external factors.

Roso-Aceretum platanoidis shows a central Pyrenean range, as it is known from Val d'Aran, Alta Ribagorça and Pallars Sobirà (Carrillo & Ninot 1995, sub "comunitat d'*Acer platanoides* i *Sorbus aucuparia*"). From both a floristic stand point and that of its situation in the landscape, it is closely related to the central European mountain communities contained in the suballiance *Lunario-Acerenion pseudoplatani* (Moor) Müller 1992 (Oberdorfer 1992; Richard 1975; Wallnöfer *et al.* 1993).

APPENDIX: Syntaxonomic scheme

All the above treated syntaxa are related according to the following hierarchic scheme.

- Cl. *Vaccinio-Piceetea* Br.-Bl. in Br.-Bl. *et al.* 1939
 - O. *Pinetalia sylvestris* Oberd. 1956
 - Al. *Deschampsio-Pinion* Br.-Bl. 1961
 - Hylocomio-Pinetum catalaunicae* Vigo 1968
 - lathyretosum montani* Vigo 1979 (=typicum)
 - var. of *Betula pendula*
 - var. of *Populus tremula*
 - Veronico-Pinetum sylvestris* Rivas-Mart. 1968
 - pinetosum uncinatae* Rivas-Mart. 1968
 - O. *Vaccinio-Piceetalia* Br.-Bl. 1939
 - Al. *Rhododendro-Vaccinion* Br.-Bl. in Br.-Bl. & Jenny 1926
 - Subal. *Rhododendro-Vaccinienion*
 - Saxifrago-Rhododendretum* Br.-Bl. (1939) 1948
 - pinetosum uncinatae* Br.-Bl. 1948
 - abietetosum albae* (Rivas-Mart.) Vigo 1979
 - Cl. *Quercu-Fagetalia* Br.-Bl. & Vlieger in Vlieger 1937
 - O. *Quercetalia robori-petraeae* R. Tüxen (1931) 1937
 - Al. *Quercion robori-petraeae* Br.-Bl. 1932
 - Lathyro montani-Quercetum petraeae* (Lapraz) Rivas-Mart. 1983 (=Teucricio-*Quercetum petraeae* Lapraz 1966, em. Bolòs 1983, nom. illeg.)
 - var. of *Quercus petraea* (=typicum)
 - var. of *Betula pendula*
 - O. *Quercetalia pubescenti-petraeae* Br.-Bl. (1931) 1940
 - Al. *Quercion pubescenti-petraeae* Br.-Bl. 1931
 - Pteridio-Quercetum pubescentis* (Suspl.) Bolòs 1983
 - pteridietosum* (=typicum)
 - var. of *Quercus humilis* (=typicum)
 - var. of *Quercus cerrioides*
 - var. of *Quercus petraea*
 - betuletosum pendulae*, subass. nova
 - pinetosum sylvestris*, subass. nova
 - O. *Fagetalia sylvaticae* Pawl. 1928
 - Al. *Tilio-Acerion* Klika 1955
 - Subal. *Lunario-Acerenion pseudoplatani* (Moor 1973) Müller 1992
 - Roso pendulinae-Aceretum platanoidis*, ass. nova
 - Al. *Fagion sylvaticae* Pawl. 1928
 - Subal. *Luzulo-Fagenion* Lohm. & R. Tüxen 1954
 - Veronico urticifoliae-Betuletum pendulae* Vigo 1984

- Cl. *Quercetea ilicis* Br.-Bl. 1947
 O. *Quercetalia ilicis* Br.-Bl. 1936
 Al. *Quercion ilicis* Br.-Bl. (1931) 1936
 Subal. *Quercenion rotundifoliae* Rivas Goday *et al.* 1959
Quercetum rotundifoliae Br.-Bl. & Bolòs in Vives 1956
asplenietosum adiantinigris, *subass. nova*

Acknowledgements. This study was partially supported by the projects of the Spanish D.G.C.I.Y.T., numbers PB90-0059 and PB 92-0547. Also, we are grateful to our colleagues Albert Ferré and Sílvia March for their help with some of the relevés, and to Xavier Font for assistance when using his computerized set of programs XTRINAU in the preparation of the relevé tables.

REFERENCES

- BOLÒS O. DE 1960. La transición entre la Depresión del Ebro y los Pirineos en el aspecto geobotánico. – *Anales Inst. Bot. Cavanilles* 18: 199–254.
- BOLÒS O. DE 1973. Observations sur les forêts caducifoliées humides des Pyrénées catalanes. – *Pirineos* 108: 65–85.
- BOLÒS O. DE 1983. La vegetació del Montseny. 170 pp. Diputació de Barcelona, Barcelona.
- BOLÒS O. DE 1984. De vegetatione notulae IV. – *Collect. Bot. (Barcelona)* 15: 101–107.
- BOLÒS O. DE 1988. La roureda acidòfila (*Quercion robori-petraeae*) a Catalunya. – *Monogr. Inst. Piren. Ecol.* 4: 447–453.
- BOLÒS, O. DE, VIGO J., MASALLES R. M. & NINOT J.-M. 1993. *Flora Manual dels Països Catalans*. Ed. 2. 1247 pp. Pòrtic S.A., Barcelona.
- BRAUN-BLANQUET J. & BOLÒS O. DE 1957. Les groupements végétaux du bassin moyen de l'Ebre et leur dynamisme. – *Anales Estac. Exp. Aula Dei* 5 (1–4): 1–266 + 48 Tables.
- BRAUN-BLANQUET J. & SUSPLUGAS J. 1937. Reconnaissance phytogéographique dans les Corbières. – *Bull. Soc. Bot. France* 84 (Comm. S.I.G.M.A 61): 669–685.
- CARRERAS J. 1993. Flora i vegetació de Sant Joan de l'Erm i de la vall de Santa Magdalena (Pirineus catalans). 321 pp. Institut d'Estudis Ilerdencs, Lleida.
- CARRERAS J., CARRILLO E., FONT X., NINOT J.-M., SORIANO I. & VIGO J. 1995. La vegetación de las sierras prepirenaicas situadas entre los ríos Segre y Llobregat. I. Comunidades forestales (bosques, mantos marginales y orlas herbáceas). – *Ecol. Medit.* 21 (3–4): 21–73.
- CARRERAS J., GIL J. & VIGO J. 1987. Le chêne pedunculé (*Quercus robur*) dans les Pyrénées orientales. – *Colloq. Intern. Bot. Pyrénéenne. La Cabanasse (Pyrénées Orientales)* 1986: 183–191.
- CARRILLO E. & NINOT J.-M. 1992. Flora i vegetació de les valls d'Espot i Bof, II. – *Arxius Secc. Ci. Inst. Estud. Catalans* 99 (2): 1–350.
- CARRILLO E. & NINOT J.-M. 1995. Les comunitats vegetals de la Mata de València d'Àneu i del Gardar de Sorpe. – III Jornades sobre Recerca al Parc Nacional d'Aigüestortes i Estany de Sant Maurici: 51–71. Bof, Spain.
- CASAS C. 1991. New checklist of Spanish mosses. – *Orsis* 6: 3–26.
- FONT X. 1990. "Xtrinau (ver. 1.0)". Un programa para la gestión de los inventarios fitocenológicos. – *Monogr. Inst. Piren. Ecol.* 5: 531–539.
- GAMISANS J. & GRUBER M. 1988. Els boscos de pinassa (*Pinus nigra* subsp. *salzmannii*) als Pirineus catalans i est-aragonesos: estudi fitosociològic. – *Monogr. Inst. Piren. Ecol.* 4: 543–552.
- GRUBER M. 1974. Les forêts de *Quercus pubescens* Willd., de *Quercus rotundifolia* Lam. et les gar-
- rigues à *Quercus coccifera* L. des Pyrénées catalanes. – *Bull. Soc. Hist. Nat. Toulouse* 110 (1–2): 141–156.
- LAPRAZ G. 1966. Recherches phytosociologiques en Catalogne. – *Collect. Bot. (Barcelona)* 6 (4): 545–607.
- NÈGRE R. 1972. La végétation du bassin de l'One (Pyrénées centrales) Quatrième note: les forêts. – *Veröff. Geobot. Inst. Rübel Zürich* 49: 1–125.
- OBERDORFER E. (in cooperation with T. MÜLLER & P. SEIBERT) 1992. *Süddeutsche Pflanzengesellschaften*. Ed. 2. Teil IV: Wälder und Gebüsche. 282 pp. (Textband) + 580 pp. (Tabellenband). Gustav Fischer Verlag, Jena – Stuttgart – New York.
- PALLAS J. 1996. Beitrag zur Syntaxonomie und Nomenklatur der bodensauren Eichenmischwälder in Mitteleuropa. – *Phytocoenologia* 26 (1): 1–79.
- RICHARD J. L. 1975. Les groupements végétaux du Clos du Doubs (Jura Suisse). 67 pp. + 1 Map. Hans Huber, Berne.
- RIVAS-MARTÍNEZ S. 1968. Contribución al estudio geobotánico de los bosques araneses (Pirineo ilerdense). – *Publ. Inst. Biol. Aplicada* 45: 81–105.
- SUSPLUGAS J. 1942. Le sol et la végétation dans le Haut-Vallespir (Pyrénées-orientales). – *Commun. Stat. Int. Géobot. Médit. Alp. Montpellier* 79: 1–225.
- TÜXEN R. (in cooperation with OBERDORFER E.) 1958. Die Pflanzenwelt Spaniens. Ergebnisse der 10. Internationalen Pflanzengeographischen Exkursion (IPE) durch Spanien 1953. Teil II: Eurosibirische Phanerogamen-Gesellschaften Spaniens mit Ausblicken auf die Alpine- und Mediterran-Region dieses Landes. – *Veröff. Geobot. Inst. Rübel Zürich* 32: 1–328.
- VIGO J. 1968. Notas sobre la vegetación del Valle de Ribes. – *Collect. Bot. (Barcelona)* 7: 1171–1185.
- VIGO J. 1984. Notes fitocenològiques IV. – *Collect. Bot. (Barcelona)* 15: 459–485.
- VIGO J. 1996. Les comunitats vegetals i el paisatge. – In: J. VIGO & R. M. MASALLES (eds), *El poblament vegetal de la vall de Ribes*, pp. 20–442 & 467–468. Inst. Cart. Cat. Barcelona.
- VIVES J. 1956. Contribución al conocimiento de los paisajes de la sierra de Castellatallat. – In: Dr. F. Pardillo. *Homenaje póstumo*, pp. 199–206. Universidad de Barcelona, Barcelona.
- VIVES J. 1964. Vegetación de la alta cuenca del Cardener (Estudio florístico y fitocenológico comarcal). – *Acta Geobot. Barcin.* 1: 1–218.
- WALLNÖFER S., MUCINA L. & GRASS V. 1993. *Quercus-Fageteta*. – In: L. MUCINA, G. GRABHERR & S. WALLNÖFER (eds), *Die Pflanzengesellschaften Österreichs*. 3, pp. 85–236. Gustav Fischer Verlag, Jena.

Received 8 July 1996; accepted 2 October 1996