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# Study of alder forests in the Basque Country and bordering territories by means of multivariate analysis

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## Abstract

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A systematic revision of riverine alder forests from the Basque Country and High Ebro river valley is made, using 111 relevés distributed over the whole fluvial system; they have been taken both from bibliography (69) and from sampling made for this purpose (42). After a numerical analysis with ordination (PCA) and classification, three main groups of relevés have been established: the first one concerns alder forests from the atlantic versant, typical of small rivers with fast running waters and slight low water; the second one spreads out into the Navarro-Alavés *Alnus* forests, in rivers of slow stream and a certain low water, and the third one corresponds to those from rivers which penetrate into the Mediterranean area. Finally we propose a syntaxonomy to group them, where we describe the new subassociation *loniceretosum xylostei* within the *Hyperico androsamei-Alnetum*, and the new association *Humulo lupuli-Alnetum glutinosae*.

*Key words:* *Alnus glutinosa*, phytosociology, multivariate analysis, northern Spain.

## Introduction

The knowledge of alder riparian forests in the northern part of the Iberian Peninsula has experienced great advances in the last few years, either by means of small contributions (Báscones 1978, C. Navarro 1982, Loidi 1983, Rivas-Martínez et al. 1985, Onaindia 1986, Catalán 1987, M. Herrera 1989, Loidi et al. 1990, Rivas-Martínez et al. 1991, Loidi et al. 1992 and Peralta 1992), or by means of more general syntheses over a broader geographical scope (Bolòs 1984, Amigo et al. 1987, T.E. Díaz et al. 1987, F. Navarro et al. 1986, Rivas-Martínez et al. 1986). In spite of that, a considerable amount of these *Alnus* forests of the upper Ebro valley are difficult to insert in the classificatory system set up by Dierschke (1975, 1984) and Rivas-Martínez (1975) for these riverine forests in southwest Europe. The transitional nature of this territory between the Atlantic and the Mediterranean phytogeographical regions displays a floristic gradient between the typically Atlantic alder forests comprised in *Alno-Ulmion* and the Mediterranean ones of

*Populion albae*; the western Iberian alliance *Osmundo-Alnion* is not present in this territory. A sampling has been performed, in which 42 new relevés have been contributed. They have been added to the 69 published ones in order to complete a representative data set of the whole area. Most of the available relevés are concentrated in the Atlantic territories (Euskaldun oriental and Santanderino-Vizcaino subsectors); for that reason our sampling focused on the Mediterranean versant territories: the Navarro-Alavés subsector and the Castellano-Cantábrico sector.

### **Study area: biogeography and physical description**

The territory studied comprises the central stretch of the Pirenaean-Cantabrian range system, where mountain elevations are lower, that is, the Basque Country and its lowland adjacent areas. The north versant of the axial mountain range constitutes the eastern part of the Cantabrian fringe. There we have a difference in altitude of 1000 m over a distance of 50 km from the mountain summits to the coast of the bay of Biscay. Its abrupt relief has been carved by many short and torrential rivers and rivulets forced into narrow valleys. The south versant has a less abrupt orography and the fluvial system is formed by slower rivers that flow into the Ebro.

The climatic conditions display a strong north-south gradient (Loidi 1987), from the temperate oceanic type in the Cantabrian valleys to the Mediterranean mesophitic, or even xerophitic one of the central areas of the Ebro valley (Rivas-Martínez 1993). This gradient decisively influences the river flow and, even more, the low water régime. The biogeographical territories shown in figure 1 are those proposed by Rivas-Martínez et al. (1991) and Loidi (1992). Our study is centered on the alder forests of the Navarro-Alavés subsector and the Castellano-Cantábrico sector, by means of comparing them with those from the Santanderino-Vizcaino and the Euskaldun oriental subsectors. The river typology is different in each of these territories: the ones with origin in the Cantabrian versant show little summer low water due to the high precipitations over the entire year and a riverbed forced into narrow valleys with steep slopes. The riverine forest is concealed into a narrow fringe on each river bank, often a single row of trees. In the Navarro-Alavés subsector the situation is quite similar, although the fluvial system runs through gentler slopes and the precipitation régime causes a noticeable low water level at the end of the summer. The absence of alder forests in many little rivers of this area is due to this low water. In the whole Cantabro-Euskaldun sector alder forests border the greater part of the fluvial system; little rivers (regatos) only bear them in the subsectors placed in the Atlantic versant. In the Castellano-Cantábrico sector, placed in the Mediterranean region, the secondary fluvial system bears strong stational fluctuations of the water level, so that the diminution of alder forests is stronger and we can only find them by big rivers, such as the Ebro, the Bayas, the Zadorra, the Arakil, the Irati or the Ega.

### **Methods**

A set of 111 relevés has been used in the analysis, 69 of them taken from bibliography and the other 42 from the sampling made by means of the Braun-Blanquet method.

For data processing TABLAS program (Quintana 1993) has been used to introduce the relevés into the data base, to make the phytosociological tables and to transform them to MULVA format (Wildi and Orloci 1988) for later statistic treatment. Through TRAFQA program (PPS, Fischer

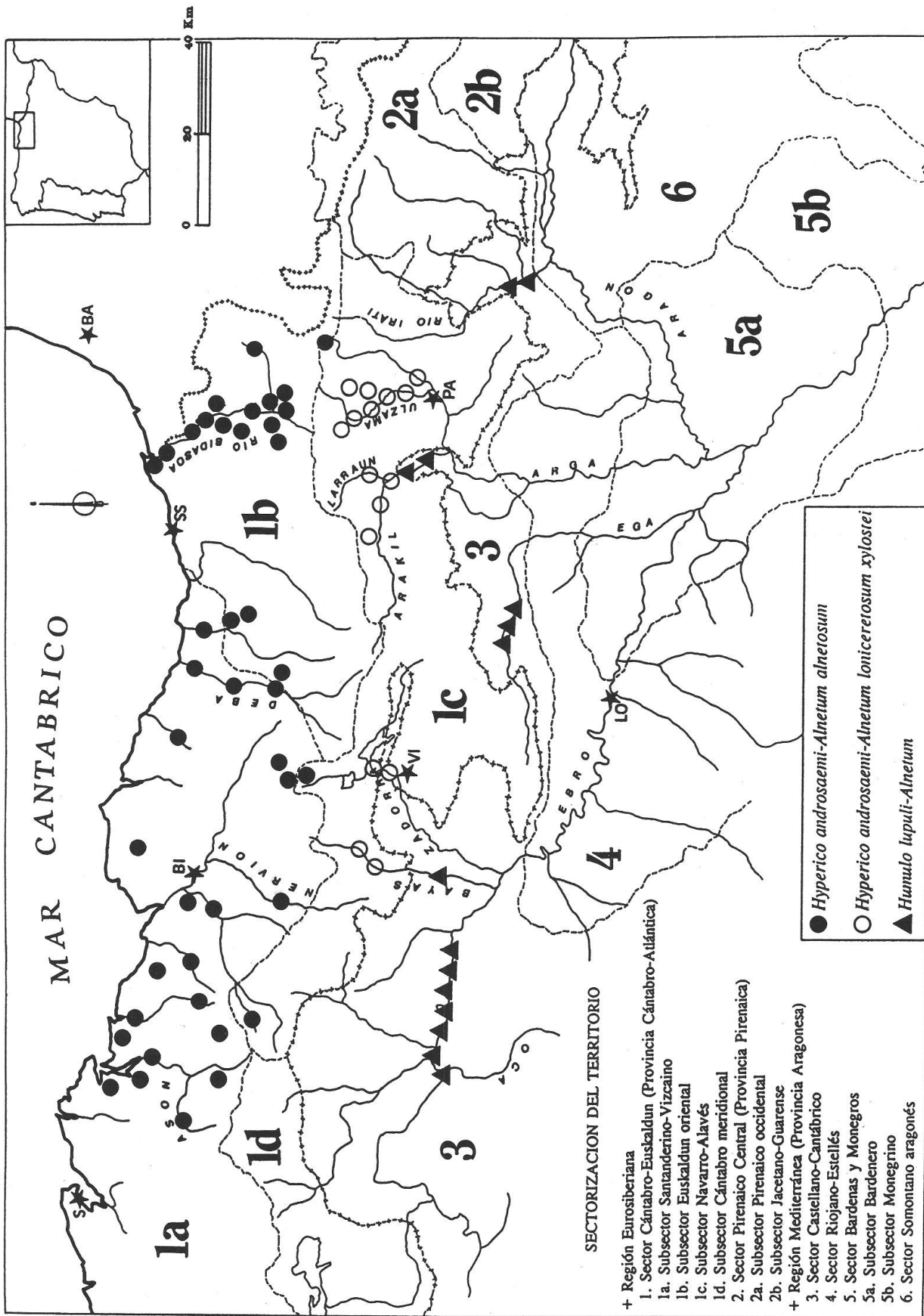


Fig. 1. Map of the territory studied, with location of the relevés used in the analysis.



1989) abundance-dominance data have been transformed to absence/presence binary values. In the same way, species occurring in less than eight relevés have been removed to minimize noise as much as possible.

A Principal Component Analysis (PCA, CANOCO program, ter Braak 1988) has been made to ordinate species and relevés; results are grafically displayed through CANODRAW.3 (Smilauer 1992). A discriminant analysis by means of DIAN (MULVA 4, Wildi and Orloci 1988) has been carried out to select the most significant species in group discrimination. In DIAN we chose a Jancey's F value  $> 5$ .

Numerical classification has been carried out through SYNTAX program (Podani 1993). We have chosen chord distance, which is less sensitive than the euclidean one to relevés' richness (Jongman et al. 1987). The classification method used is the "average link" (UPGMA). Results are shown by dendrogram and by minimum spanning tree.

### Results and discussion of numerical analysis

**Classification.** – The dendrogram in figure 2, obtained using chord distance and UPGMA, shows the classification of the relevés. It shows a first division between the relevés made in the Cantabrian versant (Santanderino-Vizcaino and Euskaldun oriental subsectors) on the left and the rest of them on the right. That is due to the rarefaction of some ombrofilic species such as *Hypericum androsaemum*, *Athyrium filix-femina*, *Dryopteris affinis*, *Lysimachia nemorum*, *Myosotis lamottiana*, etc. A new division can be made in this second group, so that relevés made in the Mediterranean region (Castellano-Cantábrico sector) stay on the right and those of Navarro-Alavés subsector on the left.

Classification results are also displayed by means of the "minimum spanning tree" (Podani 1993) shown in figure 3, in which we have marked with different shades the three groups resulting from previous classification. The graphic shows the transitional nature of the relevés from the Navarro-Alavés subsector.

**Ordination.** – Results of a PCA are shown in figures 4 and 5. Figure 4 displays the situation of relevés in the first two axes. The groups obtained from classification have

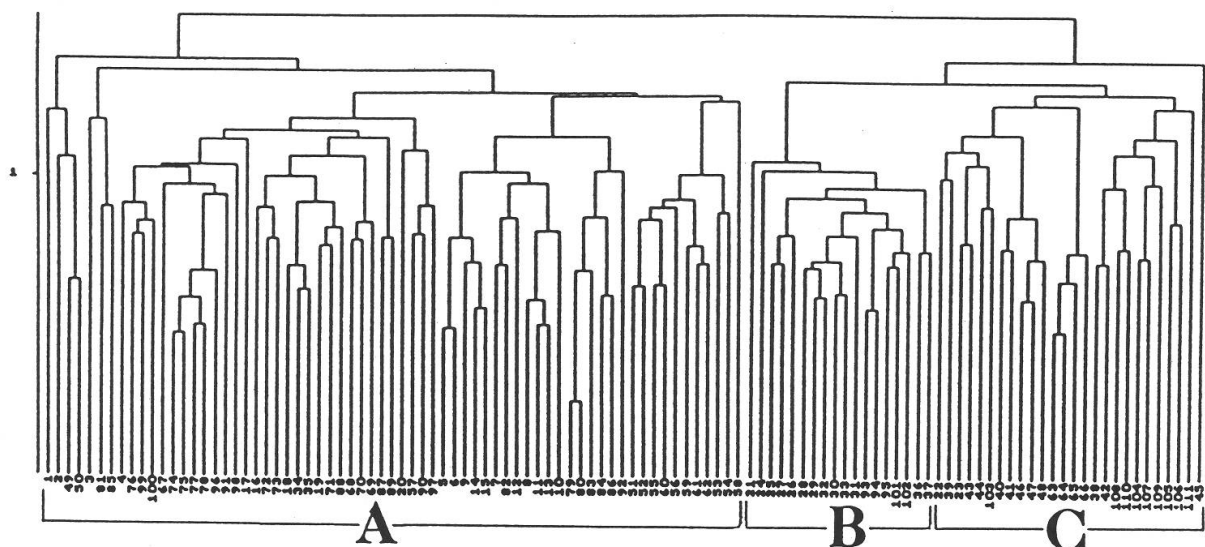


Fig. 2. Dendrogram of the classification of relevés.

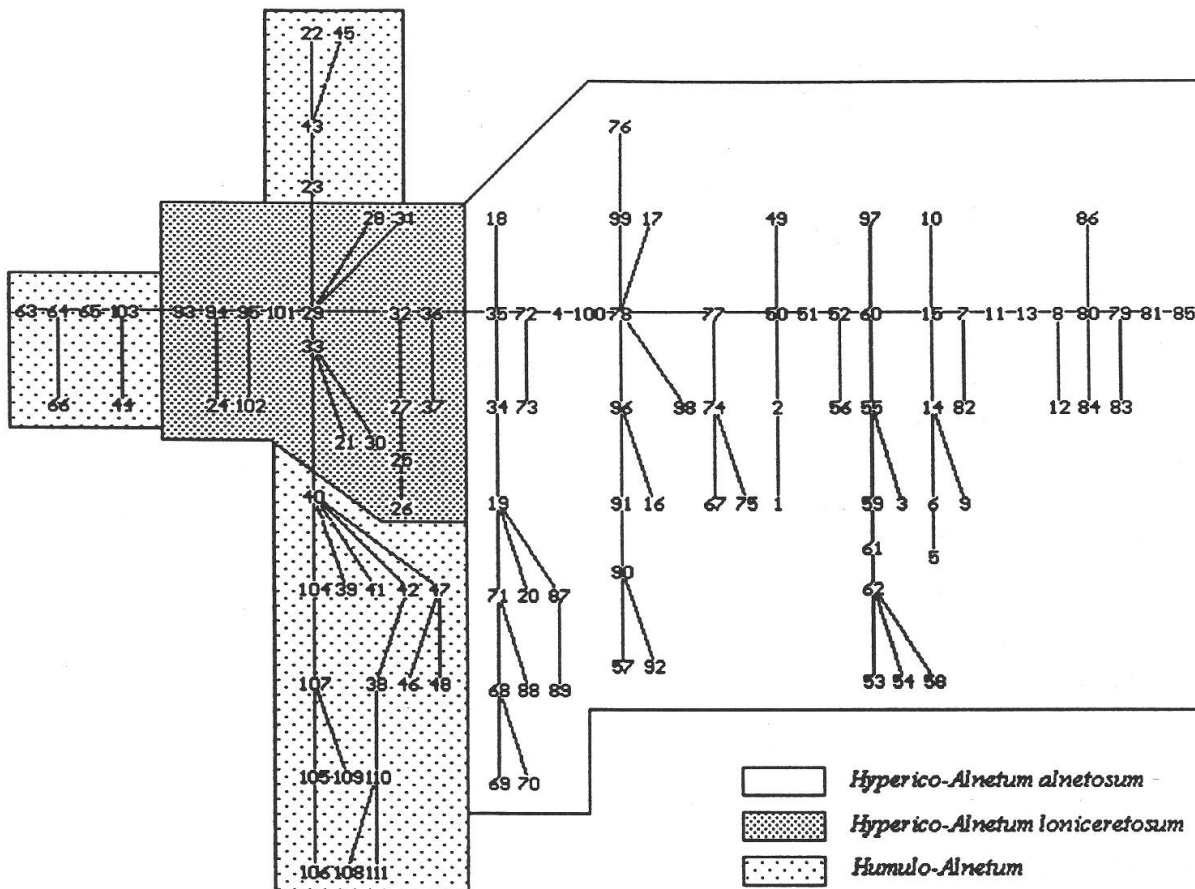


Fig. 3. Minimum spanning tree.

been overimpressed in the ordination through different symbols and enclosed inside a polygonal figure. The first two axes clearly separate groups which are coincident with those of the first divisions in classification. Figure 5 shows the display of species; only those selected by means of a discriminant analysis with Jancey's  $F > 5$  are represented.

**Discussion.** – Classification reveals the existence of three groups which have been validated by the results of ordination. As the minimum spanning tree shows, there is a transition of alder forest types from Atlantic versant southwards to the Castellano-Cantábrico sector; the Navarro-Alavés type is clearly transitional.

The increasing mediterraneity and continentality of the climatic transition in the studied territory produces a decrease of character species of *Alno-Ulmion* and *Quercus-Fagetum* in general, which find their optimum in the A group (*Dryopteris sp.pl.*, *Polystichum setiferum*, *Carex remota*, *Hypericum androsaemum*, *Lysimachia nemorum*). In the southern part of the watershed, we can still find a high number of plants belonging to this element in group B (*Festuca gigantea*, *Fraxinus excelsior*, *Primula elatior*, *Symphytum tuberosum*, *Bromus ramosus*). Nevertheless, in group C it is hardly represented. On the other hand, an important participation of the Mediterranean element is found in the Castellano-Cantábrico alder forests (*Iris foetidissima*, *Humulus lupulus*, *Vitis vinifera*, *Fraxinus angustifolia*, *Salix neotricha*). This element can also appear in Navarro-Alavés alder forests, where it mixes with those of *Alno-Ulmion*. Those Navarro-Alavés alder

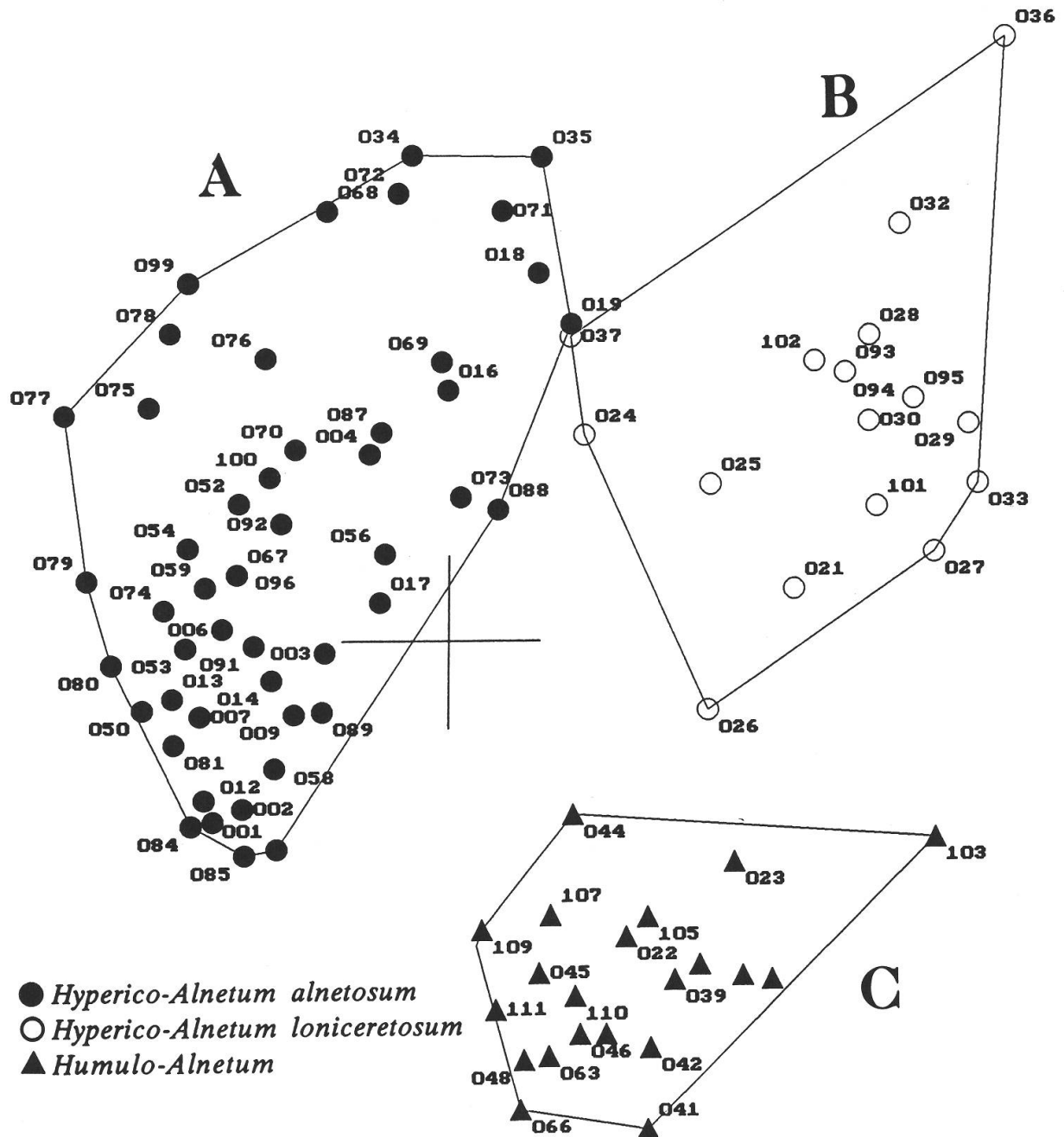


Fig. 4. Ordination (PCA) diagram of relevés.

forests also display a floristic element reflecting climatic continentality (*Lonicera xylosteum*, *Anthriscus sylvestris*, *Viburnum lantana*, *Elymus caninus*). Part of this ecological group also occurs in the Castellano-Cantábrico (Mediterranean) alder forests.

### Syntaxonomy

Tables 1 and 2 group the new relevés made for this work. The first one has 28 relevés belonging to the association *Hyperico androsaemi-Alnetum*, which includes all the riverine

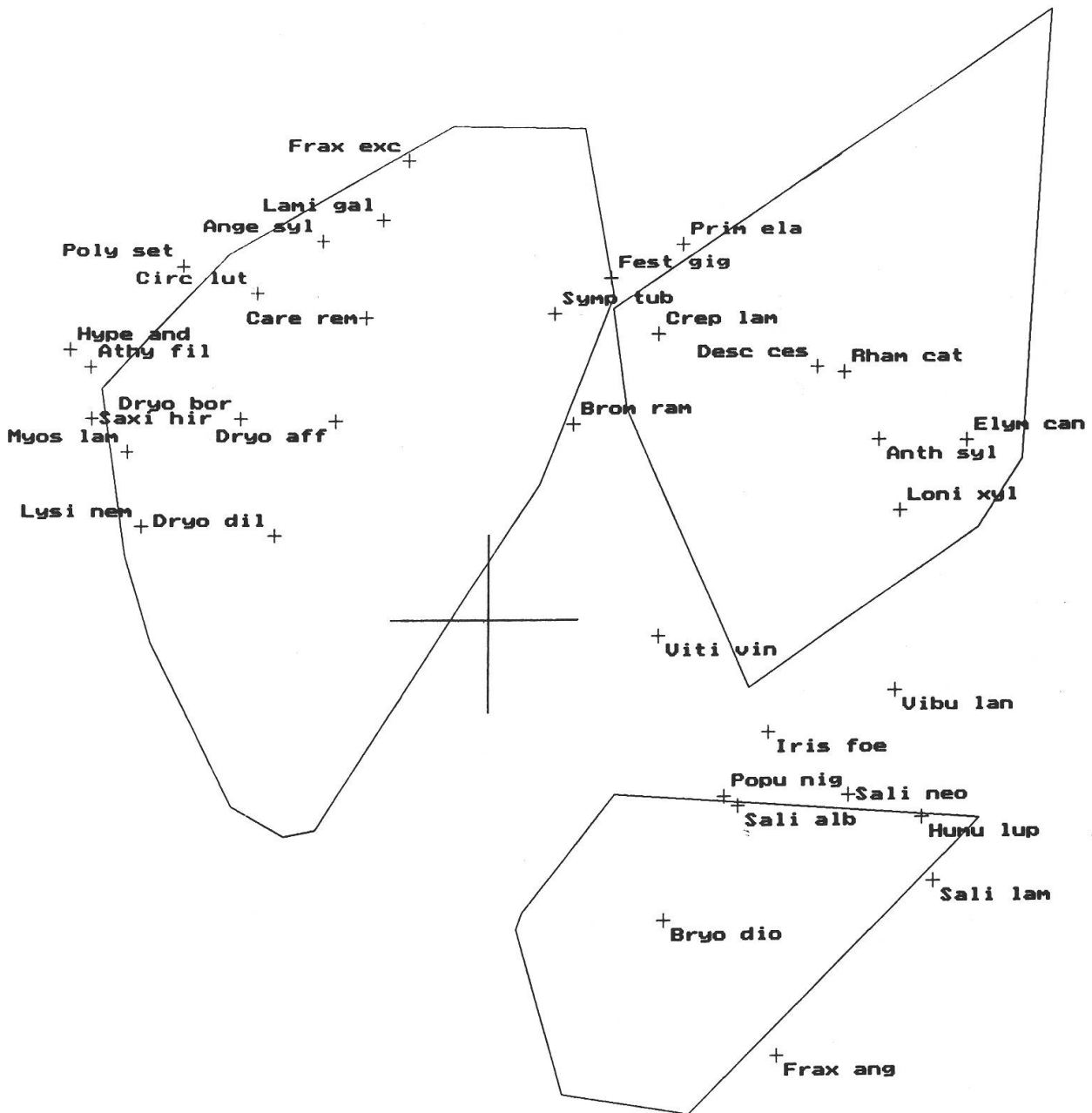


Fig. 5. Ordination (PCA) diagram of species.

alder forests of the eastern stretch of the Cantabrian fringe (Aedo 1985, T.E. Díaz and Fernández Prieto 1992, Rivas-Martínez et al. 1984 and other authors cited above). The first ten relevés of this table are mainly from the Bidasoa and Agüera networks and their similarity with those from the literature is high; together they constitute group A in numerical ordinations and classifications. The other 18 have been made in the Navarro-Alavés subsector, from where there are very few available relevés in the bibliography and they constitute group B. Several dark shade-tolerant plants like *Lysimachia nemorum*, *Dryopteris affinis*, *D. borrieri*, *Hypericum androsaemum*, *Carex remota*, *Oxalis acetosella*, *Athyrium filix-femina*, etc., are quite common in group A and scarce or completely lacking in B. On the contrary we can mention *Lonicera xylosteum*, *Anthriscus sylvestris*,











Table 1 (cont.)

| Order no.                     | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 | 21 | 22 | 23 | 24 | 25 | 26 | 27 | 28 |
|-------------------------------|---|---|---|---|---|---|---|---|---|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|
| <i>Conopodium pyrenaicum</i>  | . | . | . | . | . | . | . | . | . | .  | 1  | .  | .  | .  | .  | .  | .  | .  | .  | .  | .  | .  | .  | .  | .  | .  | .  | .  |
| <i>Prunella vulgaris</i>      | . | + | . | . | . | . | . | . | . | .  | .  | .  | .  | .  | .  | .  | .  | .  | .  | .  | .  | .  | .  | .  | .  | .  | .  | .  |
| <i>Chaerophyllum hirsutum</i> | . | . | + | . | . | . | . | . | . | .  | .  | .  | .  | .  | .  | .  | .  | .  | .  | .  | .  | .  | .  | .  | .  | .  | .  | .  |
| <i>Cardamine impatiens</i>    | . | . | . | . | . | . | . | . | . | .  | .  | +  | .  | .  | .  | .  | .  | .  | .  | .  | .  | .  | .  | .  | .  | .  | .  | .  |
| <i>Hesperis candida</i>       | . | . | . | . | . | . | . | . | . | .  | .  | .  | .  | .  | .  | .  | .  | .  | .  | .  | .  | .  | .  | .  | .  | .  | .  | .  |
| <i>Crepis lampanoides</i>     | . | . | . | . | . | . | . | . | . | .  | .  | .  | .  | .  | .  | .  | .  | .  | .  | .  | .  | .  | .  | .  | .  | .  | .  | .  |
| <i>Iris pseudacorus</i>       | + | . | . | . | . | . | . | . | . | .  | .  | .  | .  | .  | .  | .  | .  | .  | .  | .  | .  | .  | .  | .  | .  | .  | .  | .  |
| <i>Carex elata</i>            | + | . | . | . | . | . | . | . | . | .  | .  | .  | .  | .  | .  | .  | .  | .  | .  | .  | .  | .  | .  | .  | .  | .  | .  | .  |
| <i>Agrostis capillaris</i>    | 1 | . | . | . | . | . | . | . | . | .  | .  | .  | .  | .  | .  | .  | .  | .  | .  | .  | .  | .  | .  | .  | .  | .  | .  | .  |
| <i>Platanus hybrida</i>       | . | 1 | . | 2 | . | . | . | + | . | .  | .  | .  | .  | .  | .  | .  | .  | .  | .  | .  | .  | .  | .  | .  | .  | .  | .  | .  |
| <i>Equisetum telmateia</i>    | . | . | + | . | 2 | . | 1 | . | . | .  | .  | .  | .  | .  | .  | .  | .  | .  | .  | .  | .  | .  | .  | .  | .  | .  | .  | .  |
| <i>Chaerophyllum hirsutum</i> | . | . | + | . | . | . | . | + | . | .  | .  | .  | .  | .  | .  | 2  | .  | .  | .  | .  | .  | .  | .  | .  | .  | .  | .  | .  |
| <i>Blechnum spicant</i>       | . | . | . | . | . | . | . | . | . | .  | .  | .  | .  | .  | .  | .  | .  | .  | .  | .  | .  | .  | .  | .  | .  | .  | .  | .  |
| <i>Rubia perigrina</i>        | . | . | . | . | . | . | . | + | . | .  | .  | .  | .  | .  | .  | .  | .  | .  | .  | .  | .  | .  | .  | .  | .  | .  | .  | .  |
| <i>Festuca arundinacea</i>    | . | . | . | . | . | . | . | . | . | .  | .  | .  | .  | .  | .  | .  | 1  | .  | .  | .  | .  | .  | .  | .  | .  | .  | .  | .  |
| <i>Taraxacum officinale</i>   | . | . | . | . | . | . | . | . | . | .  | .  | .  | .  | .  | .  | .  | .  | .  | .  | .  | .  | .  | .  | .  | .  | .  | .  | .  |
| <i>Colchicum autumnale</i>    | . | . | . | . | . | . | . | . | . | .  | .  | .  | .  | .  | .  | .  | .  | .  | .  | .  | .  | .  | .  | .  | .  | .  | .  | .  |
| <i>Aconitum vulgare</i>       | . | . | . | . | . | . | . | . | . | .  | .  | .  | .  | .  | .  | .  | .  | .  | .  | .  | .  | .  | .  | .  | .  | .  | .  | .  |

Low frequency companion species: Rel. 1: *Phyllitis scolopendrium* +, *Pimpinella major* +, *Polygonum persicaria* +, *Rumex sanguineus* +, *Holcus mollis* +, *Leersia oryzoides* +, *Oenanthe crocata* +, *Phalaris arundinacea* +, *Sambucus ebulus* +; Rel. 2: *Castanea sativa* +, *Cyperus eragrostis* +, *Equisetum hyemale* +, *Robinia pseudacacia* +, *Asplenium trichomanes* +, *Knautia arvensis* 1, *Laurus nobilis* +; Rel. 3: *Castanea sativa* 2, *Chrysosplenium oppositifolium* +, *Dryopteris dilatata* 1, *Stachys officinalis* +, *Aquilegia vulgaris* +, *Asphodelus albus* +, *Hypericum tetrapterum* +, *Juncus effusus* +, *Narcissus pallidiflorus* +, *Primula vulgaris* +, *Rosa sempervirens* 1, *Smilax aspera* 1, *Valeriana dioica* +, *Woodwardia radicans* +; Rel. 4: *Agrostis stolonifera* +, *Cyperus eragrostis* +, *Pimpinella major* +, *Polystichum aculeatum* +, *Tritonia x crocosmiflora* 1, *Chelidonium majus* +; Rel. 5: *Euphorbia dulcis* +, *Robinia pseudacacia* +, *Carex paniculata* 2, *Juncus conglomeratus* +; Rel. 6: *Euphorbia dulcis* 1, *Erica lusitanica* +, *Galium palustre* 1, *Lastrea limbosperma* +, *Quercus ilex* +; Rel. 7: *Agrostis stolonifera* 1, *Dryopteris dilatata* +, *Ilex aquifolium* +, *Alisma plantago-aquatica* +, *Apium nodiflorum* +, *Ranunculus flammula* +, *Sibthorpia europaea* +, *Sparanium neglectum* 1; Rel. 8: *Phyllitis scolopendrium* 1, *Solidago virgaurea* +, *Veronica montana* +; Rel. 9: *Polygonum hydropiper* +, *Tritonia x crocosmiflora* 1, *Impatiens balfourii* +, *Robinia pseudacacia* pl. +, *Veronica beccabunga* +; Rel. 10: *Chrysosplenium oppositifolium* +, *Solidago virgaurea* pl. +, *Castanea sativa* pl. +, *Valeriana pyrenaica* +; Rel. 11: *Fraxinus angustifolia* 1, *Polygonum hydropiper* +, *Rumex sanguineus* +; Rel. 12: *Rosa arvensis* +, *Moehringia trinervia* +, *Ornithogalum pyrenaicum* +; Rel. 13: *Ilex aquifolium* +, *Fagus sylvatica* 1, *Luzula sylvatica* +, *Polypodium interjectum* +, *Sorbus torminalis* +; Rel. 14: *Equisetum hyemale* 1, *Polygonum persicaria* +, *Stachys officinalis* +, *Acer monspessulanum* +, *Astragalus glycyphyllos* +, *Brachypodium rupestre* +, *Campanula patula* +, *Centauria debeauxii* +, *Clinopodium vulgare* +, *Cruciata laevipes* +, *Dryopteris filix-mas* +, *Frangula alnus* +, *Galium elongatum* +, *Poa pratensis* +, *Pulmonaria longifolia* +, *Ribes alpinus* +, *Torilis arvensis* +, *Tussilago farfara* +; Rel. 16: *Rosa squarrosa* +, *Epipactis helleborine* +, *Poa annua* +, *Populus alba* 1, *Sonchus oleraceus* +; Rel. 17: *Rosa squarrosa* +, *Fagus sylvatica* pl. +, *Ilex aquifolium* pl. +, *Prunus squarrosa* +, *Vaccinium myrtillus* +; Rel.

18: *Crataegus laevigata* (+); Rel. 19: *Fraxinus angustifolia* 2, *Coronilla glauca* +, *Euphorbia villosa* +, *Plantago lanceolata* +, *Rumex sp.* +; Rel. 20: *Veronica montana* +; Rel. 21: *Populus nigra pl.* +; Rel. 22: *Rosa arvensis* +, *Arctium minus* +, *Arrhenatherum bulbosum* +, *Thalictrum minus* +; Rel. 23: *Viola gr. alba* +; Rel. 24: *Trifolium repens* +, *Silene vulgaris* +; Rel. 25: *Acer pseudoplatanus* 1, *Thalictrum flavum* +; Rel. 27: *Polystichum aculeatum* +, *Salix x expectata* 1, *Rosa corymbifera* +; Rel. 28: *Salix x expectata* +, *Trifolium repens* +, *Astrantia major* +, *Holcus lanatus* +, *Quercus faginea* +, *Rosa nitidula* +.

Places: 1. Vera del Bidasoa, río Bidasoa, 30TXN0592 (NA); 2. Guriezo: Ferreria de Laiseca, río Aguera, 30TVP7300 (S); 3. From Ontón to Otañes, 30TVN8698 (S); 4. Near Etxalar, Urrizogietea, regata Etxalar, 30TXN0887 (NA); 5. Maruri, near Villabaso, 30TWP10 (BI); 6. Villaverde de Trucios: Mollinedo, río Aguera, 30TVN7885 (S); 7. Guriezo: El Pontarrón, río Aguera, 30TVP7303 (S); 8. Baztán, from Pto. Belate to NARBATE, regata Marín, 30TXN1376 (NA); 9. Ituren, río Ezkurra, 30TXN0576 (NA); 10. Labaien: Venta Lotzabian, río Ezkurra, 30TXN0073 (NA); 11. Durana, río Zadorra, 30TWN2949 (VI); 12. Ulzama: from Atez to Iraizoz, río Ulzama, 30TXN0861 (NA); 13. Anue, Etxaide, río Mediano, 30TXN1256 (NA); 14. Arakil, from Irurzun to Latasa, río Larraun, 30TWN9554 (NA) (*ypus subass.*); 15. Arbizu, río Lizarrusti, 30TWN7752 (NA); 16. Esteribar, Zabaldika, río Arga, 30TXN1545 (NA); 17. Lanz, río Elizarrain, 30TXN1260 (NA); 18. From Yabar to Villameuva, río Arakil, 30TWN8992 (NA); 19. From Izurdiaga to Erroz, río Arakil, 30TWN9550 (NA); 20. Ulzama: Gerendain, río Ulzama, 30TXN0857 (NA); 21. Odieta: Ripa, río Ulzama, 30TXN1155 (NA); 22. Odieta: Ciaurriz, río Ulzama, 30TXN1154 (NA); 23. Odieta: Ostiz, río Ulzama, 30TXN1252 (NA); 24. Olaiibar: Enderitz, río Ulzama, 30TXN1351 (NA); 25. Mendivil, río Santa Engracia, 30TWN3051 (VI); 26. Etxebarri, río Bayas, 30TWN0848 (VI); 27. Kuartango, Andagoia, río Bayas, 30TWN0852 (VI); 28. Kuartango, Katadiano, río Bayas, 30TWN0850 (VI).

Table 2.- *Humulo lupuli-Alnetum glutinosae* ass. nova.

(Populion albae, Populion albae, Populenia albae, Populeta albae, Salici purpureae-Populenea nigrae, Querco-Fagetea)

| Altitude (1 = 10 m)                             | 39  | 40  | 55  | 55  | 55  | 52  | 56  | 52  | 50  | 47 | 50 | 50  | 50  | 49  |
|---|-----|-----|-----|-----|-----|-----|-----|-----|-----|----|----|-----|-----|-----|
| Area (m <sup>2</sup> )                          | 150 | 100 | 100 | 100 | 150 | 100 | 200 | 100 | 100 | 80 | 40 | 150 | 100 | 100 |
| Species richness                                | 31  | 40  | 57  | 36  | 41  | 34  | 41  | 35  | 32  | 31 | 25 | 39  | 21  | 46  |
| Order no.                                       | 1   | 2   | 3   | 4   | 5   | 6   | 7   | 8   | 9   | 10 | 11 | 12  | 13  | 14  |
| Character species from association to subclass: |     |     |     |     |     |     |     |     |     |    |    |     |     |     |
| <i>Alnus glutinosa</i>                          | 5   | 4   | 4   | 4   | 4   | 5   | 4   | 4   | 5   | 5  | 4  | 3   | 5   | 3   |
| <i>Salix lambertiana</i>                        | +   | 1   | 1   | 2   | 1   | 1   | +   | .   | .   | 1  | 1  | +   | +   | +   |
| <i>Humulus lupulus</i>                          | 1   | 1   | .   | +   | 1   | +   | +   | +   | 1   | .  | 1  | 2   | 1   | 2   |
| <i>Salix neotricha</i>                          | 1   | 1   | 1   | 1   | .   | .   | 1   | 1   | +   | +  | +  | +   | .   | 2   |
| <i>Fraxinus angustifolia</i>                    | 1   | .   | 2   | 1   | 2   | 1   | 2   | 1   | 1   | 2  | +  | .   | .   | 3   |
| <i>Elymus caninus</i>                           | 1   | 3   | +   | .   | .   | .   | .   | +   | 1   | .  | .  | .   | .   | 1   |
| <i>Salix alba</i>                               | .   | .   | .   | .   | 1   | +   | .   | 1   | .   | .  | 2  | 3   | 1   | .   |
| <i>Iris foetidissima</i>                        | .   | +   | +   | .   | .   | .   | 1   | .   | +   | .  | .  | .   | .   | +   |
| <i>Populus nigra</i>                            | .   | .   | 3   | .   | 1   | .   | 4   | .   | 1   | .  | .  | .   | .   | +   |
| <i>Carex pendula</i>                            | +   | 2   | .   | .   | 1   | .   | .   | .   | +   | .  | .  | .   | .   | .   |
| <i>Bryonia dioica</i>                           | +   | .   | .   | +   | .   | .   | .   | .   | 1   | .  | .  | .   | .   | 1   |
| <i>Salix angustifolia</i>                       | .   | .   | 2   | +   | .   | .   | .   | .   | .   | +  | .  | .   | .   | +   |
| <i>Fraxinus oxycarpa</i>                        | 2   | 2   | .   | .   | .   | .   | .   | .   | .   | .  | .  | .   | .   | 1   |
| <i>Ulmus minor</i>                              | .   | +   | .   | .   | 1   | .   | .   | .   | .   | +  | .  | .   | .   | .   |
| <i>Populus x canadensis</i>                     | .   | +   | .   | .   | .   | .   | .   | 1   | .   | .  | .  | .   | .   | 1   |
| <i>Solanum dulcamara</i>                        | .   | +   | .   | .   | .   | .   | .   | .   | .   | .  | .  | +   | .   | +   |
| <i>Salix x pormensis</i>                        | .   | .   | +   | .   | .   | .   | .   | .   | .   | +  | .  | +   | .   | .   |
| <i>Salix x expectata</i>                        | .   | .   | .   | .   | .   | 2   | .   | .   | .   | +  | .  | 1   | .   | .   |
| <i>Salix x erythroclados</i>                    | .   | .   | .   | .   | +   | 1   | .   | .   | .   | .  | .  | .   | .   | .   |
| <i>Saponaria officinalis</i>                    | .   | .   | .   | .   | .   | .   | +   | 1   | .   | .  | .  | .   | .   | .   |
| Character species of class:                     |     |     |     |     |     |     |     |     |     |    |    |     |     |     |
| <i>Cornus sanguinea</i>                         | .   | 1   | 1   | 1   | 1   | +   | 1   | +   | 2   | 1  | +  | +   | +   | 1   |
| <i>Hedera helix</i>                             | +   | 1   | 1   | .   | +   | .   | 3   | +   | 1   | .  | +  | +   | +   | 1   |
| <i>Brachypodium sylvaticum</i>                  | +   | 3   | 2   | .   | 2   | +   | 2   | 3   | 4   | 3  | .  | .   | .   | 2   |
| <i>Clematis vitalba</i>                         | +   | .   | 1   | 1   | 1   | +   | 1   | .   | .   | .  | 1  | 1   | .   | 1   |
| <i>Crataegus monogyna</i>                       | .   | 1   | +   | 1   | +   | .   | 1   | .   | .   | .  | +  | +   | .   | +   |
| <i>Rubus caesius</i>                            | .   | .   | 2   | 1   | 2   | 1   | .   | 1   | .   | .  | .  | 3   | 1   | 1   |
| <i>Salix atrocinerea</i>                        | +   | .   | .   | 1   | 1   | .   | 1   | .   | .   | .  | 1  | 1   | .   | +   |
| <i>Frangula alnus</i>                           | +   | .   | .   | +   | .   | +   | +   | +   | .   | 1  | .  | .   | .   | .   |
| <i>Ligustrum vulgare</i>                        | .   | .   | .   | .   | +   | .   | 1   | .   | .   | .  | +  | 1   | +   | +   |
| <i>Rosa canina</i>                              | +   | .   | .   | .   | .   | .   | .   | .   | +   | 1  | .  | .   | 1   | +   |
| <i>Viburnum lantana</i>                         | .   | .   | 1   | .   | +   | +   | +   | .   | .   | +  | .  | .   | .   | .   |
| <i>Euphorbia amygdaloides</i>                   | .   | .   | +   | .   | +   | .   | +   | .   | +   | .  | .  | .   | .   | .   |
| <i>Geranium robertianum</i>                     | .   | .   | .   | .   | +   | .   | .   | .   | +   | .  | .  | +   | .   | +   |
| <i>Arum italicum</i>                            | .   | .   | .   | .   | .   | .   | .   | .   | +   | .  | 1  | +   | .   | +   |
| <i>Epipactis helleborine</i>                    | .   | +   | +   | .   | .   | .   | .   | +   | .   | .  | .  | .   | .   | .   |
| <i>Corylus avellana</i>                         | .   | .   | 1   | +   | .   | .   | .   | .   | +   | .  | .  | .   | .   | .   |
| <i>Rosa agrestis</i>                            | .   | .   | +   | +   | .   | .   | .   | .   | .   | .  | +  | .   | .   | .   |
| <i>Lonicera xylosteum</i>                       | .   | .   | +   | .   | .   | .   | 1   | .   | .   | .  | .  | .   | .   | +   |
| <i>Rosa squarrosa</i>                           | .   | .   | .   | .   | .   | 1   | +   | .   | .   | .  | 1  | .   | .   | .   |
| <i>Prunus spinosa</i>                           | .   | .   | .   | +   | .   | .   | .   | .   | .   | .  | .  | .   | .   | +   |
| <i>Euonymus europaeus</i>                       | .   | .   | .   | .   | +   | .   | .   | .   | .   | .  | .  | .   | .   | +   |
| <i>Prunus avium</i>                             | .   | .   | .   | .   | .   | .   | .   | .   | .   | .  | .  | +   | .   | +   |
| Companion species:                              |     |     |     |     |     |     |     |     |     |    |    |     |     |     |
| <i>Filipendula ulmaria</i>                      | +   | 1   | .   | 1   | 1   | +   | .   | 1   | +   | .  | +  | +   | 1   | .   |

Table 2 (cont.)

| Order no.                    | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 |
|------------------------------|---|---|---|---|---|---|---|---|---|----|----|----|----|----|
| <i>Agrostis stolonifera</i>  | 1 | 1 | 1 | + | 1 | 2 | 1 | 1 | . | 2  | .  | .  | .  | .  |
| <i>Lythrum salicaria</i>     | + | 1 | 1 | + | + | 1 | . | + | . | .  | +  | .  | .  | .  |
| <i>Urtica dioica</i>         | + | 1 | . | + | . | 1 | . | 1 | 2 | .  | .  | +  | .  | +  |
| <i>Equisetum arvense</i>     | . | + | + | 1 | 1 | + | 1 | . | . | .  | +  | 1  | .  | .  |
| <i>Calystegia sepium</i>     | + | . | . | . | + | . | . | . | + | .  | 1  | 3  | 2  | +  |
| <i>Lysimachia vulgaris</i>   | . | 1 | . | . | + | 1 | . | + | 1 | .  | .  | 1  | +  | .  |
| <i>Carex elata</i>           | . | . | 1 | + | 1 | 1 | . | . | . | 1  | .  | +  | 3  | .  |
| <i>Ranunculus repens</i>     | + | . | 1 | 1 | + | . | . | 1 | . | 1  | .  | .  | .  | .  |
| <i>Mentha aquatica</i>       | . | . | . | 1 | + | . | . | 1 | . | 2  | .  | +  | +  | .  |
| <i>Rumex conglomeratus</i>   | . | + | . | 1 | . | . | . | + | + | +  | .  | .  | .  | .  |
| <i>Phragmites australis</i>  | . | . | . | . | + | 1 | + | . | . | .  | .  | +  | +  | .  |
| <i>Iris pseudacorus</i>      | . | . | . | . | + | + | . | . | . | .  | 1  | 1  | 3  | .  |
| <i>Sambucus nigra</i>        | + | + | . | . | . | . | . | + | . | .  | .  | .  | .  | 1  |
| <i>Alliaria petiolata</i>    | . | 1 | . | + | . | . | . | . | 1 | .  | .  | .  | .  | 1  |
| <i>Senecio aquaticus</i>     | . | + | . | . | . | + | . | . | . | +  | .  | .  | .  | 1  |
| <i>Prunella vulgaris</i>     | . | + | . | . | . | . | . | + | . | 1  | .  | +  | .  | .  |
| <i>Heracleum sphondylium</i> | . | + | . | . | . | . | . | + | . | .  | .  | +  | .  | +  |
| <i>Buxus sempervirens</i>    | . | . | + | + | + | . | 1 | . | . | .  | .  | .  | .  | .  |
| <i>Lapsana communis</i>      | . | . | + | . | . | 1 | . | . | 1 | .  | .  | .  | .  | 1  |
| <i>Epilobium hirsutum</i>    | . | . | . | + | + | . | + | . | + | .  | .  | .  | .  | .  |
| <i>Sonchus oleraceus</i>     | . | + | . | . | . | + | . | 1 | . | .  | .  | .  | .  | .  |
| <i>Sisymbrium austriacum</i> | . | + | . | . | . | . | . | 1 | . | .  | .  | .  | .  | +  |
| <i>Poa nemoralis</i>         | . | . | + | . | + | . | . | + | . | .  | .  | .  | .  | .  |
| <i>Galium aparine</i>        | . | . | + | . | . | + | . | . | . | .  | .  | .  | .  | +  |
| <i>Holcus lanatus</i>        | . | . | + | . | . | . | 1 | . | . | .  | .  | +  | .  | .  |
| <i>Cirsium arvense</i>       | . | . | . | . | . | . | . | + | . | .  | 1  | +  | .  | .  |
| <i>Equisetum palustre</i>    | . | . | . | . | . | . | . | . | . | .  | 1  | 1  | 1  | .  |
| <i>Poa pratensis</i>         | + | . | . | + | . | . | . | . | . | .  | .  | .  | .  | .  |
| <i>Rubus sp.</i>             | 1 | . | . | . | . | . | . | . | . | 1  | .  | .  | .  | .  |
| <i>Eupatorium cannabinum</i> | + | . | . | . | . | . | . | . | . | .  | .  | .  | +  | .  |
| <i>Ajuga reptans</i>         | . | . | . | 1 | + | . | . | . | . | .  | .  | .  | .  | .  |
| <i>Cardamine impatiens</i>   | . | + | . | . | . | + | . | . | . | .  | .  | .  | .  | .  |
| <i>Phalaris arundinacea</i>  | . | + | . | . | . | . | . | . | 2 | .  | .  | .  | .  | .  |
| <i>Galium boreale</i>        | . | . | + | . | . | . | + | . | . | .  | .  | .  | .  | .  |
| <i>Viburnum tinus</i>        | . | . | 1 | . | . | . | 1 | . | . | .  | .  | .  | .  | .  |
| <i>Trifolium pratense</i>    | . | . | + | . | . | . | . | + | . | .  | .  | .  | .  | .  |
| <i>Torilis arvensis</i>      | . | . | + | . | . | . | . | . | . | .  | .  | .  | .  | 1  |
| <i>Vicia nigra</i>           | . | . | + | . | . | . | . | . | . | .  | .  | .  | .  | +  |
| <i>Potentilla reptans</i>    | . | . | . | + | . | . | . | . | . | 1  | .  | .  | .  | .  |
| <i>Ranunculus despectus</i>  | . | . | . | . | 1 | . | . | . | . | +  | .  | .  | .  | .  |
| <i>Carex flacca</i>          | . | . | . | . | + | . | . | . | . | .  | +  | .  | .  | .  |
| <i>Galium elongatum</i>      | . | . | . | . | . | + | . | . | . | .  | .  | .  | 1  | .  |
| <i>Sinapis arvensis</i>      | . | . | . | . | . | + | . | . | . | .  | .  | .  | .  | +  |
| <i>Cruciata laevipes</i>     | . | . | . | . | . | . | . | 1 | . | .  | .  | .  | .  | +  |
| <i>Poa trivialis</i>         | . | . | . | . | . | . | . | + | . | .  | .  | .  | .  | 1  |

Low frequency companion species: Rel. 1: *Deschampsia cespitosa* +, *Galium mollugo* +, *Rumex obtusifolius* +, *Veronica chamaedrys* +, *Vicia cracca* +, *Vitis vinifera* +; Rel. 2: *Anthriscus sylvestris* +, *Arctium minus* +, *Campanula trachelium* +, *Circaea lutetiana* +, *Dactylis glomerata* 1, *Melissa officinalis* +, *Rumex sanguineus* +, *Stachys sylvatica* +; Rel. 3: *Acer pseudoplatanus* +, *Amelanchier ovalis* +, *Arbutus unedo* +, *Bellis perennis* +, *Bromus rigidus* +, *Cynosurus echinatus* +, *Dactylis hispanica* +, *Elymus campestris* 1, *Equisetum ramosissimum* +, *Hepatica nobilis* +, *Lathyrus pratensis* +, *Medicago lupulina* 1, *Medicago sativa* +, *Melilotus officinalis* +, *Morus nigra* +, *Prunus mahaleb* +, *Quercus faginea* +, *Salix discolor* +, *Tanacetum parthenium* +, *Teucrium scorodonia*



+, *Trifolium campestre* +; Rel. 4: *Brachypodium rupestre* 1, *Cardamine flexuosa* 1, *Cardamine pratensis* 1, *Scrophularia auriculata* 1, *Taraxacum officinale* +; Rel. 5: *Conium maculatum* +, *Mentha longifolia* +, *Plantago major* +; Rel. 6: *Apium nodiflorum* +, *Epilobium parviflorum* 1, *Polygonum persicaria* +, *Tussilago farfara* +; Rel. 7: *Acer monspessulanum* +, *Buglossoides purpureocaerulea* +, *Carex divulsa* +, *Melica uniflora* +, *Origanum vulgare* +, *Orobanche hederæ* +, *Picris hieracioides* +, *Pteridium aquilinum* +, *Quercus rotundifolia* +, *Rhamnus alaternus* +, *Ruscus aculeatus* +, *Spiraea obovata* +, *Tilia platyphyllos* +; Rel. 8: *Conyza canadensis* +, *Lactuca virosa* 1, *Torilis japonica* +; Rel. 9: *Angelica sylvestris* +, *Fraxinus excelsior* +, *Melilotus albus* +, *Rubia peregrina* +, *Rubus sec. corylifolii* +, *Sambucus ebulus* 1; Rel. 10: *Agrimonia eupatoria* +, *Berberis cantabrica* +, *Hypericum tetrapterum* +, *Rosa micrantha* +, *Scirpus cernuus* +, *Seseli cantabricum* 1, *Ulmus glabra* +, *Viola gr. silvestris* 1; Rel. 11: *Cucubalus baccifer* +, *Rubus ulmifolius* 2; Rel. 12: *Glechoma hederacea* +, *Juglans regia* +, *Lonicera etrusca* +, *Rosa corymbifera* +, *Rosa nitidula* +, *Scirpus holoschoenus* +, *Tamus communis* +; Rel. 13: *Carex paniculata* +, *Lycopus europaeus* +; Rel. 14: *Acer campestre* +, *Geum urbanum* +, *Hesperis candida* +, *Lamium maculatum* +.

Places: 1. Arakil, Asiain, río Arakil, 30TWN9843 (NA); 2. Ollo, Anoz, río Arakil, 30TWN9646 (NA); 3. Cañón la Horadada, Oña-Trespaderne, río Ebro, 30TVN6638 (BU); 4. Puente la Horadada, Oña-Trespaderne, río Ebro, 30TVN6435 (BU); 5. Cañón la Horadada, Oña-Trespaderne, río Ebro, 30TVN6536 (BU); 6. Frías, soto, río Ebro, 30TVN7734 (BU); 7. Cañón la Horadada, Oña-Trespaderne, río Ebro, 30TVN6738 (BU); 8. Quintanaseca, río Ebro, 30TVN7335 (BU) (*typus*); 9. Montejo de Cebas, río Ebro, 30TVN7834 (BU); 10. Sobrón, in front of the camping, 30TVN9334 (BU); 11. From Quintana to Sobrón, río Ebro, 30TVN8534 (BU); 12. From Garoña to Sobrón, río Ebro, 30TVN8435 (BU); 13. From Garoña to Sobrón, río Ebro, 30TVN8335 (BU); 14. Ribera alta: Mimbredo, río Bayas, 30TWN0887 (VI).

*Rhamnus catharticus*, *Salix neotricha*, *Viburnum lantana* and *Fraxinus oxycarpa*. All these species can be used to distinguish both relevés groups. Nevertheless they have in common an important and meaningful group of typical wet forest plants like *Festuca gigantea*, *Bromus ramosus*, *Primula elatior*, *Fraxinus excelsior*, *Carex pendula*, *Symphytum tuberosum*, etc., which suggests that both belong to the same association. The subassociation status can be adequate enough to express the explained floristical, biogeographical and ecological relationships between them and so, we propose for group B the subassociation *loniceretosum xylostei nova*, inside *Hyperico androsaemi-Alnetum*; relevé no. 14 from table 1 is appointed as nomenclatural type.

Table 2 groups 14 relevés corresponding to group C of the numerical analysis; they come from middle-sized to big rivers in the Castellano-Cantábrico sector. Although this area is submitted to a Mediterranean climate, alder riverine forests can still be found in big rivers where the summer low water effect is deadened. Differential species for this group are: *Fraxinus angustifolia*, *Bryonia dioica*, *Humulus lupulus*, *Iris foetidissima*, *Salix alba*, *S. neotricha* and *Populus nigra*; among them there are several which are characteristic of the Mediterranean riverine suborder *Populentalia albae*. There is also a strong decrease of shade-tolerant plants, frequent in the other two groups (table 3). These differences are enough not only to separate this group floristically, but also to consider this group as a good association because they reveal the location of these alder forests in a different biogeographical and bioclimatic setting. For that reason we propose *Humulo lupuli-Alnetum glutinosae* ass. nova and appoint relevé no. 8 of table 2 as nomenclatural type. About its classification in the accepted phytosociological system (Rivas-Martínez et al. 1991), we consider that it should be included in the Mediterranean suborder *Populentalia albae*, which has two alliances: *Populion* and *Osmundo-Alnion*. The last one has a western distribution and its characteristic taxa (Rivas-Martínez et al. 1986) are completely lacking in our area, so our new association fits better in *Populion*, and specifically in the true riverine suballiance *Populion*.

Table 3. Synthetic table of studied alder forests  
*Hyperico androsaemi-Alnetum glutinosae alnetosum* (1-10)  
*Hyperico androsaemi-Alnetum glutinosae loniceretosum xylostei* (11)  
*Humulo lupuli-Alnetum glutinosae* (12-14)

| Relevés richness                               | 15  | 8   | 2 | 11  | 12  | 3 | 6   | 2 | 1 | 10  | 18  | 14  | 4  | 8   |
|--|-----|-----|---|-----|-----|---|-----|---|---|-----|-----|-----|----|-----|
| Order no.                                      | 1   | 2   | 3 | 4   | 5   | 6 | 7   | 8 | 9 | 10  | 11  | 12  | 13 | 14  |
| Character species of order and higher syntaxa: |     |     |   |     |     |   |     |   |   |     |     |     |    |     |
| <i>Alnus glutinosa</i>                         | V   | V   | 2 | V   | V   | 3 | V   | 2 | 1 | V   | V   | V   | 4  | V   |
| <i>Salix atrocinerea</i>                       | III | III | 1 | +   | II  | 1 | IV  | 2 | . | III | III | III | 1  | .   |
| <i>Hedera helix</i>                            | V   | .   | 2 | III | III | 1 | IV  | . | 1 | V   | V   | IV  | .  | IV  |
| <i>Brachypodium sylvaticum</i>                 | III | .   | 2 | IV  | +   | 2 | V   | . | . | IV  | V   | IV  | 4  | V   |
| <i>Viola gr. silvestris</i>                    | IV  | II  | 2 | III | II  | . | II  | . | . | II  | III | +   | .  | III |
| <i>Geranium robertianum</i>                    | V   | .   | 1 | II  | II  | . | I   | . | 1 | III | II  | II  | .  | IV  |
| <i>Corylus avellana</i>                        | V   | II  | 2 | .   | III | 2 | IV  | . | . | IV  | IV  | II  | .  | .   |
| <i>Euphorbia amygdaloides</i>                  | II  | II  | 1 | .   | .   | 2 | I   | . | . | III | I   | II  | .  | II  |
| <i>Polystichum setiferum</i>                   | V   | III | . | II  | III | 2 | IV  | 2 | . | IV  | I   | .   | .  | .   |
| <i>Carex pendula</i>                           | V   | V   | . | V   | IV  | 1 | V   | . | . | V   | V   | II  | .  | .   |
| <i>Arum italicum</i>                           | II  | III | . | III | III | 3 | II  | . | . | II  | IV  | II  | .  | .   |
| <i>Tamus communis</i>                          | IV  | .   | 2 | +   | .   | 2 | IV  | . | . | IV  | III | +   | 1  | .   |
| <i>Cornus sanguinea</i>                        | III | .   | 2 | .   | .   | 1 | II  | . | . | III | V   | V   | 2  | III |
| <i>Crataegus monogyna</i>                      | III | .   | 1 | .   | .   | 1 | I   | . | . | II  | IV  | III | 3  | IV  |
| <i>Saxifraga hirsuta</i>                       | III | IV  | . | IV  | III | 2 | II  | . | . | III | +   | .   | .  | .   |
| <i>Prunus spinosa</i>                          | I   | .   | 1 | .   | .   | 1 | I   | . | . | I   | III | I   | 1  | .   |
| <i>Clematis vitalba</i>                        | +   | .   | 1 | .   | .   | 1 | .   | . | . | I   | IV  | IV  | 2  | IV  |
| <i>Phyllitis scolopendrium</i>                 | II  | III | . | .   | III | 1 | I   | 1 | . | I   | .   | .   | .  | .   |
| <i>Lonicera perichlymenum</i>                  | III | .   | 2 | .   | +   | 1 | II  | . | . | II  | I   | .   | .  | .   |
| <i>Lamiastrum galeobdolon</i>                  | IV  | .   | . | III | V   | 2 | III | . | . | III | III | .   | .  | .   |
| <i>Acer campestre</i>                          | +   | .   | . | .   | .   | 1 | .   | . | . | II  | V   | +   | 1  | III |
| <i>Rubus caesius</i>                           | .   | .   | . | .   | .   | 2 | II  | . | 1 | .   | II  | III | 3  | IV  |
| <i>Frangula alnus</i>                          | +   | II  | . | .   | I   | . | II  | . | . | .   | +   | III | .  | .   |
| <i>Helleborus occidentalis</i>                 | II  | .   | 1 | +   | .   | 1 | .   | . | . | I   | II  | .   | .  | .   |
| <i>Symphytum tuberosum</i>                     | III | .   | 1 | .   | .   | 1 | III | . | . | I   | II  | .   | .  | .   |
| <i>Ranunculus ficaria</i>                      | II  | .   | 1 | .   | .   | 1 | .   | . | . | +   | II  | .   | 4  | .   |
| <i>Rubus ulmifolius</i>                        | IV  | .   | 1 | .   | .   | . | II  | . | . | II  | .   | +   | .  | IV  |
| <i>Hepatica nobilis</i>                        | +   | .   | . | +   | .   | . | .   | . | . | +   | I   | +   | .  | II  |
| <i>Euonymus europaeus</i>                      | II  | .   | . | .   | +   | . | I   | . | . | I   | IV  | I   | .  | .   |
| <i>Ligustrum vulgare</i>                       | II  | .   | . | .   | .   | . | I   | . | . | I   | IV  | III | 1  | .   |
| <i>Populus nigra</i>                           | +   | .   | . | .   | .   | . | .   | . | . | +   | II  | II  | 3  | II  |
| <i>Euphorbia dulcis</i>                        | III | .   | 2 | .   | +   | . | I   | . | . | I   | .   | .   | .  | .   |
| <i>Oxalis acetosella</i>                       | III | .   | 2 | .   | .   | 1 | .   | . | 1 | III | .   | .   | .  | .   |
| <i>Veronica montana</i>                        | +   | .   | 1 | .   | .   | 2 | .   | . | . | +   | +   | .   | .  | .   |
| <i>Vicia sepium</i>                            | +   | .   | 1 | .   | .   | . | I   | . | . | II  | I   | .   | .  | .   |
| <i>Melica uniflora</i>                         | +   | .   | 1 | .   | .   | . | .   | . | . | +   | I   | +   | .  | .   |
| <i>Primula elatior</i>                         | II  | .   | . | .   | II  | 1 | .   | . | . | II  | IV  | .   | .  | .   |
| <i>Quercus robur</i>                           | IV  | .   | . | .   | .   | . | III | . | . | I   | I   | .   | .  | II  |
| <i>Dryopteris filix-mas</i>                    | .   | II  | . | III | +   | 1 | .   | . | . | .   | +   | .   | .  | .   |
| <i>Carex sylvatica</i>                         | .   | .   | 1 | .   | .   | 1 | .   | . | 1 | I   | II  | .   | .  | .   |
| <i>Ulmus minor</i>                             | .   | .   | . | II  | II  | . | .   | . | . | .   | II  | II  | 3  | .   |
| <i>Solanum dulcamara</i>                       | .   | .   | . | .   | +   | . | .   | . | . | +   | I   | II  | .  | II  |
| <i>Pulmonaria longifolia</i>                   | +   | .   | 1 | .   | .   | . | I   | . | . | .   | +   | .   | .  | .   |
| <i>Stellaria holostea</i>                      | II  | .   | 1 | .   | .   | . | .   | . | . | +   | I   | .   | .  | .   |
| <i>Osmunda regalis</i>                         | I   | .   | . | .   | .   | . | IV  | 1 | . | III | .   | .   | .  | .   |

Table 3 (cont.)

| Order no.  | 1   | 2   | 3 | 4   | 5   | 6 | 7   | 8 | 9 | 10  | 11  | 12  | 13 | 14  |
|--|-----|-----|---|-----|-----|---|-----|---|---|-----|-----|-----|----|-----|
| <i>Dryopteris dilatata</i>   | II  | .   | . | .   | .   | . | .   | 1 | 1 | I   | .   | .   | .  | .   |
| <i>Lastrea limbosperma</i>   | +   | .   | . | .   | .   | . | .   | 1 | 1 | +   | .   | .   | .  | .   |
| <i>Ulmus glabra</i>  | I   | .   | . | .   | .   | . | .   | . | . | +   | II  | +   | .  | .   |
| <i>Elymus caninus</i>  | +   | .   | . | .   | .   | . | .   | . | . | +   | IV  | III | .  | .   |
| <i>Rosa canina</i>   | .   | .   | . | .   | I   | . | .   | . | . | .   | I   | II  | .  | I   |
| <i>Salix alba</i>  | .   | .   | . | .   | .   | . | IV  | . | . | .   | II  | III | 4  | .   |
| <i>Salix discolor</i>  | .   | .   | . | .   | .   | . | .   | . | . | +   | II  | +   | 1  | .   |
| <i>Poa nemoralis</i>   | .   | .   | . | .   | .   | . | .   | . | . | +   | III | II  | .  | III |
| <i>Salix lambertiana</i>   | .   | .   | . | .   | .   | . | .   | . | . | .   | III | V   | 4  | I   |
| <i>Potentilla sterilis</i>   | I   | .   | 2 | .   | .   | . | .   | . | . | II  | .   | .   | .  | .   |
| <i>Lathraea clandestina</i>  | +   | .   | . | .   | .   | 1 | .   | . | . | .   | III | .   | .  | .   |
| <i>Rosa arvensis</i>   | +   | .   | . | .   | .   | 1 | .   | . | . | .   | I   | .   | .  | .   |
| <i>Prunus avium</i>  | +   | .   | . | .   | .   | 1 | .   | . | . | .   | .   | I   | .  | .   |
| <i>Luzula sylvatica</i>  | I   | .   | . | .   | .   | . | .   | 2 | . | .   | +   | .   | .  | .   |
| <i>Ilex aquifolium</i>   | +   | .   | . | .   | .   | . | .   | . | . | +   | +   | .   | .  | .   |
| <i>Holcus mollis</i>   | .   | .   | 1 | .   | .   | 1 | .   | . | . | +   | .   | .   | .  | .   |
| <i>Polystichum aculeatum</i>   | .   | .   | . | .   | +   | . | .   | . | . | +   | +   | .   | .  | .   |
| <i>Acer pseudoplatanus</i>   | .   | .   | . | .   | II  | . | .   | . | . | .   | +   | +   | .  | .   |
| <i>Viburnum opulus</i>   | .   | .   | . | .   | .   | . | III | . | . | +   | II  | .   | .  | .   |
| <i>Saponaria officinalis</i>   | .   | .   | . | .   | .   | . | II  | . | . | .   | .   | I   | .  | II  |
| <i>Campanula trachelium</i>  | .   | .   | . | .   | .   | . | .   | . | . | II  | +   | +   | .  | .   |
| <i>Tilia platyphyllos</i>  | .   | .   | . | .   | .   | . | .   | . | . | I   | I   | +   | .  | .   |
| <i>Rosa nitidula</i>   | .   | .   | . | .   | .   | . | .   | . | . | .   | +   | +   | .  | I   |
| Character species of <i>Alno-Ulmion</i> :                                |     |     |   |     |     |   |     |   |   |     |     |     |    |     |
| <i>Circaea lutetiana</i>   | IV  | III | 1 | III | V   | 1 | II  | 1 | . | III | II  | +   | .  | .   |
| <i>Fraxinus excelsior</i>  | V   | III | 1 | V   | V   | 1 | V   | . | . | III | V   | +   | .  | .   |
| <i>Carex remota</i>  | III | II  | . | .   | III | 1 | II  | 1 | 1 | IV  | II  | .   | .  | .   |
| <i>Festuca gigantea</i>  | I   | .   | 1 | .   | III | 1 | I   | . | . | II  | III | .   | .  | .   |
| <i>Bromus ramosus</i>  | +   | .   | . | .   | IV  | . | I   | . | . | .   | II  | .   | .  | .   |
| <i>Rumex sanguineus</i>  | +   | .   | . | .   | .   | . | .   | . | . | +   | +   | +   | .  | .   |
| Character species of <i>Populion</i> :                                   |     |     |   |     |     |   |     |   |   |     |     |     |    |     |
| <i>Iris foetidissima</i>   | .   | .   | . | .   | .   | . | I   | . | . | .   | II  | II  | 2  | I   |
| <i>Vitis vinifera</i>  | .   | .   | . | .   | .   | . | .   | . | . | I   | I   | +   | .  | III |
| <i>Humulus lupulus</i>   | .   | .   | . | .   | .   | . | .   | . | . | .   | III | V   | 1  | II  |
| Differential species of <i>Hyperico-Alnetum alnetosum</i> :              |     |     |   |     |     |   |     |   |   |     |     |     |    |     |
| <i>Hypericum androsaemum</i>   | V   | V   | 1 | IV  | II  | 2 | V   | 2 | . | V   | +   | .   | .  | .   |
| <i>Myosotis lamottiana</i>   | III | II  | 1 | IV  | III | 2 | III | 1 | . | I   | +   | .   | .  | .   |
| <i>Athyrium filix-femina</i>   | IV  | III | 2 | IV  | III | 1 | IV  | . | . | IV  | I   | .   | .  | .   |
| <i>Lysimachia nemorum</i>  | III | IV  | . | III | I   | 2 | .   | 2 | 1 | II  | .   | .   | .  | .   |
| <i>Dryopteris borreri</i>  | II  | .   | . | .   | II  | . | .   | 1 | . | III | .   | .   | .  | .   |
| <i>Dryopteris affinis</i>  | III | .   | . | .   | .   | 1 | II  | . | . | II  | .   | .   | .  | .   |
| Differential species of <i>Hyperico-Alnetum loniceretosum xylostei</i> : |     |     |   |     |     |   |     |   |   |     |     |     |    |     |
| <i>Lonicera xylosteum</i>  | .   | .   | . | .   | .   | 1 | .   | . | . | .   | IV  | II  | .  | I   |
| <i>Viburnum lantana</i>  | .   | .   | . | .   | .   | . | .   | . | . | .   | III | II  | 1  | II  |
| Differential species of <i>Humulo lupuli-Alnetum</i> :                   |     |     |   |     |     |   |     |   |   |     |     |     |    |     |
| <i>Fraxinus angustifolia</i>   | .   | .   | . | .   | .   | . | .   | . | . | .   | I   | IV  | 4  | IV  |
| <i>Bryonia dioica</i>  | .   | .   | . | .   | .   | . | .   | . | . | .   | .   | II  | 4  | II  |

Table 3 (cont.)

| Order no.                            | 1   | 2   | 3 | 4   | 5   | 6 | 7   | 8 | 9 | 10  | 11  | 12  | 13 | 14  |
|--------------------------------------|-----|-----|---|-----|-----|---|-----|---|---|-----|-----|-----|----|-----|
| Companion species:                   |     |     |   |     |     |   |     |   |   |     |     |     |    |     |
| <i>Angelica sylvestris</i>           | III | II  | . | IV  | V   | 1 | V   | 2 | 1 | IV  | IV  | +   | .  | .   |
| <i>Urtica dioica</i>                 | II  | .   | 1 | III | I   | 2 | I   | . | . | IV  | III | III | 3  | III |
| <i>Scrophularia auriculata</i>       | II  | IV  | 1 | III | I   | . | II  | . | . | III | II  | +   | .  | II  |
| <i>Filipendula ulmaria</i>           | III | IV  | . | .   | I   | 1 | V   | 1 | . | II  | II  | IV  | .  | I   |
| <i>Ranunculus repens</i>             | IV  | .   | 2 | .   | II  | 1 | I   | 2 | . | V   | IV  | III | .  | III |
| <i>Lamium maculatum</i>              | II  | II  | 1 | .   | +   | 1 | .   | . | . | +   | III | +   | .  | I   |
| <i>Sambucus nigra</i>                | II  | .   | . | III | I   | . | I   | . | . | II  | V   | II  | 2  | II  |
| <i>Blechnum spicant</i>              | III | IV  | 1 | .   | .   | 1 | I   | 2 | . | II  | .   | .   | .  | .   |
| <i>Ajuga reptans</i>                 | II  | .   | 2 | III | .   | 1 | .   | . | . | III | II  | I   | .  | .   |
| <i>Pteridium aquilinum</i>           | II  | .   | 1 | II  | .   | 1 | .   | . | . | III | .   | +   | .  | I   |
| <i>Geum urbanum</i>                  | III | .   | 1 | .   | III | . | III | . | . | IV  | IV  | +   | .  | .   |
| <i>Cardamine raphanifolia</i>        | III | .   | . | .   | III | 1 | .   | 2 | 1 | II  | I   | .   | .  | .   |
| <i>Cardamine pratensis</i>           | I   | .   | . | .   | .   | 1 | .   | 1 | 1 | II  | I   | +   | .  | .   |
| <i>Rubus sp.</i>                     | .   | .   | 2 | .   | IV  | 1 | .   | 2 | . | III | V   | I   | .  | .   |
| <i>Alliaria petiolata</i>            | .   | .   | . | .   | .   | 1 | III | . | . | I   | IV  | II  | 1  | IV  |
| <i>Lythrum salicaria</i>             | +   | II  | . | .   | .   | . | II  | . | . | I   | II  | III | .  | .   |
| <i>Stachys officinalis</i>           | I   | .   | 1 | .   | I   | . | .   | . | . | +   | +   | .   | .  | II  |
| <i>Prunella vulgaris</i>             | +   | .   | 2 | .   | .   | . | I   | . | . | +   | I   | II  | .  | .   |
| <i>Rubia peregrina</i>               | I   | .   | 1 | .   | .   | . | .   | . | . | +   | I   | +   | .  | II  |
| <i>Ranunculus despectus</i>          | +   | .   | 1 | .   | .   | . | .   | . | . | +   | II  | I   | .  | II  |
| <i>Silene dioica</i>                 | II  | .   | . | IV  | .   | 1 | II  | . | . | III | III | .   | .  | .   |
| <i>Poa trivialis</i>                 | III | .   | . | .   | II  | 1 | .   | . | . | +   | IV  | I   | .  | .   |
| <i>Glechoma hederacea</i>            | II  | .   | . | .   | II  | . | I   | . | . | I   | III | +   | .  | .   |
| <i>Senecio aquaticus</i>             | I   | .   | . | .   | I   | . | III | . | . | I   | II  | II  | .  | .   |
| <i>Mentha aquatica</i>               | I   | .   | . | .   | +   | . | II  | . | . | III | II  | III | .  | .   |
| <i>Galium aparine</i>                | II  | .   | . | .   | +   | . | .   | . | . | +   | IV  | II  | 3  | .   |
| <i>Equisetum arvense</i>             | I   | .   | . | .   | .   | . | I   | . | . | II  | III | III | .  | II  |
| <i>Cardamine hirsuta</i>             | .   | II  | 1 | I   | II  | . | .   | . | . | +   | II  | .   | .  | .   |
| <i>Equisetum palustre</i>            | .   | I   | . | .   | II  | 1 | I   | . | . | .   | .   | II  | .  | I   |
| <i>Aquilegia vulgaris</i>            | II  | II  | 1 | III | .   | . | .   | . | . | +   | .   | .   | .  | .   |
| <i>Ruscus aculeatus</i>              | III | .   | 1 | .   | .   | . | .   | . | . | II  | I   | +   | .  | .   |
| <i>Cruciata laevipes</i>             | I   | .   | 1 | .   | .   | . | .   | . | . | .   | +   | I   | .  | II  |
| <i>Chrysosplenium oppositifolium</i> | I   | .   | . | .   | II  | 2 | .   | 1 | . | I   | .   | .   | .  | .   |
| <i>Agrostis stolonifera</i>          | +   | .   | . | .   | .   | . | I   | . | . | I   | .   | IV  | .  | I   |
| <i>Rumex obtusifolius</i>            | +   | .   | . | .   | .   | . | .   | . | . | II  | I   | +   | 1  | .   |
| <i>Dactylis glomerata</i>            | II  | .   | . | .   | .   | . | .   | . | . | +   | II  | +   | .  | I   |
| <i>Stachys sylvatica</i>             | .   | II  | . | III | +   | . | .   | . | . | .   | II  | +   | .  | .   |
| <i>Potentilla reptans</i>            | .   | .   | 1 | .   | +   | . | .   | . | . | .   | .   | I   | 2  | I   |
| <i>Chaerophyllum hirsutum</i>        | .   | .   | . | II  | IV  | . | .   | 1 | . | I   | +   | .   | .  | .   |
| <i>Eupatorium cannabinum</i>         | .   | .   | . | .   | .   | . | II  | . | . | I   | I   | I   | .  | II  |
| <i>Calystegia sepium</i>             | .   | .   | . | .   | .   | . | I   | . | . | II  | I   | III | .  | I   |
| <i>Heracleum sphondylium</i>         | .   | .   | . | .   | .   | . | .   | . | . | +   | V   | II  | 3  | I   |
| <i>Cardamine flexuosa</i>            | I   | .   | . | .   | .   | . | .   | . | . | II  | II  | +   | .  | .   |
| <i>Castanea sativa</i>               | III | III | . | II  | .   | . | .   | . | . | I   | .   | .   | .  | .   |
| <i>Rosa sempervirens</i>             | II  | .   | 2 | .   | .   | . | .   | . | . | +   | .   | .   | .  | I   |
| <i>Teucrium scorodonia</i>           | II  | .   | 1 | .   | .   | . | .   | . | . | .   | .   | +   | .  | II  |
| <i>Equisetum telmateia</i>           | II  | .   | . | .   | I   | . | I   | . | . | II  | .   | .   | .  | .   |
| <i>Smilax aspera</i>                 | II  | .   | . | .   | +   | . | I   | . | . | +   | .   | .   | .  | .   |
| <i>Juncus effusus</i>                | I   | .   | . | .   | .   | 1 | I   | . | . | +   | .   | .   | .  | .   |
| <i>Galeopsis tetrahit</i>            | +   | .   | . | .   | .   | . | III | . | . | II  | I   | .   | .  | .   |
| <i>Agrostis capillaris</i>           | .   | .   | 2 | .   | .   | . | I   | . | . | +   | I   | .   | .  | .   |
| <i>Taraxacum officinale</i>          | .   | .   | 1 | .   | .   | . | .   | . | . | .   | I   | +   | 2  | .   |

Table 3 (cont.)

| Order no.                             | 1  | 2  | 3 | 4 | 5  | 6 | 7   | 8 | 9 | 10 | 11  | 12  | 13 | 14 |
|---------------------------------------|----|----|---|---|----|---|-----|---|---|----|-----|-----|----|----|
| <i>Hesperis candida</i>               | .  | .  | . | . | II | . | I   | . | . | .  | II  | +   | .  | .  |
| <i>Polygonum persicaria</i>           | .  | .  | . | . | .  | . | III | . | . | +  | +   | +   | .  | .  |
| <i>Lysimachia vulgaris</i>            | .  | .  | . | . | .  | . | II  | . | . | +  | II  | III | .  | .  |
| <i>Lycopus europaeus</i>              | .  | .  | . | . | .  | . | I   | . | . | II | I   | +   | .  | .  |
| <i>Buxus sempervirens</i>             | .  | .  | . | . | .  | . | II  | . | . | .  | III | II  | .  | V  |
| <i>Cardamine impatiens</i>            | .  | .  | . | . | .  | . | .   | . | 1 | .  | II  | I   | .  | I  |
| <i>Lapsana communis</i>               | .  | .  | . | . | .  | . | .   | . | . | II | I   | II  | .  | I  |
| <i>Betula celtiberica</i>             | +  | II | . | + | .  | . | .   | . | . | .  | .   | .   | .  | .  |
| <i>Primula vulgaris</i>               | II | .  | 1 | . | .  | . | .   | . | . | +  | .   | .   | .  | .  |
| <i>Asphodelus albus</i>               | +  | .  | 1 | . | .  | . | .   | . | . | +  | .   | .   | .  | .  |
| <i>Crepis lampanoides</i>             | II | .  | 1 | . | .  | . | .   | . | . | .  | II  | .   | .  | .  |
| <i>Knautia arvernensis</i>            | +  | .  | . | . | +  | . | .   | . | . | +  | .   | .   | .  | .  |
| <i>Apium nodiflorum</i>               | +  | .  | . | . | .  | . | .   | . | . | +  | .   | +   | .  | .  |
| <i>Veronica chamaedrys</i>            | II | .  | . | . | .  | . | .   | . | . | .  | III | +   | .  | .  |
| <i>Ranunculus tuberosus</i>           | .  | .  | 1 | . | II | . | II  | . | . | .  | .   | .   | .  | .  |
| <i>Galium palustre</i>                | .  | .  | 1 | . | I  | . | .   | . | . | +  | .   | .   | .  | .  |
| <i>Carex flacca</i>                   | .  | .  | 1 | . | I  | . | .   | . | . | .  | .   | I   | .  | .  |
| <i>Moehringia trinervia</i>           | .  | .  | 1 | . | .  | 2 | .   | . | . | .  | +   | .   | .  | .  |
| <i>Tritonia x crocosmiflora</i>       | .  | .  | 1 | . | .  | . | III | . | . | I  | .   | .   | .  | .  |
| <i>Hypericum tetrapterum</i>          | .  | .  | 1 | . | .  | . | .   | . | . | +  | .   | +   | .  | .  |
| <i>Buglossoides purpureo-caerulea</i> | .  | .  | 1 | . | .  | . | .   | . | . | .  | .   | +   | .  | II |
| <i>Juncus inflexus</i>                | .  | .  | . | . | +  | . | II  | . | . | .  | .   | .   | 2  | .  |
| <i>Rumex conglomeratus</i>            | .  | .  | . | . | .  | . | .   | . | . | II | I   | II  | .  | .  |
| <i>Deschampsia cespitosa</i>          | .  | .  | . | . | .  | . | .   | . | . | II | III | +   | .  | .  |
| <i>Iris pseudacorus</i>               | .  | .  | . | . | .  | . | .   | . | . | I  | +   | II  | .  | .  |
| <i>Carex elata</i>                    | .  | .  | . | . | .  | . | .   | . | . | +  | I   | III | .  | .  |
| <i>Arctium minus</i>                  | .  | .  | . | . | .  | . | .   | . | . | .  | +   | +   | 2  | .  |
| <i>Torilis arvensis</i>               | .  | .  | . | . | .  | . | .   | . | . | .  | +   | I   | .  | I  |
| <i>Brachypodium rupestre</i>          | .  | .  | . | . | .  | . | .   | . | . | .  | +   | +   | .  | I  |
| <i>Holcus lanatus</i>                 | .  | .  | . | . | .  | . | .   | . | . | .  | +   | II  | .  | II |
| <i>Phragmites australis</i>           | .  | .  | . | . | .  | . | .   | . | . | .  | .   | II  | 3  | I  |

Low frequency companion species: 1: *Anthoxanthum odoratum* II, *Astrantia major* +, *Bellis perennis* +, *Carex divulsa* +, *Fragaria vesca* +, *Juncus conglomeratus* +, *Laurus nobilis* II, *Mentha suaveolens* +, *Picris hieracioides* +, *Pimpinella major* +, *Quercus ilex* II, *Rhamnus alaternus* I, *Robinia pseudacacia* +, *Rumex acetosa* I, *Valeriana dioica* I, *Veronica beccabunga* +, *Woodwardia radicans* II, *Adiantum capillus-veneris* +, *Asplenium onopteris* +, *Brassica napus* +, *Cystopteris viridula* +, *Cytisus cantabricus* +, *Digitalis purpurea* II, *Dryopteris aemula* +, *Eucalyptus globulus* +, *Ficus carica* +, *Juncus bulbosus* +, *Luzula henriquesii* +, *Mespilus germanica* +, *Polypodium cambricum* +, *Polypodium vulgare* +, *Potentilla erecta* +, *Scabiosa columbaria* +, *Scrophularia alpestris* I, *Stegogramma pozoi* +, *Stellaria media* +, *Typha latifolia* +, *Valeriana officinalis* +, *Vandenboschia speciosa* +; 2: *Erica arborea* II; 3: *Acer campestre* pl. 1, *Anthoxanthum odoratum* 2, *Cirsium arvense* 1, *Cirsium filipendulum* 1, *Fragaria vesca* 1, *Viola gr. alba* 1, *Anagallis arvensis* 1, *Euonymus europaeus* pl. 1, *Galium saxatile* 1, *Geranium purpureum* 1, *Hypericum pulchrum* 1, *Quercus pyrenaica* 1, *Quercus robur* pl. 1, *Sambucus nigra* pl. 1; 4: *Caltha palustris* II, *Meconopsis cambrica* II, *Polygonatum multiflorum* +, *Vaccinium myrtillus* +, *Stachys alpina* +, *Vincetoxicum hirsutinaria* s.l. I; 5: *Meconopsis cambrica* I; 6: *Juglans regia* 1, *Rumex acetosa* 2, *Sparganium neglectum* 1, *Gymnocarpium* sp. 1; 7: *Cyperus eragrostis* I, *Mentha suaveolens* II, *Oenanthe crocata* IV, *Polygonatum multiflorum* I, *Cruciata glabra* I, *Datura stramonium* I, *Equisetum x moorei* I, *Geranium phaeum* I, *Salix caprea* I, *Scirpus setaceus* I, *Senecio bayonnensis* I; 8: *Valeriana pyrenaica* 1, *Carex echinata* 1, *Carex laevigata* 1, *Carex panicea* 2, *Cirsium heterophyllum* 1, *Cirsium palustre* 2, *Crepis paludosa* 1, *Lychnis flos-cuculi* 1, *Molinia caerulea* 1, *Wahlenbergia hederacea* 1; 9: *Caltha palustris* 1, *Cirsium filipendulum* 1, *Anemone nemorosa* 1, *Viola palustris* 1; 10: *Acer campestre* pl. +, *Carex paniculata* +, *Cyperus eragrostis* I, *Equisetum hyemale* +, *Juncus conglomeratus* +, *Laurus nobilis* +, *Mercurialis perennis* +, *Oenanthe crocata* +, *Phalaris arundinacea* +, *Pimpinella major* I,

*Polygonum hydropiper* +, *Quercus ilex* +, *Robinia pseudacacia* I, *Rosa* sp. +, *Sambucus ebulus* +, *Solidago virgaurea* I, *Sparganium neglectum* +, *Valeriana dioica* +, *Valeriana pyrenaica* +, *Veronica beccabunga* +, *Woodwardia radicans* +, *Alisma plantago-aquatica* +, *Asplenium trichomanes* +, *Castanea sativa* pl. +, *Chelidonium majus* +, *Erica lusitanica* +, *Impatiens balfourii* +, *Leersia oryzoides* +, *Narcissus pallidiflorus* +, *Platanus hybrida* II, *Ranunculus flammula* +, *Robinia pseudacacia* pl. +, *Sibthorpia europea* +; 11: *Acer monspessulanum* +, *Anthriscus sylvestris* III, *Astrantia major* +, *Clinopodium vulgare* +, *Epipactis helleborine* +, *Equisetum hyemale* +, *Fraxinus oxycarpa* II, *Galium elongatum* +, *Mercurialis perennis* I, *Poa annua* +, *Poa pratensis* +, *Polygonum hydropiper* +, *Populus x canadensis* II, *Quercus faginea* +, *Rosa corymbifera* +, *Rosa* sp. IV, *Rosa squarrosa* I, *Salix neotricha* II, *Salix x expectata* I, *Sisymbrium austriacum* II, *Sonchus oleraceus* +, *Thalictrum minus* +, *Tussilago farfara* +, *Vaccinium myrtillus* +, *Viola gr. alba* +, *Aconitum vulgare* I, *Allium ursinum* II, *Arrhenatherum bulbosum* +, *Astragalus glycyphyllos* +, *Campanula patula* +, *Centaurea debeauxii* +, *Colchicum autumnale* I, *Conopodium pyrenaicum* II, *Coronilla glauca* +, *Crataegus laevigata* +, *Euphorbia villosa* +, *Fagus sylvatica* +, *Fagus sylvatica* pl. +, *Festuca arundinacea* I, *Lolium multiflorum* II, *Ornithogalum pyrenaicum* +, *Plantago lanceolata* +, *Polypodium interjectum* +, *Populus alba* +, *Populus nigra* pl. +, *Prunus insititia* +, *Rhamnus catharticus* III, *Ribes alpinus* +, *Scilla lilio-hyacinthus* +, *Silene vulgaris* +, *Sorbus torminalis* +, *Thalictrum flavum* +, *Trifolium repens* I; 12: *Acer monspessulanum* +, *Anthriscus sylvestris* +, *Arbutus unedo* +, *Bellis perennis* +, *Carex divulsa* +, *Carex paniculata* +, *Cirsium arvense* II, *Epilobium hirsutum* II, *Epipactis helleborine* II, *Equisetum ramosissimum* +, *Fraxinus oxycarpa* II, *Galium elongatum* I, *Juglans regia* +, *Origanum vulgare* +, *Phalaris arundinacea* I, *Picris hieracioides* +, *Poa pratensis* I, *Populus x canadensis* II, *Quercus faginea* +, *Rhamnus alaternus* +, *Rosa corymbifera* +, *Rosa squarrosa* II, *Salix angustifolia* II, *Salix neotricha* IV, *Salix x expectata* II, *Sambucus ebulus* +, *Sisymbrium austriacum* II, *Sonchus oleraceus* II, *Tussilago farfara* +, *Viburnum tinus* I, *Agrimonia eupatoria* +, *Amelanchier ovalis* +, *Berberis cantabrica* +, *Bromus rigidus* +, *Conium maculatum* +, *Coryza canadensis* +, *Cucubalus baccifer* +, *Cynosurus echinatus* +, *Dactylis hispanica* +, *Elymus campestris* +, *Epilobium parviflorum* +, *Galium boreale* I, *Galium mollugo* +, *Lactuca virosa* +, *Lathyrus pratensis* +, *Lonicera etrusca* +, *Medicago lupulina* +, *Medicago sativa* +, *Melilotus albus* +, *Melilotus officinalis* +, *Melissa officinalis* +, *Mentha longifolia* +, *Morus nigra* +, *Orobanche hederæ* +, *Plantago major* +, *Prunus mahaleb* +, *Quercus rotundifolia* +, *Rosa agrestis* II, *Rosa micrantha* +, *Rubus sec. corylifolii* +, *Salix x erythroclados* I, *Salix x pormensis* II, *Scirpus cernuus* +, *Scirpus holoschoenus* +, *Seseli cantabricum* +, *Sinapis arvensis* I, *Spiraea obovata* +, *Tanacetum parthenium* +, *Torilis parthenica* +, *Trifolium pratense* +, *Trifolium campestre* I, *Vicia cracca* +, *Vicia nigra* I; 13: *Salix angustifolia* 3, *Dipsacus fullonum* 1, *Pastinaca sylvestris* 1, *Polygonum lapathifolium* 1, *Ranunculus bulbosus* 3, *Rosa gr. canina* 3; 14: *Arbutus unedo* II, *Clinopodium vulgare* I, *Epilobium hirsutum* II, *Equisetum ramosissimum* I, *Origanum vulgare* I, *Poa annua* I, *Solidago virgaurea* III, *Thalictrum minus* I, *Viburnum tinus* II, *Campanula rapunculoides* II, *Erica vagans* I, *Geranium columbinum* I, *Hypericum perforatum* II, *Phillyrea media* I, *Torilis nodosa* II.

Source: 1. M. Herrera, Vegetación y flora vascular de la cuenca del río Asón (Cantabria). Doctoral Thesis, tab. 72, rel. 1-5, 7-8 and 10-14 (1989); 2. M. Onaindia, Estudio florístico, fitosociológico y ecológico de la comarca de las Encartaciones y macizo del Gorbea. Doctoral Thesis, tab. 42, rel. 1-8 (1986); 3. J. Loidi & al., Los ecosistemas forestales, preforestales y pascícolas de las comarcas de Ayala, Mena y Orduña: tipificación, procesos de degradación, propuestas para su preservación, valoración naturalística, Informe final del proyecto de investigación PGV 8919, tab. 14, rel. 1-2 (1992); 4. C. Navarro, Contribución al estudio de la flora y vegetación del Duranguesado y la Busturia (Vizcaya). Doctoral Thesis, tab. 34, inv. 1-11 (1982) (*sub. Circaeo lutetianae-Alnetum*); 5. J. Loidi, Estudio de la flora y vegetación de las cuencas de los ríos Deva y Urola en la provincia de Guipúzcoa. Doctoral Thesis, tab. 40, rel. 1-12 (1983); 6. Rivas-Martínez & al., Lazaroa 6: 145, tab. 6, rel. 1-3 (1985); 7. P. Catalán, Geobotánica de las cuencas Bidasoa-Urumea (NO de Navarra-NE de Guipúzcoa). Doctoral Thesis, tab. 5, rel. 1-6 (1987); 8. J.C. Bascónes, Relaciones suelo-vegetación en la Navarra húmeda del Noroeste. Doctoral Thesis, tab. 17, rel. 1-2 (1978) (*sub. Carici laevigatae-Alnetum*); 9. S. Rivas-Martínez & al, Itinera Geobot. 5: 263, tab. 25, rel. 7 (1991); 10. Table 1: rel. 1-10; 11. Table 1: rel. 11-28; 12. Table 2; 13. J. Peralta, Suelos y vegetación de la sierra de Leyre. Doctoral Thesis, tab. 22, rel. 1-3 and 8 (1992) (*sub. Lathraeo-Populetum fraxinetosum angustifoliae*); 14. J. Loidi & al., Estudio de las comunidades forestales y preforestales de la Sierra de Lokiz (Navarra), Informe final del proyecto de investigación de interés especial para Navarra, tab. 5, rel. 1-8 (1990).



The association *Populo nigrae-Salicetum neotrichae* Rivas-Martínez and Cantó in T.E. Díaz and Penas 1987 fits into a similar syntaxonomical position; this association was described for willow-poplar forests from the rivers of the northern Meseta in the central part of the Iberian Peninsula. Although *Alnus glutinosa* is not a common tree in this association, a comparison with our alder forests is necessary because of their geographical and ecological proximity. There are only two available tables of this association in the literature (T. E. Díaz and Penas 1987, F. Navarro et al. 1987) which bear considerable quantities of *Populus alba*; this species is completely absent from *Humulo-Alnetum*. Another group of plants like *Hedera helix*, *Clematis vitalba*, *Elymus caninus*, *Iris foetidissima*, *Carex pendula*, *Salix angustifolia*, *Fraxinus oxycarpa*, *Euphorbia amygdaloides*, *Lonicera xylosteum*, *Euonymus europaeus*, *Filipendula ulmaria* and *Carex elata* can be used as differential ones as they occur in *Humulo-Alnetum* and are lacking in *Populo-Salicetum* which has a more Mediterranean character. Such differences are sufficient to distinguish them as separate associations.

Synthetic table 3 is constructed with the 111 relevés used for numerical analysis and the floristical differences between the previously discussed alder forest syntaxa are exposed. The following syntaxonomy expresses these relations:

- C. *QUERCO-FAGETEA* Br.-Bl. and Vlieger 1937
- SC. *Salici purpureae-Populenea nigrae* Rivas-Martínez and Cantó in Rivas-Martínez 1987
- O. *Populetalia albae* Br.-Bl. ex Tchou 1948
- SO. *Populentalia albae*
- A. *Populion albae* Br.-Bl. ex Tchou 1948
- SA. *Populention albae*  
*Humulo lupuli-Alnetum glutinosae* ass. nova
- SO. *Alno-Fraxinenalia excelsioris* Rivas-Martínez, Báscones, T. E. Díaz, F. Fernández González and Loidi 1991
- A. *Alno-Ulmion* Br.-Bl. and Tüxen ex Tchou 1948  
*Hyperico androsaemi-Alnetum glutinosae* (Br.-Bl. 1967) Rivas-Martínez in Loidi 1983  
*alnetosum glutinosae*  
*loniceretosum xylostei* subass. nova

## Floristic appendix

Text and tables use binomial names for subspecies; nomenclature and author citation of taxa mentioned follow Flora Europaea (Tutin et al. 1964–1980, 5 vols.) and Flora Iberica (Castroviejo et al. 1986–1993, 4 vols.) except in the following cases:

*Salix neotricha* Görz in Bol. Soc. Esp. Hist. Nat 26: 386, 1926.

*Berberis vulgaris* L. subsp. *cantabrica* Rivas-Martínez et al., Los Picos de Europa: 257, 1984.

*Fraxinus angustifolia* subsp. *oxycarpa*. Under this name have been grouped all individuals which bear intermediate features between *Fraxinus excelsior* and *F. angustifolia*.

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## Resumen

Se realiza una revisión de la sistemática de las alisedas riparias de la zona del País Vasco y alto valle del Ebro utilizando 111 inventarios repartidos por toda la red fluvial procedentes tanto de la bibliografía (69) como de muestreos realizados al efecto (42). Tras realizar un análisis numérico con ordenación (ACP) y clasificación, se han establecido tres grupos principales de inventarios: el primero correspondiente a las alisedas de la vertiente atlántica, propias de ríos con poco estiaje y aguas rápidas, un segundo grupo extendido por los territorios navarro-alaveses, de ríos con un cierto estiaje, y el tercero correspondiente a las alisedas de ríos que se adentran en la zona mediterránea. Finalmente se propone una sintaxonomía para agruparlos, en la cual se describen como nuevas la subasociación *loniceretosum xylostei*, dentro de *Hyperico androsaemi-Alnetum*, y la asociación *Humulo lupuli-Alnetum glutinosae*.

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**Appendix:** Correspondence between relevé numbers in the numerical analysis and the synthetic table

| # of order in synthetic table | Relevé # in numerical analysis   | Author  |
|-------------------------------|----------------------------------|---|
| 1                             | 67–78                            | M. Herrera (1989), tab. 72, rel. 1–5, 7–8 and 10–14 |
| 2                             | 79–86                            | M. Onaindia (1986), tab. 42, rel. 1–8               |
| 3                             | 16–17                            | J. Loidi et al. (1992), tab. 14, rel. 1–2           |
| 4                             | 5–15                             | C. Navarro (1982), tab. 34, rel. 1–11               |
| 5                             | 51–62                            | J. Loidi (1983), tab. 40, rel. 1–12                 |
| 6                             | 2–4                              | Rivas-Martínez et al. (1985), tab. 6, rel. 1–3      |
| 7                             | 87–92                            | P. Catalán (1987), tab. 5, rel. 1–6                 |
| 8                             | 49–50                            | J. C. Bascónes (1978), tab. 17, rel. 1–2            |
| 9                             | 1                                | Rivas-Martínez et al. (1991), tab. 25, rel. 7       |
| 10                            | 18–20, 34–35, 96–100             | Original relevés: Table 1, rel. 1–10                |
| 11                            | 21, 24–33, 36–37, 93–95, 101–102 | Original relevés: Table 1, rel. 11–28               |
| 12                            | 22–23, 38–48, 103                | Original relevés: Table 2                           |
| 13                            | 63–66                            | J. Peralta (1992), tab. 22, rel. 1–3 and 8          |
| 14                            | 104–111                          | J. Loidi et al. (1990), tab. 5, rel. 1–8            |