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Plant communities with *Pinus sylvestris* L. and *P. nigra* Arnold subsp. *salzmannii* (Dunal) Franco of the Spanish Sistema Central: a phytosociological approximation

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Abstract

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A phytosociological study of forests with *Pinus sylvestris* and *P. nigra* subsp. *salzmannii* of the Spanish Sistema Central has been made, establishing a comparison with 683 coniferous communities. As a result of the application of the concepts of Kopecký & Hejný (1974), Foucault (1981), Dierschke (1993) and Kopecký et al. (1995), on the relevés made following Braun-Blanquet (1964), the Vaccinio-Piceetea class and the Pinetalia sylvestris order are recognized inside the Iberian Peninsula. Moreover, the plant communities with *Echinospartum barnadesii* and *Senecio carpetanus* are interpreted as geographical races. Other aspects of the juniper communities of Junipero nanae-Cytisetum oromediterranei (subassociations, variants and relic forms) are also races. The presence of *P. nigra* subsp. *salzmannii* inside the forests of *Quercus pyrenaica* is considered as a thermic relic form, and the communities with *P. sylvestris* as altitudinal forms.

Key words: Phytosociology, multivariate analysis, Sistema Central, Iberian Peninsula, pine forests.

Introduction

In Europe the natural communities with *Pinus subsectio sylvestris* (Little & Critchfield 1969) have a boreal origin (Jan du Chene 1976, Bauerochse & Katenhusen 1997, Millar 1993). Their expansion was favoured by the glacial periods (Costa Tenorio et al. 1988, Cristina Peñalba 1994, Wilmanns 1997). Presently, *Pinus sylvestris* L. is a widely distributed species in eurosiberian Europe, with some radiations in the Mediterranean region (Hultén & Fries 1986). On the other hand, *P. nigra* Arnold, is distributed in the mountains near the Mediterranean sea (Wendelberger 1963, Blanco Castro et al. 1996), diversifying in several subspecies taxa.

Some contributions to the ecology and phytosociology of *P. sylvestris* and *P. nigra* subsp. *salzmannii* (Dunal) Franco in the Iberian Peninsula have been noted: Rivas Goday 1955, Rivas Goday & Borja Carbonell 1961, Rivas-Martínez 1963, 1964, Esteve Chueca 1973–74, Vigo 1979, Losa Quintana et al. 1986, Rivas-Martínez & Cantó 1987, Rivas-Martínez et al. 1987, 1991, Gamisans & Gruber 1988, Valle et al. 1988, Regato & Escudero 1989, Elena Rosselló & Sánchez Palomares 1991, Fernández-González 1991, Gamisans et al. 1991, Ninot 1996, Rojo y Alboreca & Montero González 1996. They have been considered for the construction of the current syntaxonomic scheme in this article.

P. sylvestris is one of the most important forest species in Spain and is widely distributed in the Sistema Central, while *P. nigra* subsp. *salzmannii* is only a relic form in this territory. As Costa Tenorio et al. (1990) comment, the interpretations of the vegetation where the former is included are much too strict if the classic aspect of the phytosociological method is considered (Rivas-Martínez 1987). Some authors point out the absence of *P. sylvestris* (Sánchez Mata 1989) in areas visited by other authors (Mancebo et al. 1993) who allege its existence, as in the case of the Gredos Mountains. The communities with *P. nigra* subsp. *salzmannii* have been known in the Sistema Central for a long time, including in the Guadarrama Mountains (Gómez Manzaneque 1988, Regato et al. 1992). However, there has been no phytosociological interpretation (Rivas-Martínez 1975, Regato et al. 1995).

The aim of the present study is precisely to show a new phytosociological approximation which explains the ecology of these communities with *P. sylvestris* and *P. nigra* subsp. *salzmannii* in the Sistema Central, in the context of the coniferous European forests.

Phytogeography of the area studied

The Sistema Central are the siliceous Paleozoic mountains which go through the Iberian Peninsula (Fig. 1), from W-SW to E-NE from the Estrela Mountains (Portugal) to the Ayllón and Las Cabras mountains (Guadalajara-Segovia-Soria, Spain). The highest peaks are: Estrela (1891 m), La Ceja (2425 m), Peña de Francia (1723 m), Calvitero (2401 m), Pico de Almanzor (2592 m), Cabeza de Hierro (2383 m), Pico de Peñalara (2489 m), Ocejón (2058 m) and Pico del Lobo (2273 m).

The Sistema Central belongs to the Iberomarroqui-Atlantica superprovince (Pérez Latorre et al. 1996, Deil & Galán de Mera 1998). This encompasses the areas of the Iberian Peninsula and northern Africa with Atlantic-Mediterranean climatic regime (Gaussen et al. 1958), according to the distribution of Atlantic elements in northern Africa (Dahlgren & Lassen 1972). This superprovince is a migratory space of Atlantic eurosiberian species to the southern Iberian Peninsula and northern Africa. From the 8 provinces in which this wide Iberic-Northafrican territory is divided (Carpetano-Iberico-Leonesa, Luso-Extremadurense, Tingitano-Onubo-Algarviense, Betica, Rifeña, Atlasica, Atlantica and Sud-Occidental), our area studied is encompassed in the Carpetano-Iberico-Leonesa province (Sistema Central, León, Orense and Soria mountains). This province is divided into various sectors (Rivas-Martínez et al. 1990): A – Guadarramico sector (Guadarrama Mountains), B – Bejarano-Gredense sector (Bejar and Gredos mountains), C – Salmantino sector (Peña de Francia and plains of Salamanca) and D – Estrellense sector (Estrela Mountain). The localities where relevés have been made are included in the Guadarramico and Bejarano-Gredense sectors (Fig. 1).

Following the bioclimatic classification of Rivas-Martínez et al. (1991), the data obtained from Müller (1982), and the National Institute of Meteorology (Spain), and the discriminatory indexes, Summer and Winter Humidity of Galán de Mera et al. (1995), the Sistema Cen-

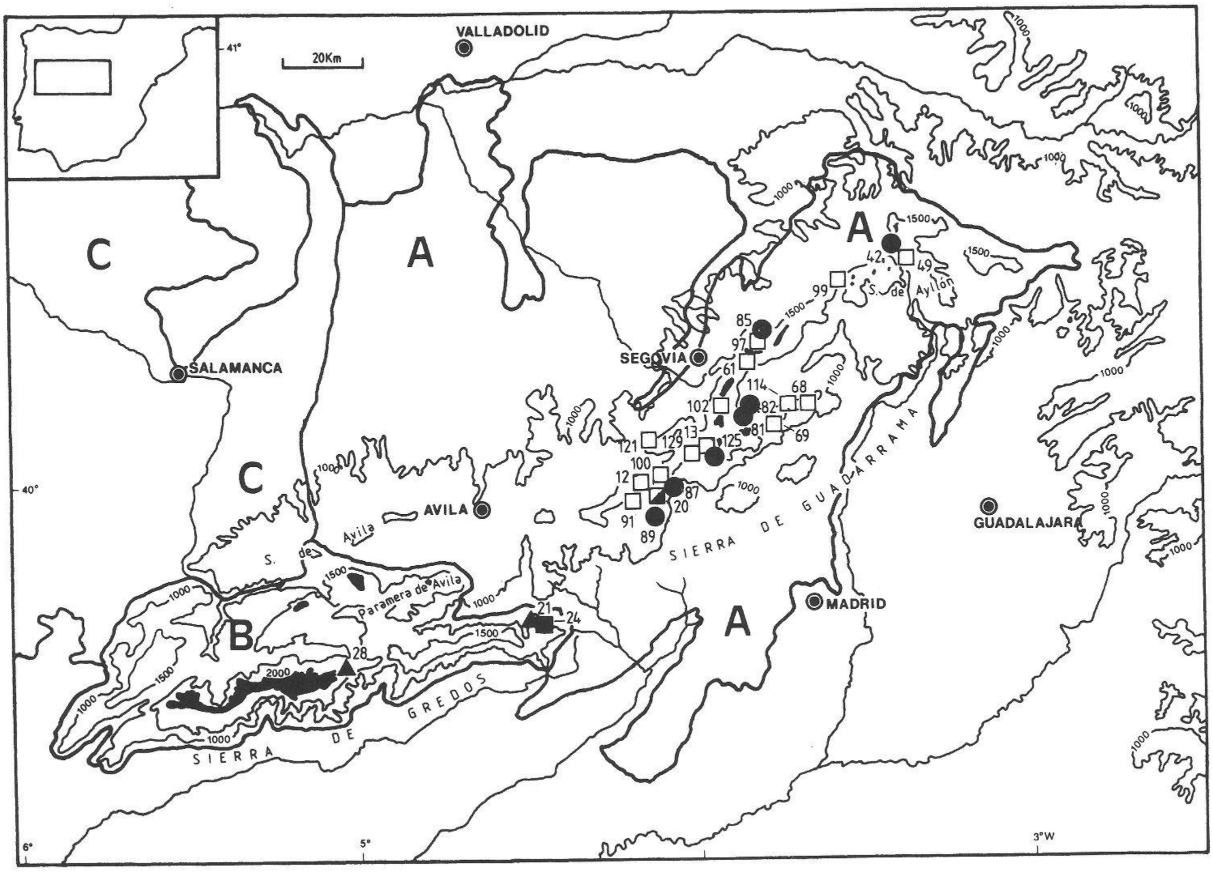

Fig. 1. Map of the Spanish Sistema Central , phytogeography and localities studied (following several references and relevés made by the authors). Symbols: □ Junipero nanae-Cytisetum oromediterranei geographical race with *Senecio carpetanus* pinetosum sylvestris, ▲ Junipero nanae-Cytisetum oromediterranei geographic race with *Echinospartum barnadesii* pinetosum sylvestris altitudinal form with *Pinus nigra* subsp. *salzmannii*, ● *Pinus sylvestris* DC, ◪ *Luzulo forsteri-Quercetum pyrenaicae* relic form with *Pinus nigra* subsp. *salzmannii*, ■ *Genisto falcatae-Quercetum pyrenaicae* relic form with *Pinus nigra* subsp. *salzmannii*. The numbers indicate the relevés of Table 3. A – Guadarramico sector, B – Bejarano-Gredense sector, C – Salmantino sector.

tral is included in the Mediterranean Region (Table 1), which ranges from subhumid to hyperhumid (Table 2).

The diagonal position which the Sistema Central presents in the Iberian Peninsula implies different perception of temperature and rainfall in the mountains, depending on the localities. The Gredos Mountains and the northern slopes are more influenced by the Atlantic disturbances. Moreover, the Ayllón Mountains receive the rainfall of the Mediterranean summer-autumm low pressures as a consequence of their distance from the Azores anticyclone (Capel Molina 1981). This causes the southern slopes of the Guadarrama Mountains to be the driest and also the most continental, because of the higher contrast between temperatures. Therefore, this is the area of wide distribution of *P. sylvestris*. However, *P. nigra* subsp. *salzmannii* is only found in the Gredos Mountains and some western sites of the Guadarrama Mountains because of its high thermic exigences. The bioclimatic belts are displaced in the Sistema Central because of the thermic differences between the slopes. Thus, for example, on the southern slope of the Guadarrama Mountains, the Oromediterranean belt extends from 1500 to 2300 m, while on the northern slope it descends to 1300 m.

Table 1. Values of the summer (HE) and winter (HI) humidity indexes in European meteorological stations and of the Sistema Central. Eurosiberian Region PI > PE/HE > 1; Mediterranean region PI > PE/HE < 1; $HI = \Sigma_{D\text{-}M}(P + HR/ETP)$; $HE = \Sigma_{J\text{-}S}(P + HR/ETP)$; P: rainfall in mm, HR: relative humidity of the air in %, ETP: potential evaporation in mm.

METEOROLOGICAL STATION	ALTITUDE (m)	P(D,Jan,F,M)	P(J,J,A,S)	HR(D,Jan,F,M)	HR(J,J,A,S)	ETP(D,Jan,F,M)	ETP(J,J,A,S)	HI	HE	CLIMATE TYPE AND PLANT FORMATIONS
Madrid (Spain), 40°25'N/3°41'W	667	165	85	298	208	66	479	7,0	0,6	Mediterranean, Sclerophyllous vegetation
Lyon (France), 45°43'N/4°57'E	200	208	323	324	279	57	453	9,3	1,3	Temperate climate, Deciduous forests
Genéve (Switzerland), 46°12'N/6°09'E	405	233	346	319	282	37	417	14,9	1,5	Temperate climate, Deciduous forests
Zürich (Switzerland), 47°23'N/8°34'E	569	275	518	312	276	25	399	23,5	1,9	Temperate climate, Deciduous forests
Stuttgart (Germany), 48°42'N/9°12'E	401	161	311	324	301	39	422	12,4	1,4	Temperate climate, Deciduous forests
Nürnberg (Germany), 49°30'N/11°06'E	310	159	282	328	292	23	412	21,2	1,4	Temperate climate, Deciduous forests
Praha (Czech Republic), 50°05'N/14°25'E	197	96	251	335	288	19	430	22,7	1,3	Temperate climate, Deciduous forests
Dresden (Germany), 51°07'N/13°41'E	246	148	297	318	292	22	407	21,2	1,4	Temperate climate, Deciduous forests

Table 2. Climatic values of some meteorological stations near the localities studied with *Pinus sylvestris* and *P. nigra* subsp. *salzmannii*. Symbols: A = altitude of the meteorological station (m), It = thermicity index (T + M + m) 10, T = annual mean temperature (°C), M = maximal mean temperatures of the coldest month (°C), m = minimal mean temperature of the coldest month (°C), P = annual mean rainfall (mm), H = number of days with sure frost, N = number of days with snow covering, * Only pluviometric stations.

METEOROLOGICAL STATION	A	It	T	M	m	P	H	N	BIOCLIMATIC DIAGNOSIS
Cerezo de Arriba "Gran Plato" (Segovia)	1880	83,1	7,0	3,5	-2,2	1218,4	36	30 – 31	Oromediterranean humid
Puerto de Navacerrada (Madrid)	1890	48,7	6,2	1,9	-3,3	1335,4	45	115 – 116	Oromediterranean humid
Cercedilla "Fuenfria" (Madrid) *	1350	—	—	—	—	1121,3	—	6 – 7	Humid
Guadarrama (Madrid)	981	107,8	6,7	5,7	-1,7	655,3	15	4 – 5	Supramediterranean subhumid
Valle de los Caidos (Madrid) *	1300	—	—	—	—	980,5	—	16 – 17	Subhumid
Navalperal de Pinares (Ávila) *	1287	—	—	—	—	704,7	—	7 – 8	Subhumid
San Bartolomé de Pinares (Ávila) *	1150	—	—	—	—	416,9	—	39	Dry
Serranillos (Ávila) *	1235	—	—	—	—	1366,6	—	8	Humid
Puerto del Pico (Ávila) *	1395	—	—	—	—	946,8	—	11 – 12	Subhumid
Embalse La Jarosa (Madrid)	1060	165	10,7	7,1	-1,3	938,6	9 – 10	3 – 4	Supramediterranean subhumid
Navarredonda de Gredos (Ávila)	1525	119	8,5	5,9	-2,5	828,4	37	22 – 23	Supramediterranean subhumid

Materials and methods

Treatment of the data.

The present study is based on 683 phytosociological relevés made following the method of Braun-Blanquet (1964). These relevés are located in the mountains of western Europe and northern Africa, to establish a comparison with those of the Sistema Central. From these relevés, 131 correspond to the area studied, and are represented in Table 3. Table 5 is a synthetic table of the communities of the *Vaccinio-Piceetea* class in western Europe and northern Africa, with the different species of *Pinus* of the mountain pine groves of the Iberian Peninsula (*P. sylvestris*, *P. nigra* subsp. *salzmannii* and *P. uncinata*). The references of Table 3 are in Table 4, and those of Table 5 in Table 6.

We have made statistical analyses of Tables 3 and 5, with the SYN-TAX program (Podani 1994). Dendrograms to observe the degree of similarity between relevés were obtained applying the Jaccard index (1929) (Figs. 2 and 3). After this, the tables were put in order considering the relationship between relevés, to study the ecological and phytosociological behaviour.

Phytosociological treatment

The conceptual treatment of the phytosociological association and its subdivision made by the Iberian phytosociologists have limited ecological facts to a rigid syntaxonomic scheme and forced the placing of some plant communities in specific associations. The same occurs with the subassociation, which, since its definition by Braun-Blanquet (1964), has been interpreted in several ways. It has been used to design altitudinal, geological, ecological and edaphic variations. These induce us to consider the studies of Kopecký & Hejný (1974), Foucault (1981), Dierschke (1993) and Kopecký et al. (1995), which explain the basal community (BC) and derived community (DC) concepts. A basal community is a plant community sited in anthropogenic places and colonized by plants of the highest syntaxonomic unities. The derived community means the invasion of one association by plants different from the characteristic ones, and whose number decreases considerably because of a derived change in human activity. The concept of relic form (as opposed to normal historic form), given by Schuhwerk (1990), is used to distinguish small regions with critical plants which lend a historic and ancestral aspect to the association, for example, the result of a low exposure to past glacial periods (Ojeda et al. 1995). This concept was used in Spain to explain some aspects of the Aragonese relic vegetation (Montserrat 1975), without, however, a phytosociological viewpoint.

The interpretation of the variability of the association by Matuszkiewicz (1981) leads us to define the meaning of subassociation more accurately. This author considers vegetation as a relative continuum and concludes that the association has 3 variants (Fig. 5): 1 – horizontal-referring to the geographical races, 2 – vertical-referring to the altitudinal forms, and 3 – local-referring to the edaphic differences, considering this as the concept of subassociation.

Results and discussion

Vaccinio-Piceetea and Pino-Juniperetea

The Vaccinio-Piceetea class encompasses the coniferous forests and the heaths with boreal origin, characteristic of continental areas (Julve 1993, Ellenberg 1996). According to Rivas-Martínez et al. (1991), they were developed in northeastern Europe and the southern Alps after the Tardiglacial, as a wooded tundra. Braun-Blanquet et al. (1952) and Rivas Goday & Borja Carbonell (1961) consider that this phytosociological class exists inside the Iberian Peninsula. Rivas-Martínez (1963) maintains that the pine groves of the Sistema Central do not belong to the Vaccinio-Piceetea, and have to be included in the Cytision oromediterranei alliance because of the importance of the Genisteae in our mountains and the impoverishment in some characteristic plants of the class. Later Rivas-Martínez (1964) created the Pino-Juniperetea class to isolate the Mediterranean pine groves from the centereuropean ones.

Table 3. Relevés of the Sistema Central with *Pinus sylvestris* and *P. nigra* subsp. *salzmannii*. Symbols: AS = association, VA = variant of association, SA = subassociation, AL = alliance, O = order, CL = class, DC = derived community.

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Relevé number                      1                   11                        1 1 1    11111111111 1     11       1          11111111111
                     34444618888883333      4444 99999990011112 2222222223323333115151616699900000101011 011 5611141565277774567822222332222567557756767888
                     15168727146523697836752534202145634867890431724569208134350516185689702136370912850293749194532717830909014689012305445784669280798

Altitude             11111111111111111111111111111111111111111111111111112212111111122111111111122211112111112111111111111211211111111111111111
                     7447887765567644447777666677767667782222272313111555553577339299999987007767887878011995509799909887489987680991676588877778887726 5
                     169983550283176755000019220006194350111220272660034304940700085513132959006358800610099221020382005680550085355053646265858500293 05
                     5555500000000000550000550050000000000550500000050005000050000000000000000000000000000050000000050000000000000000000000000000000000

Area (m²)            11111111111111 11 1  11111511  1 1  112121111111111111111 12  11          1 1 1  111 1 225   1211 211  1111111 12 11 1  2   1111 111  1
                     0000000000000050050550000000005205055000000000000000000002003300445555402050550005050004450000600056200000070080080880343505032006505
                     000000000000000000000000000000000000000000000000000000005000000000000000000000000000000E000000000000000050000000000000000000000000000

Orientation                                                                                                                       N          NNNNEEN E
                       NN NNN N  SS  SS     NNN S  SSS        N SN N N  SS SNS N    NN    S                  SSS    NNSSS  N  NNNNNNNN N N S S S  SSNS  S
                     -NEWNWEEWWESEESSEE----NWWW-OSSWWWWNSNNNNW-EWNWNWNSEESEEEWWSSSSEESSSSENESNESSSNWS-NWS-SEEENNWSSOEEEEENEEEEEWWEEEWWEEWSWSESESESEWWWWESE

Junipero nanae-Cytisetum oromediterranei AS
pinetosum sylvestris SA
Deschampsia flexuosa iberica    321...22222112...........1222122112.1121........11+1...1133222222222322222322222.+...33++..1222322331211213333333221232232322232...
Juniperus communis              .13.2222+...1+.+.1.2+.1....21+21.221.....+........11.1..1155444333333222433332332543422334212331222222442232333333313++21111+.+.....
Cytisus balansae europaeus      ..123411....11+++.................1........121...33333..44..2+..33332213.31.+.32.+3333322234433333433143343233223322332323234 2334..1
Luzula lactea                   4.112111121.11111...2.....+2.2221+.2..++1.....11.....................1...121.1221.....2211...+..2.+..11111212.111..112122121+1211...
Deschampsia flexuosa s. str.    ...11..................22.+......................................................2....................................
Geographic race with Senecio carpetanus
Senecio carpetanus              ...+..++..............................................1........+1..........11.........+..+.++..+..+....++.....+.+...........
Geographic race with Echinospartum barnadesii
Festuca elegans                 ..................................+1...........2211134.................................................................
Festuca summilusitana           ..............................................221321..................................................................
Echinospatum barnadesii         ..............................................11.11...................................................................
Linaria nivea VA
Linaria nivea                   ..........+..........................................+.......1+.++..1..........+.........111.++11+.....+........+1..+.1111.++++...
Digitalis purpurea s. str.      ...........................................................................................+.+++.+........+....++.1..............
Koeleria and Corynephorus VA
Koeleria crassipes              +.................1.+.....11.++......1....+11..+...........................................+..............................
Stipa gigantea                  ..................+.......12.2111...+.....................................................................................1.+
Corynephorus canescens          ................................................111.2.....................................................................
Relic form with Vaccinium myrtillus
Vaccinium myrtillus             ........................1...................................................................1...................11.................
Altitudinal form with Pinus nigra salzmannii
Relic form with P. nigra salzmannii
Pinus nigra salzmannii          .................................12232.333313312111++.....................................................................
Luzulo forsteri-Quercetum pyrenaicae AS
Quercus pyrenaica               ........21.+44.....................+11++....+.............................................................................+.+
Luzula forsteri                 ........+1................................................................................................................
Festuco heterophyllae-Quercetum pyrenaicae AS
Festuca heterophylla            ...+.................1....................................................................1+..+.2222.....................
Pseudarrhenatherum longifolium  .......................................................................................+..........++....2..1..............
Polytrichum juniperinum         .......................................................................................+..........1..1...2...............
Agrostis alpina                 ..............................................................................................++++.......................
Genisto falcatae-Quercetum pyrenaicae AS
Genista falcata                 ...............................................312.......................................................................
Pinus sylvestris DC
Pinus sylvestris                1334234445553234321114444431212311 22+.+111+......11+.++.1+++++1133333+++211++11++211122222111221332443222244545334455333 5454+4442+++
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Table 3. (continued)

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Relevé number                        1                          11                       1 1 1     11111111111 1     11      1         11111111111
                              34444618888883333    4444 99999990011112 22222222332333115151616699900000101011 011 5611141565277774567822222332222567557756767888
                              15168727146523697836752534202145634867890431724569208134350516185689702136370912850293749194532717830909014689012305445784669280798

Arctostaphylos uva-ursi       ..................2.......2443333315243443..............................1133241+32.................................................
Halimium umbellatum viscosum  ..................3111....22233232231.2.................................+++21211....................+..............................
Pteridium aquilinum           ........222312..23........4...............2..1224.....2..................................................++.....+.22............324
Galium rotundifolium          ......11212311..................................1.............112121...............................1......+.....2+11...............
Cistus laurifolius            ..........................122121....31113..........................................................................................
Querco-Fagetea CL
Genista florida               ........221..1...2.....+................+.............+..................................................11.....1111............423
Genista cinerea               ..........+.......+....1...+.+21....1111.1........+...1................................11........................................2.
Veronica officinalis          ....1...121.1+.........1.+.........................................................................................................
Viola riviniana               ......11+1.1..................................................++...................................................................
Poa nemoralis                 .......11+1111.....................................................................................................................
Clinopodium vulgare arundanum ........+.1..1..........+.................+.....1..................................................................................
Viola odorata                 ...........+..........2111.........................................................................................................
Populus tremula               ......22......................................................++...................................................................
Galium rivulare               ......++......................................................++...................................................................
Rubus idaeus                  .....++..............................................................................................2..2..........................
Sanicula europaea             ........111........................................................................................................................
Holcus mollis                 ........12.2.......................................................................................................................
Melica uniflora               .......................121.........................................................................................................
Rosa corymbifera              .................1..............................................................................................................1.+
Fragaria vesca                ......................2..2.........................................................................................................
Campanula rapunculoides       ......................1.1..........................................................................................................
Helleborus niger              ......................+..1.........................................................................................................
Aconitum napellus castellanum ........................1+.........................................................................................................
Athyrium filix-femina         ........................11.........................................................................................................
Betula pendula                ........................++.........................................................................................................
Rosa tomentosa                .......................+.+.........................................................................................................
Sorbus aucuparia              ........+...+......................................................................................................................
Crataegus monogyna            .........................+................+........................................................................................
Hepatica nobilis              .........................1.........................................................................................................
Geum sylvaticum               ...........................................+.......................................................................................
Rosa micrantha                ...........+.......................................................................................................................
Origanum vulgare              ................................................+..................................................................................
Paris quadrifolia             .........................+.........................................................................................................
Conopodium filifolium         ....................................................................................................+..............................
Rubus ulmifolius              ..........................................1........................................................................................
Brachypodium sylvaticum       ................................................+..................................................................................
Rosa canina                   .................................................................................................................................+.
Mosses and lichens
Hypnum cupressiforme          .1.............1......21.1................................................................1........................................
Moss                          ..1...........1.11..................................................................................1..............................
Dicranum pellucidum           .11.................................................................................................1..............................
Pseudoevernia furfuracea      ................+1..................................................................................+..............................
Bartramia halleriana          ...............11..................................................................................................................
Polytrichum sp.               ..........................................................................................1........................................
Polytrichum piliferum         ....................................................................................................1..............................
Cladonia furcata              ..........................................................................................+........................................
Cladonia fimbriata            ................1..................................................................................................................
Companions
Erica arborea                 ...122.2..+.1+.....432.3331+.1.11333..1..........11..1+..................++22+232....+...4..........2112...+1+...+1................
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Table 3. (continued)

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Relevé number                          1                          11                       1 1 1     11111111111 1     11      1         11111111111
                                 34444618888883333    4444 99999990011112 22222222332333115151616699900000101011 011 5611141565277774567822222332222567557756767888
                                15168727146523697836752534202145634867890431724569208134350516185689702136370912850293749194532717830909014689012305445784669280798

Avenula sulcata s.str.          111.+.....+...1...1.+......12121111211111+..+1111.......................1..11..........................................1111111111..
Arenaria montana                +11211111111221111....11.......................++...............1212.1.....................1......+1.+..++......2132...............
Rumex angiocarpus               212+11++++....11.1...1...................+.+++....+.+++.11......................+..........1.+....+....................++++........
Festuca indigesta aragonensis   ..................................+.....................1111.2..........+211112111.+11111...1...11..+......................1+.21...
Agrostis castellana             ...+.1......11111......1.1...................+1..............+.1......................+.........+++1+..11............12..+1.++.+11.
Arrhenatherum album             ......1.1.+1+1............................+.............1...+.1.12.........................112..2112................1211212111.1...
Thymus bracteatus               ...........................22121+212....................................1112.222.2.................................................
Nardus stricta                  ..............................................................++..................1......+..1.++11.1....12122+.....................
Adenocarpus hispanicus          ...+.............+..............................................12122113...........1.........1............1.....................232
Conopodium pyrenaeum            ......++11+1....................121.....................................+....111..............+....................................
Hieracium pilosella             ...............+...................................1......................................+.....++..........+11++++....+.+.........
Lavandula pedunculata           ..................2........1+.+1+...+++++..1+2.....................................................................................
Jasione laevis carpetana        ..............................................................................................111111.....+..222212.2...............
Carduus carpetanus              .+.............+....++..+++...........................++................+1..+..+...................................................
Solidago virgaurea              ..+..+...................+...................................1............+..+...+...+.........1......++.............+.............
Agrostis capillaris             ..............................................................1.....1111.............+......+........11.............2..+1..........
Rumex acetosella                ...............................................................................................+.........++21+++11+1...............
Leucanthemopsis pallida alpina  ........................................................12........................+...+..+.1................2211.........+.........
Lactuca viminea                 ........+..+++......................................+..+..........................................+......................+1.+1.....
Cerastium gracile               ...............................................................................................+.........++211+1+.1................
Thymus praecox                  ..1...........21..121................+...+......................................2...................1..............................
Pinus pinaster                  ....................................111....111112.....1............................................................................
Hypochaeris radicata            ....+.............+.+..+.....................+++.......+...........................+...............................................
Cytisus scoparius               ..........+..+................................1++...............................................................................21+
Agrostis tenuis                 .........................................................................................................111.+2+..11...............
Arrhenatherum elatius s.l.      .......1.......................................................1..1222.1...........................................................
Hieracium vahlii                2........................................+................++.1...........................1.........................................
Cruciata glabra                 ......++11.1..........................................................................................+............................
Festuca iberica                 ........++..................................................+1..................................1+.................................
Agrostis delicatula             ...........................................+.....12.............................................+++................................
Hieracium castellanum           ........................................................................................+.......111.........................+..1...
Sedum forsteranum               ........11.........................+...1................................+....1.....................................................
Jasione montana echinata        ..........................1.........1..........+++..+..............................................................................
Helianthemum apenninum          ...................+.......11..+.............1.....................................................................................
Teucrium scorodonia             ..........+.21...........1.........................................................................................+...............
```

Further do occur:
Erica australis 45:2, 46:+, 48:+, 62:1; Festuca ampla 35:2, 59:1, 58:1, 61:2; Leontodon crispus bourgeanus 50:+, 76:+, 101:+, 115:+; Sedum brevifolium 13:1, 123:+, 127:+, 130:+; Gagea guadarramica 11:+, 124:+, 125:1, 129:+; Crocus carpetanus 3:+, 71:+, 77:+, 78:+; Leontodon carpetanus 128:+, 129:1, 130:1, 131:+; Armeria caespitosa 128:+, 129:+, 130:+; Omalotheca sylvatica 82:1, 83:1, 123:1; Cladonia pyxidata 122:1, 123:1, 131:1; Lactuca chondrillifolia 57:+, 58:1, 120:+; Dianthus laricifolius 103:1, 105:1, 109:+; Leucanthemopsis pallida s. str. 94:+, 95:+, 96:1; Gentiana lutea 10:2, 78:+, 102:+; Carex muricata 82:+, 83:1, 86:+; Centaurea alba 18:+, 19:+, 55:+; Thymus zygis 21:+, 22:1, 27:+; Urtica dioica 23:+, 43:1, 44:1; Rosa sp. 23:+, 24:+, 53:+; Jurinea humilis 61:1, 103:1, 106:1; Ranunculus olissiponensis s. str. 120:+, 123:+; Senecio sp. 43:+, 47:1; Oxalis corniculata 43:1, 44:1; Senecio jacobea 58:+, 59:1; Thymus mastichina 51:1, 55:2; Picris hieracioides 45:+, 46:+; Dactylis glomerata 26:1, 85:+; Festuca rothmaleri 81:2, 84:1; Festuca aggr. rubra 82:+, 83:1; Acinos alpinus meridionalis 82:+, 83:+; Orobanche rapum-genistae 14:+, 128:+; Rubus sect. Histrices 82:2, 83:1; Geranium robertianum 85:+, 86:+; Narcissus rupicola 9:+, 12+; Sedum album micranthum 109:+, 110:+; Ranunculus olissiponensis alpinus 4:+, 5:2; Cytisus striatus 55:3; Paeonia broteroi 26:+; Potentilla micrantha 85:+; Quercus rotundifolia 2:1; Galeopsis ladanum 82:+; Mucizonia sedoides 49:1; Blechnum spicant 44:1; Lapsana communis 62:1; Epilobium lanceolatum 81:+; Conopodium majus burgaei 122:1; Cytisus multiflorus 55:2; Juncus inflexus 3:+; Arenaria querioides 52:+; Silene saxifraga 49:+; Taraxacum sroeteranum 12:+; Saxifraga willkommia 116:+; Holcus setiglumis 44:+; Viola sp.? 47:+; Sedum hirsutum 51:+; Avenula sulcata albinervis 58:1; Pentaglottis sempervirens 85:1; Andryala integrifolia 25:+; Geranium purpureum 23:1; Thlaspi stenopterum 5:+; Juncus conglomeratus 44:+; Artemisia glutinosa 45:+; Spergula morisonii 51:+; Pinus pinaster (joung) 25:4; Jasione crispa centralis 10:+; Festuca costei 5:3; Scutellaria minor 44:1; Calluna vulgaris 45:1.

Table 4. References of the relevés of Table 3.

1, 2. Relevés of the authors. Valle de Enmedio, Malagón Mountain, Ávila

3-8. Relevés of the authors. Cueva Valiente, Malagón Mountain, Ávila

9-12. Relevés of the authors. Peñalara, Guadarrama Mountains, Madrid

13, 14. Relevés of the authors. Puerto de Navacerrada, Guadarrama Mountains, Madrid

15. Relevés of the authors. Bola del Mundo, Guadarrama Mountains, Madrid

16-20. Relevés of the authors. Calle de los Álamos, Guadarrama Mountains, Madrid

21-27. Relevés of the authors. Cabeza de la Parra, Gredos Mountains, Ávila

28-34. Relevés of the authors. El Arenal, Gredos Mountains, Ávila

35-41. Relevés of the authors. Los Leones, Guadarrama Mountains, Madrid-Segovia

42-49. Relevés of the authors. La Pinilla, Ayllón Mountain, Segovia

50. Rivas-Martínez et al. (1987). Peñalara, Guadarrama Mountains, Madrid

51. Rivas-Martínez et al. (1987). Cerro del Telégrafo, Guadarrama Mountains, Madrid

52. Rivas-Martínez et al. (1987). From Valdesquí to Valdemartín, Guadarrama Mountains, Madrid

53. Rivas-Martínez et al. (1987). Pico del Nevero, Guadarrama Mountains, Madrid

54, 97. Rivas-Martínez et al. (1987). Puerto de Navafría, Guadarrama Mountains, Madrid

55. Rivas-Martínez et al. (1987). Lomo del Noruego, from Cotos to Valdesquí, Guadarrama Mountains, Madrid

56. Rivas-Martínez et al. (1987). From puerto de la Morcuera to Las Najarras, Guadarrama Mountains, Madrid

57, 58. Rivas-Martínez et al. (1987). Puerto de Navafría, Guadarrama Mountains, Madrid

59, 60, 62. Rivas-Martínez et al. (1987). Circo de Hoyo Cerrado, Peñalara, Guadarrama Mountains, Madrid

61. Rivas-Martínez et al. (1987). El Nevero, Guadarrama Mountains, Madrid

63, 65, 66, 98. Fernández-González (1991). Puerto de Cotos, Guadarrama Mountains, Madrid

64, 73-76. Fernández-González (1991). Puerto de Navafría, Guadarrama Mountains, Madrid

67, 118. Fernández-González (1991). El Nevero, Guadarrama Mountains, Madrid

68. Fernández-González (1991). Northern slope of Mondalindo, Riofrío, Guadarrama Mountains, Madrid

69, 70, 72. Fernández-González (1991). Puerto de la Morcuera, Guadarrama Mountains, Madrid

71, 77. Fernández-González (1991). Lomo del Noruego, from Cotos to Valdesquí, Guadarrama Mountains, Madrid

78. Fernández-González (1991). From Cotos to Valdesquí, Guadarrama Mountains, Madrid

79, 80, 117. Fernández-González (1991). Circo de Hoyo Cerrado, Guadarrama Mountains, Madrid

81, 84. Fernández-González (1991). Cabeza Mediana, Guadarrama Mountains, Madrid

82, 83. Fernández-González (1991). Southern slopes of Los Pájaros, Guadarrama Mountains, Madrid

85. Fernández-González (1991). From Lozoya to Navafría, Guadarrama Mountains, Madrid

86. Fernández-González (1991). Arroyo de las Guarramillas, Cotos, Guadarrama Mountains, Madrid

87. Rivas-Martínez and Cantó (1987). Tablada, Malagón Mountain, Madrid

88, 90. Rivas-Martínez and Cantó (1987). Cabeza de Líjar, Malagón Mountain, Madrid

89. Rivas-Martínez and Cantó (1987). Abantos, Malagón Mountain, Madrid

91. Rivas-Martínez and Cantó (1987). Pinares Llanos, Malagón Mountain, Madrid

Table 4. (continued)

92, 94. Rivas-Martínez and Cantó (1987). Collado de la Mina, Guadarrama Mountains, Madrid

93. Rivas-Martínez and Cantó (1987). La Salamanca, Guadarrama Mountains, Madrid

95. Rivas-Martínez and Cantó (1987). Collado del Hornillo, Malagón Mountain, Ávila

96. Rivas-Martínez and Cantó (1987). Cueva Valiente, Malagón Mountain, Ávila

99. Rivas-Martínez et al. (1987). Somosierra, Guadarrama Mountains, Madrid

101. Rivas-Martínez et al. (1987). Hoyo de Pepe Hernando, Peñalara, Guadarrama Mountains, Madrid

102. Rivas-Martínez et al. (1987). Dos Hermanas, Peñalara, Guadarrama Mountains, Madrid

103, 113. Rivas-Martínez et al. (1987). La Salamanca, Guadarrama Mountains, Ávila

104, 105, 107-110. Rivas-Martínez et al. (1987). Cueva Valiente, Malagón Mountain, Ávila

106. Rivas-Martínez et al. (1987). Collado de la Mina, Guadarrama Mountains, Madrid

100, 111, 112. Rivas-Martínez et al. (1987). Cabeza de Líjar, Malagón Mountain, Madrid

114. Rivas-Martínez et al. (1987). From puerto de Canencia to Collado Cerrado, Guadarrama Mountains, Madrid

115. Fernández-González (1991). Peñalara, Guadarrama Mountains, Madrid

116. Fernández-González (1991). Dos Hermanas, Guadarrama Mountains, Madrid

119. Fernández-González (1991). From puerto de Canencia to Collado Cerrado, Cotos, Guadarrama Mountains, Madrid

120. Rivas-Martínez (1963). Collado Albo, Guadarrama Mountains, Madrid

121. Rivas-Martínez (1963). Barranco del río Moro, Guadarrama Mountains, Segovia

123. Rivas-Martínez (1963). Puerto de la Fuenfría, Guadarrama Mountains, Madrid

124. Rivas-Martínez (1963). Puerto de Navafría, Guadarrama Mountains, Madrid

125. Rivas-Martínez (1963). El Ventorrillo, Guadarrama Mountains, Madrid

126. Rivas-Martínez (1963). Puerto de Cotos, Guadarrama Mountains, Madrid

127. Rivas-Martínez (1963). Dos Hermanas, Peñalara, Guadarrama Mountains, Madrid

128. Rivas-Martínez (1963). Western slope of Siete Picos, Guadarrama Mountains, Madrid

129. Rivas-Martínez (1963). Eastern slope of Siete Picos, Guadarrama Mountains, Madrid

130. Rivas-Martínez (1963). Northern slope of Cerro del Telégrafo, Guadarrama Mountains, Madrid

131. Rivas-Martínez (1963). Northern slope of Siete Picos, Guadarrama Mountains, Madrid

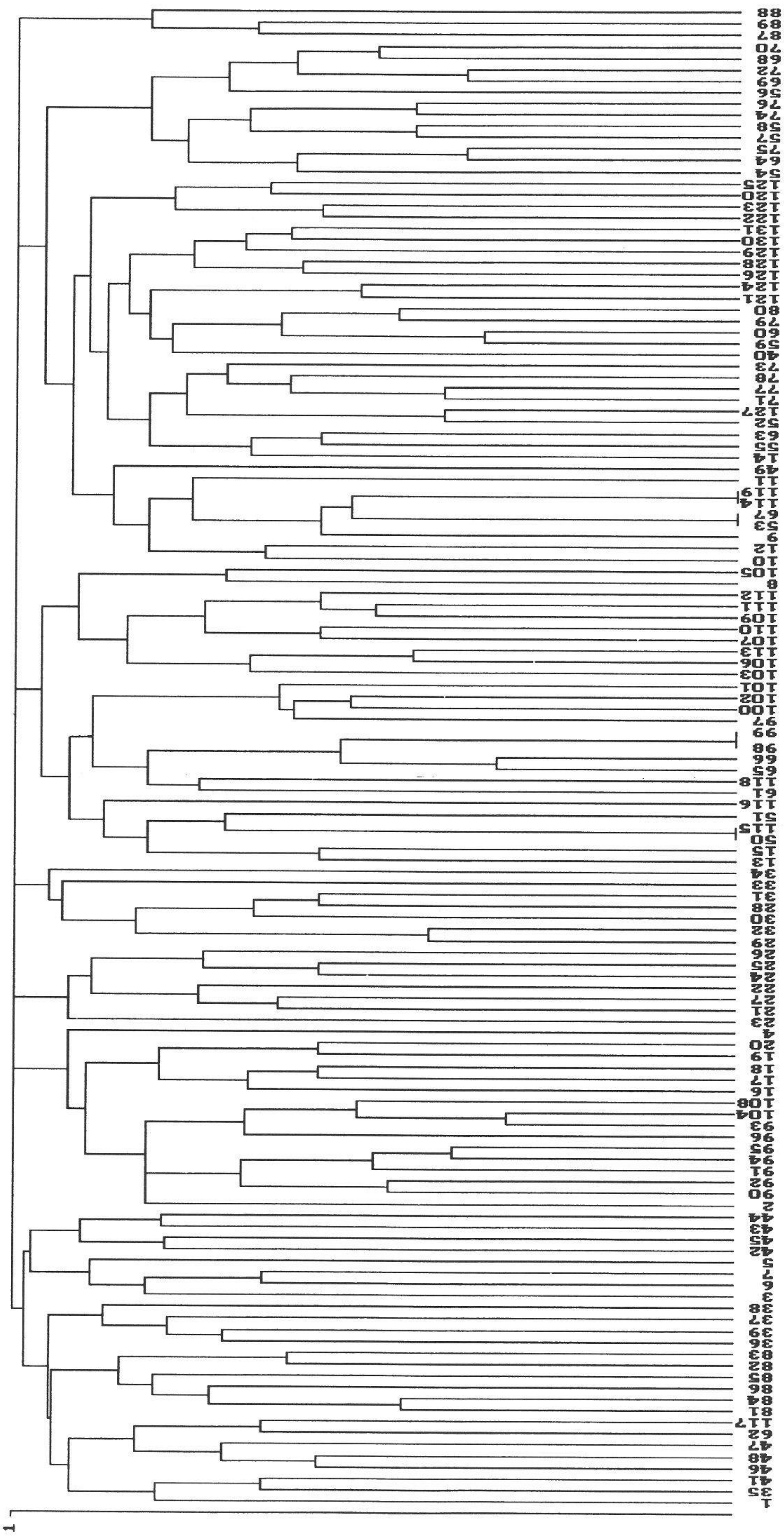

Fig. 2. Similarity dendrogram of the communities of *Pinus sylvestris* and *P. nigra* subsp. *salzmannii* of the Sistema Central.

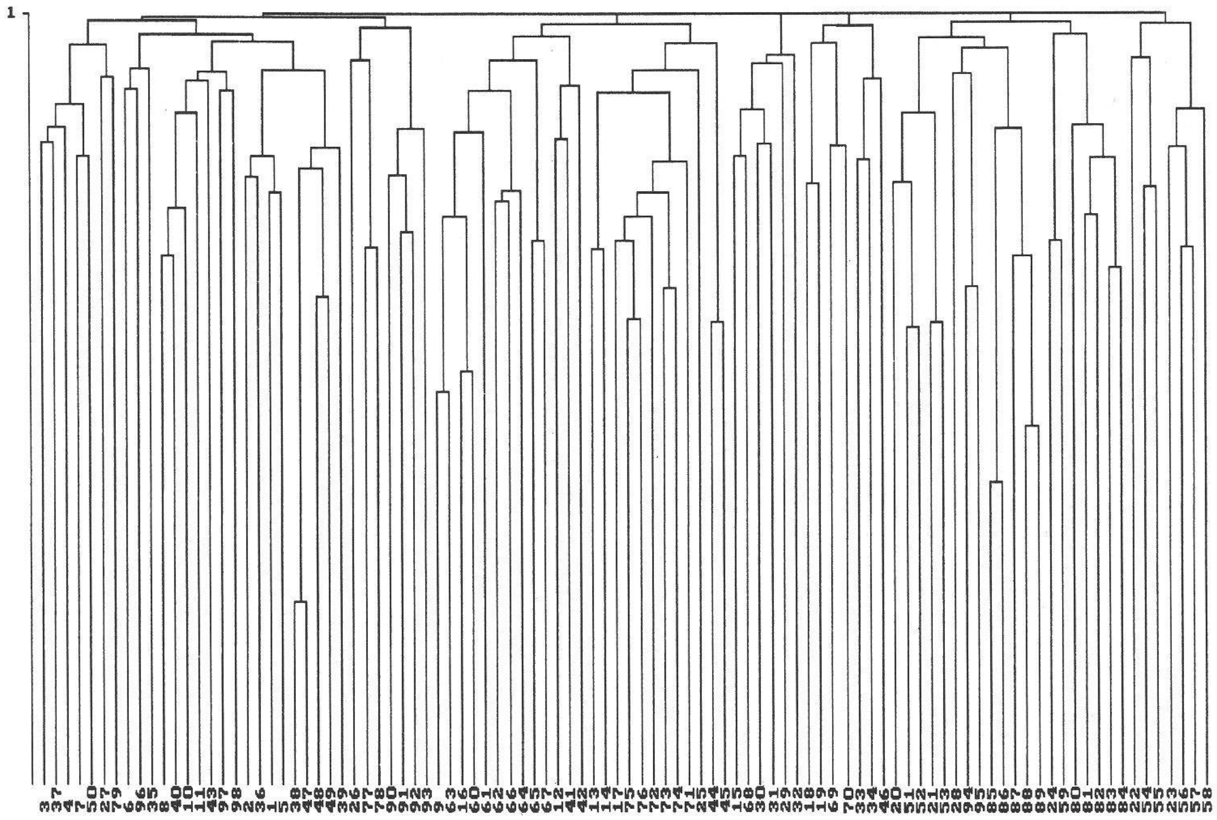

Fig. 3. Similarity dendrogram of the communities of Vaccinio-Piceetea in western Europe and of Querco-Fagetea with *Pinus sylvestris* and *P. nigra* subsp. *salzmannii*.

In Table 4 we can observe that there are several eurosiberian plants, frequent in the Vaccinio-Piceetea, which extend to the Iberian Peninsula (Font Quer 1954, Ceballos 1966): *Arctostaphylos uva-ursi*, *Juniperus communis*, *J. sabina*, *Pinus sylvestris*, *P. uncinata*, *Pyrola chlorantha*, *P. minor*, *Vaccinium myrtillus*. Though the Genisteae are highly diversified in the Mediterranean Region (Cristofolini 1997), and show a very different aspect from the Mediterranean communities, the distribution of *J. communis* and *P. sylvestris* is so evident in the boreal world (Hultén & Fries 1986) that it is not necessary to create another phytosociological class in the Iberian Peninsula. In the mountains of the Anatolian Peninsula (Turkey), there is a similar occurence with the Abietion bornmuellerianae alliance (Rehder et al. 1994).

Group *a* from Table 4 consists of characteristic elements of the *Querco-Fagetea*, whose presence is higher in the Iberian and Pyrenean pine groves, and so we include these in the Pinetalia sylvestris order (Folch i Guillén 1986, Oberdorfer 1990, Bolòs et al. 1993). This order encompasses the mountain pine groves which extend from the center of Europe to the Mediterranean Basin. On the other hand, in group *b*, the frequency of boreal elements is higher, defining the *Piceetalia* order (*Clematis alpina*, *Erica herbacea*, *Homogyne alpina*, *Larix decidua*, *Linnaea borealis*, *Listera cordata*, *Picea abies*, *Pinus cembra*, *Trientalis europaea*...). The Vaccinio-Piceetea class in divided into 2 orders: Pinetalia sylvestris-pine groves which go from Central Europe to the Iberian Peninsula, contacting with elements of Querco-Fagetea class, and Piceetalia-subalpine and alpine coniferous forests which go from boreal Europe to the Pyrenees.

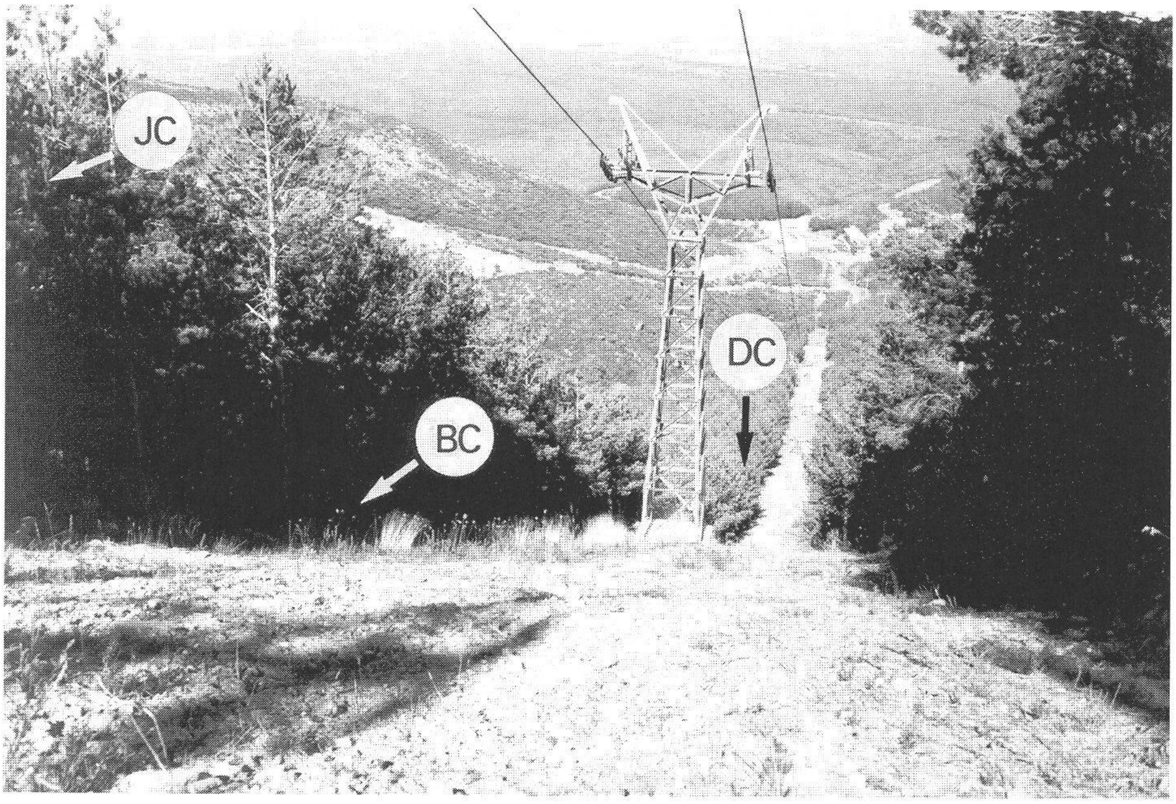

Fig. 4. Photo of a basal community (BC) developed in a track of a chair lift, a derived community (DC), because pine groves are favoured by crops, and natural pine groves of Junipero nanae-Cytisetum oromediterranei pinetosum sylvestris (JC) [La Pinilla, Segovia].

The communities with Pinus sylvestris and Pinus nigra subsp. salzmannii of the Sistema Central – Luzula lactea-Pinus sylvestris Basal Community (BC)

In Figure 4 there is a photo of a *Pinus sylvestris* climax pine grove in the center of Spain. A great part of the forest was destroyed to install a chair lift of a ski resort. Sometime later, this strip was invaded by *Luzula lactea*, while in nearby unaltered zones, there are the elements of Junipero nanae-Cytisetum oromediterranei pinetosum sylvestris. Thus, the community with *Pinus sylvestris* and *Luzula lactea* is a basal community (BC).

Junipero nanae-Cytisetum oromediterranei

It is a siliceous community dominated by *Cytisus balansae* subsp. *europaeus*, whose origin is the adaptation of some Genisteae to the high mountain during the Alpine orogeny. The characteristic floristic composition includes *Cytisus balansae* subsp. *europaeus*, *Deschampsia flexuosa* subsp. *iberica*, *Juniperus communis* and *Luzula lactea*. From a phytotopographical point of view, it is sited on central and lateral moraines and ice fields of the Sistema Central, between 1500 and 2500 m, on the southern slope, and 1300 to 2500 m on the northern slope. Pine groves appear in the deepest and most humid soils.

From a chorological point of view, it is a Carpetano-Iberico-Leonesa association with different geographical races (Schuhwerk 1990) based on microendemisms such as: *Senecio carpetanus* (=Senecioni carpetani-Cytisetum oromediterranei, Guadarrama Mountains), *Echinospartum barnadesii* (=Cytiso oromediterranei-Echinospartetum barnadesii, Gredos Moun-

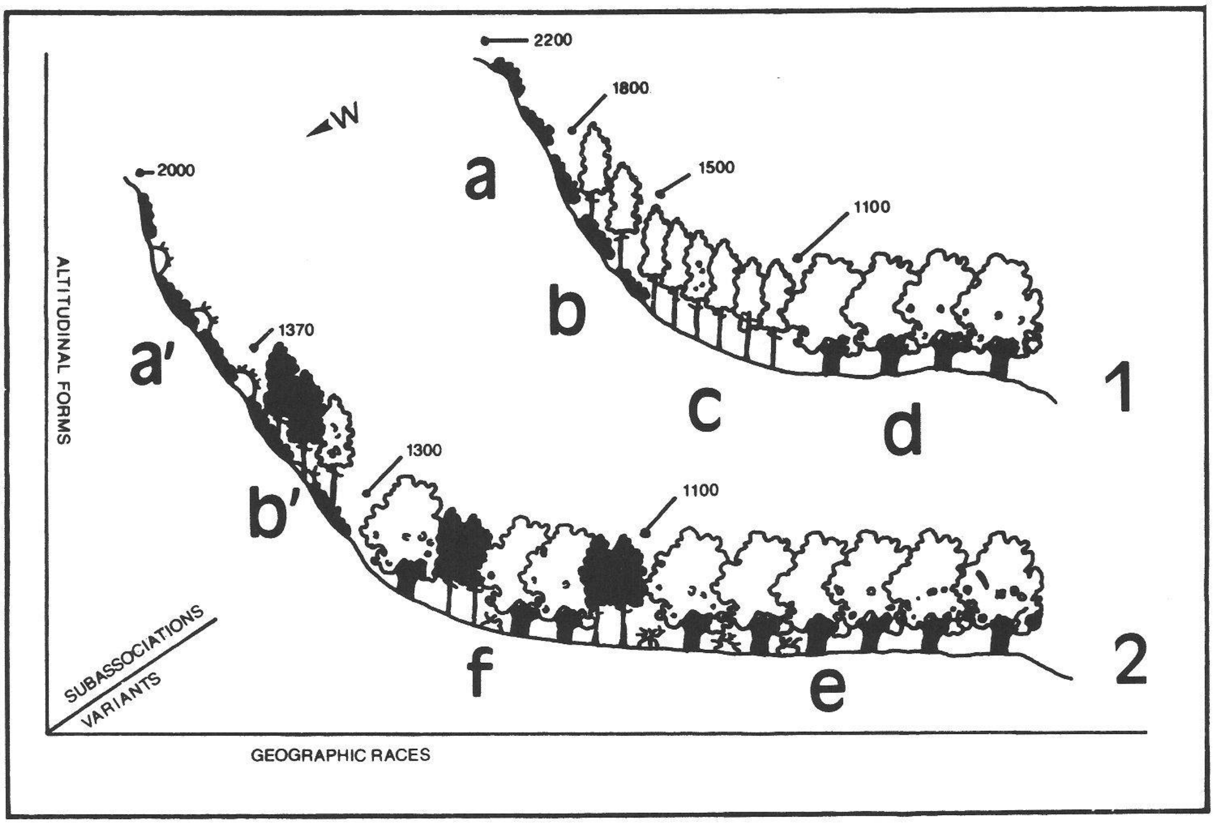

Fig. 5. Variability of the associations with *Pinus sylvestris* and *P. nigra* subsp. *salzmannii* in Navacerrada-Madrid (1) and Pico pass-Ávila (2) following the association concept of Kopecký and Hejný (1974), Matuszkiewicz (1981) and Schuhwerk (1990): a) Junipero nanae-Cytisetum oromediterranei, b) Junipero nanae-Cytisetum oromediterranei pinetosum sylvestris, c) Pinus sylvestris DC, d) Luzulo forsteri-Quercetum pyrenaicae; a′) Junipero nanae-Cytisetum oromediterranei geographic race with Echinospartum barnadesii, b′) Junipero nanae-Cytisetum oromediterranei pinetosum sylvestris altitudinal form with *Pinus nigra* subsp. *salzmannii*, e) Genisto falcatae-Quercetum pyrenaicae, f) Genisto falcatae-Quercetum pyrenaicae relic form with *P. nigra* subsp. *salzmannii*.

tains), *Echinospartum barnadesii* subsp. *dorsisericeum* (=Echinosparto pulviniformis-Cytisetum oromediterranei, Gredos Mountains and Peña de Francia), *Teucrium salviastrum* (=Lycopodio clavati-Juniperetum nanae, Estrela Mountains).

Junipero nanae-Cytisetum oromediterranei pinetosum sylvestris

This encompasses the pine groves of the Guadarrama and the Gredos mountains, sited on more developed soil than the typical association, with a similar floristic court, though there are some important plants such as *Adenocarpus hispanicus*, *Linaria nivea*, *Luzula lactea* or *Vaccinium myrtillus*.

We can deduce from Table 3 that the altitudinal limit of *Pinus sylvestris* is quite variable, depending on the relief. For example, we can find it below 1900 m in the Ayllón Mountains (Segovia), while near Peñalara (Madrid), it can be found below 2200–2300 m, depending on the highest continentality of the locality. (Fig. 5).

The typical association, Junipero-Cytisetum oromediterranei, is a substitution stage of the natural pine groves, and it is a perennial community where *P. sylvestris* cannot grow.

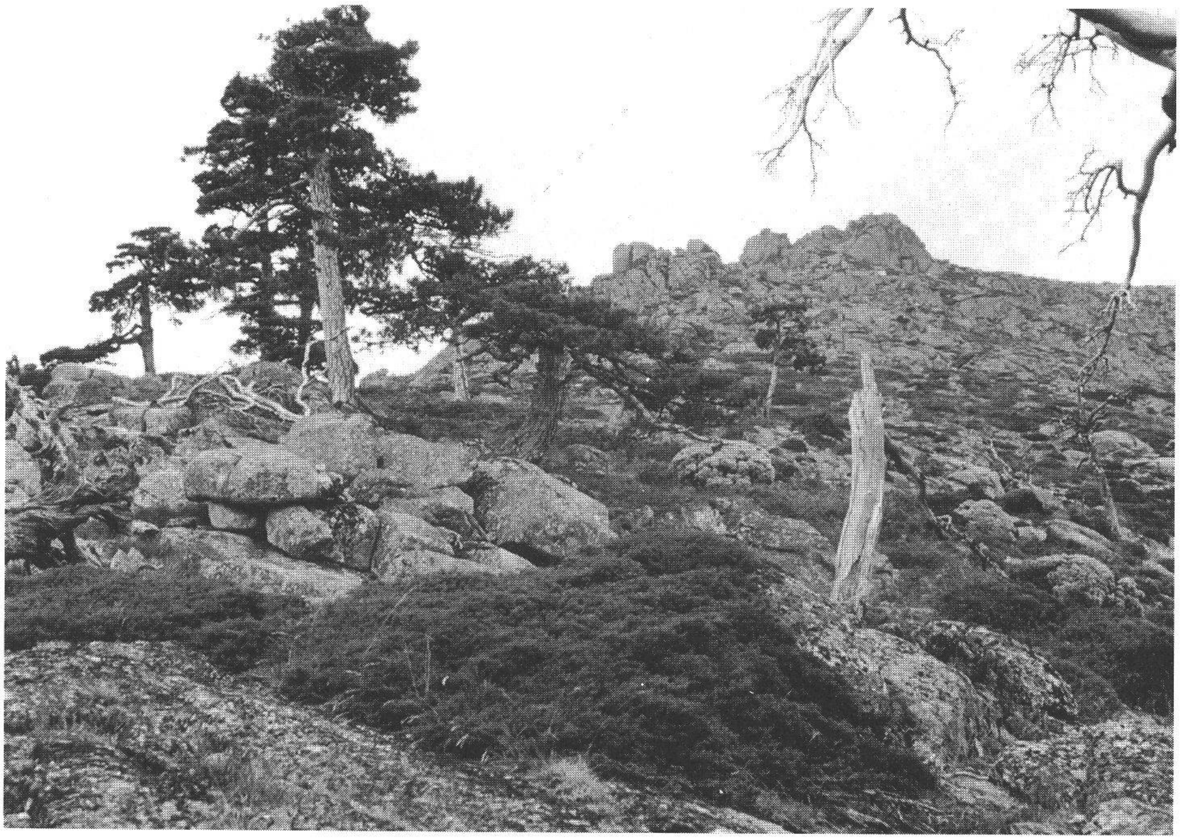

Fig. 6. Junipero nanae-Cytisetum oromediterranei geographic race with *Echinospartum barnadesii* pinetosum sylvestris and altitudinal form with *Pinus nigra* subsp. *salzmannii* (El Arenal, Sierra de Gredos, Avila).

The variability of these communities is high if we also consider the development of pines in the belt of the oak grove. In Table 3 we point out the variant with *Linaria nivea*. This plant, together with *Digitalis purpurea*, indicates soils mainly altered by fire. The pine groves were cleared a long time ago to obtain pasturages for cattle (Gil García et al. 1996). These pine groves belong to the Koelerio-Corynephoretea class and define a subserial variant with *Koeleria crassipes* and *Corynephorus canescens*. In some relevés of Table 3, the presence of *Vaccinium myrtillus*, which is not very frequent in the Guadarrama Mountains, is important. This plant is more abundant in the Ayllón Mountains, in the pine groves above 1620 m (Pinilla ski resort, Segovia); on the other hand, in Madrid it appears above 2000 m (Telégrafo hill). This Ericaceae can always be found exposed to the cold northern winds or protected in the glacial cirques, defining a relic form of cooler times.

Though Font Quer (1954) cited *Pinus sylvestris* in the Gredos Mountains, it seems that some authors do not find it in the Sistema Central (Rivas-Martínez et al. 1987, Sánchez Mata 1989). Our relevés have been made near the Pico peak (Gredos, Avila), over 1300 m. Most of these localities are on the southern slope. Here *Pinus nigra* subsp. *salzmannii* is found frequently, giving rise to an altitudinal form of more thermic exposures. (Fig. 6). The ecology and phytogeography of these localities have already been defined by Regato Pajares et al. (1992), Mancebo et al. (1993), Regato et al. (1995).

Table 5. Synthetic Table of the communities of Vaccinio-Piceetea in western Europe and of Querco-Fagetea with *Pinus sylvestris* and *P. nigra* subsp. *salzmannii* (the Arabic numbers indicate the presence: r=<6%, + =6-10%, 1=11–20%, 2=21–40%, 3=41–60%, 4=61–80%, 5=>81%). Abbreviations: AL=alliance, O=order, CL=class.

Community number	3 527 93 411499 3 344432779999 61666666661441117777772441633231167334255252998888825888882552555
	37470796658001378261587899678012393601264572123475623415455801928990346012138455678949012342453678
Releves per column	1 1 1 1121 11211111111 1 1 111 1111 123 1 1 11
	463181-77325862786725127212------1106145333431375------5400066358350332513132-------26-----15565-6
Species number	111 111321223443521121111 36645455496444543622536657684358223323245253343212353765551123354 215321
	64260205937816027377187757792547047231077928954831645781844858618368876906832258734391868038233039
Vaccinio-Piceetea CL	
Pinus sylvestris	4431115133444444444234555123235544523332.3.431414531551424....1...3..........1.212.22555555......1
Juniperus communis	4431512.2.413243234..455511514554451234545532.34455255.44434423134.21..144...42.....25.253..234555
Vaccinium myrtillus	..............1.1.............1...............11333525.................4551523444355..55555.2.345.
Pinus uncinata	................................4..........1..14215532214..............45514.55............1214555
Arctostaphylos uva-ursi	.................241445.5.2.....32312......1.....11.32.2.....................2................4555
Pinus x rhaetica	....1..22121111.1...............1..........................
Vaccinium vitis-idaea	..............................3.1...154..555...355........
Pinetalia sylvestris O, Cytision oromediterranei AL	
Cytisus balansae europaeus	443....2314241432....34531.......................21..................................4............
Luzula lactea	.1.....1..3134331142234441...5....
Deschampsia flexuosa iberica	.4315...2.444442..42345551..
Juniperus sabina	.....1...................................12............134.1..3...............................1...
Juniperus thurifera	....333..
Genista lobelii longipes	....1.......................................
Echinospatum barnadesii	........2...
Piceetalia O	
Orthilia secunda	..........................1..1211..........1..1....1.1.....................12.4553555.....14.......
Festuca gautieri	......................................4.2241.14423425322......1...............................3..4
Pyrola chlorantha	..............................1............1..1.1221321..1.............................22.1.......
Homogyne alpina	....3...................2351524511254..............
Rhododendron ferrugineum	....1115.2.................455152..............124....
Cotoneaster integerrimus	....11.11.31..11...................................1255
Pyrola minor	....1..1.1111................11114......................
Larix decidua	.............................21.2..22222234..............
Luzula nivea	....21.114....................12...443................
Monotropa hypopitys	....1111.113..1................................14.......
Moneses uniflora	....1.1.11.1.......................1.21..53...............
Pinus cembra	.............................3511.......................................221..22...............
Vaccinium uliginosum microphyllum	....3341.................551.5.
Goodyera repens	..........................1..4...11422......5.......
Polygala chamaebuxus	.............................5555..4.3.3................
Lonicera nigra	....1.......................12....11.32.............
Picea abies	....2..55555......5.......
Erica herbacea	..............................551..55..2................
Luzula sieberi	....224..112..............
Listera cordata	....11.......................1.......41..............
Empetrum nigrum hermaphroditum	....111...................5....
Loiseleuria procumbens	....1.................151....
Huperzia selago	....12.1.................3....
Blechnum spicant	................1..................................1........................13........................
Chamaecytisus supinus	.................................11..1..
Arctostaphylos alpinus	....5............1......
Daphne striata	................................4...52...................
Coronilla vaginalis	.............................3..3..1....................
Buphthalmum salicifolium	.............................424...225.............
Clematis alpina	....

b

Tab. 5. (continued)

Community number	3 527 93 411499 3 344432779999 6166666661441117777772441633231167334255252998888825888882552555 37470796658001378261587899678012393601264572123475623415455801928990346012138455678949012342453678
Linnaea borealis	....154..............
Lycopodium annotinum	....153..............
Luzula luzulina	....131..............
Aquilegia atrata	....313..............
Trientalis europaea	....145.......
Lonicera alpigena	....1......................2...1..................
Lonicera coerulea	....2.....11..............
Daphne cneorum	....112.
Galium pinetorum	....123.
Rhododendron hirsutum	....15...................
Pyrola rotundifolia	....34...................
Vaccinium uliginosum pubescens	....25...................
Crepis alpestris	................................2..2....................
Monotropa hypophegea	....1..1...
Corallorhiza trifida	....21..............
Carex ericetorum	....13........
Vaccinium uliginosum s.str.	....1.......................................1......
Rhododendron intermedium	....2...................
Epipactis atrorubens	..........................1...
Thesium rostratum	..............................2...
Chamaecytisus ratisbonensis	....4.......
Mosses and lichens	
Hylocomium splendens	..............................44...........3..4343355551...............14...1355555511..555.......
Pleurozium schreberi	............................2.42...........1..21222254.................11...14.22455..55555.......
Dicranum scoparium	..............................32...........2..331443433.41.............14....34..444..33113.......
Rhytidiadelphus triqueter	..............................43...........1..2241243421...............13...13455555..............
Hypnum cupressiforme	...............12................................32111..13.....................22..3..............
Cetraria islandica	....2..............1....55...23.........53....
Tortella tortuosa	.............................43.4.......................11...................33...................
Polytrichum formosum	....1..11.1....2.52.......
Leucobryum glaucum	....1..............1111........
Dicranum bergeri	....55555.......
Ptilium crista-castrensis	....1213.......5.......
Mnium spinosum	....41222..............
Cladonia furcata	................1..241..............
Plagiochila asplenioides	....3222...............
Scleropodium purum	..............................23..33........
Peltigera gr. aphthosa	....1..................................154..............
Chimaphila umbellata	....2515.......
Cladonia pyxidata	..............1..222..............
Barbilophozia lycopodioides	....121..............
Pseudoscleropodium purum	....1........3...
Ctenidium molluscum	.............................4.4..
Peltigera canina	....23..............
Rhytidiadelphus loreus	....11.................
Eurynchium striatum	....33.................
Ditrichum flexicaule	....21..
Cladonia foliosa	....21..
Homalothecium sericium	....32..
Hylocomium proliferum	....32..
Polytrichum piliferum	...............1..
Polytrichum juniperum	..............1...
Polytrichum sp.	................1...
Cetraria nivalis	....4.....
Cladonia fimbriata	...............1..

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Tab. 5. (continued)

Community number	3 527 93 411499 3 344432779999 6166666661441117777772441633231167334255252998888825888882552555
	37470796658001378261587899678012393601264572123475623415455801928990346012138455678949012342453678
Cetraria cucullata	....2.....
Bartramia halleriana	...............1..1.....
Cladonia rangiferina	....
Pseudoevernia furfuracea	...............2..1.....................
Dicranum sp.	....
Mosses	...............3..
Mnium undulatum	....1..
Dicranum pellucidum	...............2..
Rhytidium rugosum	.............................4..
Pinus nigra s.l. communities	
Pinus nigra salzmannii	.......44...........4............4545555555..1............4544.44455432...........................
Pinus nigra s.str.	.............................5..
Querco-Fagetea CL	
Hepatica nobilis	................1................343432251.321422112545414........31...122.4...314............1..5
Amelanchier ovalis	..........................22.44..454555454423.11.........1123331333.1........1................1...
Deschampsia flexuosa s.str.	................3..........................1..1.45543551...............245142..14.342553......155.
Fragaria vesca	................1..........3...............2113.4321355221.....................4453211.2224.......
Buxus sempervirens	.................................45455132..4314133115354.1.2.1....43..............................
Sorbus aucuparia	.............1.............................1..1.12.3124................13415...34344..33344...11..
Viola reichenbachiana	...........................13......11..233......2433243.31.............1..13...314..25............
Sorbus aria	..........................251425.12112......2.1....111...1.1................1..22.............1..2
Lonicera xylosteum	..........................245....122422.3..21...32..333..1.....................312................
Rosa pendulina	....11.1.231.................224141..22.13..........1232
Corylus avellana	......3...................244.3....111..2..12...21.112.........................2.........3........
Crataegus monogyna	.......1........1................2311..553.1..............232434....2.............................
Abies alba	....1.12111151...............11.15...55...11............
Viburnum lantana	..........................154.45.1224...4..1............11....................5..................4
Helleborus foetidus	...........................3.......2355.152.............43.113.2..3...............................
Fagus sylvatica	............................2..3...........1111....11..................1...2...31.....12......1...
Brachypodium sylvaticum	.......1...................3.......123.32..111..1........1.....1....1..12...42..21...2545.........
Melampyrum pratense s.str.	..........................222.4...
Poa nemoralis	...........1.4..........1..14..............1.....111.13.21...................34..2.2..............
Carex ornithopoda	..............................4233............11...111.........................33.................
Rubus idaeus	...........1.1..1...............................1122.21.11.............11214...44112..............
Prenanthes purpurea	....1..2.1......................12255555..............
Melampyrum sylvaticum	..............................3.1................1.1.1..
Geum sylvaticum	.......1.........................12..3.55...............32.122.4....2.............................
Quercus petraea	......4....................53...................332123................................52.5........
Hedera helix	...........................53....111242.2........................131..............................
Quercus faginea	.................................4534.233..................1.4...343..............................
Daphne laureola s.str.	.................................1..............1..1111..1.....4....1..1......................11..
Ligustrum vulgare	......1....................54.24.4523...4..1.............1..
Thalictrum tuberosum	.................................451.22233.1......................21..............................
Fraxinus excelsior	...........................3.......12......1....1121.121..
Galium rotundifolium	.1.....1..11142......................................1.........................24...2.............
Prunus mahaleb	.....1....................11.....1124...2..................11.......1.............................
Arenaria montana	.21....1..1114243..1..2......3........
Berberis vulgaris s.str.	.....11....................311422...53315.......
Betula pendula	................1................................11..2.2..
Prunus spinosa	......2....................34....11...24...................1.2.1..................................
Berberis hispanica	....123.4334.1..3.1...........................
Primula veris columnae	.................................12122..4..1........3...11..
Acer granatense	.....................................52....................12311..3.1.............................
Genista cinerascens	........11.1.1..112.3....1..
Rosa canina	.........1................1................21..11..12...1...

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Tab. 5. (continued)

Community number	3 527 93 411499 3 344432779999 6166666661441117777772441633231167334255252998888825888882552555
	37470796658001378261587899678012393601264572123475623415455801928990346012138455678949012342453678
Acer opalus	...........................1.....1211...1..211..
Viola riviniana	..........11.2.............................31121..
Cytisus sessilifolius	.................................2323......11..........1...........2..............................
Sorbus domestica	...........................1.....23232..2..........................2..............................
Cornus sanguinea	...........................53....2334...3..1..
Viola willkommii	.................................12253..................24.........2..............................
Quercus pubescens	..........................24.......12............1.111..
Dryopteris filix-mas	....11.1.11........................33.1...............
Rubus saxatilis	....11...........................335..2..44.......
Quercus robur	......4....................22...51535.......
Carex digitata	....1..1....13........................5.2.......5........
Sorbus chamaemespilus	..............................1.1......................................121...14...................
Mycelis muralis	....1...14........................334..2.............
Paeonia officinalis microcarpa	...................................113223.........................2...............................
Carex alba	..........................1...3.2..534.5................
Aquilegia vulgaris	.....................................2..2...1......12...12..
Genista florida	........13...3211...1...
Adenocarpus hispanicus	14.......3..1.111...
Lonicera etrusca	.................................1123...1...................3.....................................
Populus tremula	..........11...................3...1.12.......
Sanicula europaea	.............2.......................2..2......................................11...2.............
Euphorbia amygdaloides	...................................124..............11..............................2.............
Laserpitium latifolium	....1.......11....................................12.1
Melampyrum pratense ssp. alpestre	................................1...............11.111..
Helleborus viridis occidentalis	....1.1.124.............................2.............
Dryopteris dilatata	....2....................33..2..12.................
Polygonatum odoratum	...........................43...........3...422.......
Veronica urticifolia	....1.........................55213..............
Athyrium filix-femina	................1..................................1.1.........................31.................
Paris quadrifolia	................1....................................11........................22.................
Luzula sylvatica	....11.....................4...44.................
Rhamnus alpinus	....321....................................1..5
Daphne mezereum	....1.11.15...
Stellaria holostea	....1111.1..
Vicia sepium	....11..122...
Lathyrus montanus	....3..1241...
Festuca heterophylla	..............2.1...........3......1.........1..
Campanula persicifolia	...........................53......12...........1...
Rosa sp.	.......11.......................1.1........1..
Rubus ulmifolius	.......1...................................1...................1....1.............................
Dryopteris carthusiana	....3...41.1........
Frangula alnus	....2.153.......
Epilobium montanum	....11........................11.................
Cephalanthera rubra	.....................................2..2...............21..
Geranium sanguineum	...........................55...........................11..
Sorbus torminalis	......1....................54................1..
Betula pubescens	....1...................111........................
Acer monspessulanum	...................................12..15...
Hypericum montanum	...........................52......11...
Potentilla micrantha	.............1..................................3...................................11............
Origanum vulgare	.......1...................32......1..
Quercus pyrenaica	.......1.2...4......4...
Viola alba dehnhardtii	.................................4522...
Rosa pouzinii	....1..................14....1.............................
Ilex aquifolium	....1.........11...........2...............................

Tab. 5. (continued)

Community number	3 527 93 411499 3 344432779999 6166666661441117777772441633231167334255252998888825888882552555
	37470796658001378261587899678012393601264572123475623415455801928990346012138455678949012342453678
Acer campestre	...........................3...............1.1..
Acer platanoides	....1...14.......
Melica uniflora	................1..........................1.1..
Prunus avium	...................................13......1..
Teucrium scorodonia	.............21.1...
Viola odorata	.............1..2..3....................................
Lilium martagon	....1....22...
Poa chaixii	....1..................11.
Convallaria majalis	...........................23................1..
Clinopodium vulgare s.str.	............................3...........................11..
Berberis vulgaris seroi	......................................24...................4......................................
Rosa pimpinellifolia	....333..
Polygonatum verticillatum	....1........................11.................
Carpinus betulus	...........................24...5.......
Acer pseudoplatanus	.............................3.5...2..................
Campanula rapunculoides	................1............3..3...
Taxus baccata	...................................1..............................1...............................
Sorbus mougeotii	....1......................1...
Geranium sylvaticum	....1......4..............
Rosa sicula	....11...................................
Daphne laureola latifolia	....11....................................
Crataegus laciniata	....1......2.............................
Rosa corymbifera	.........2.....1..
Rosa spinosissima ssp. myriacantha	....21..
Viola canina	....3.......................................3.......
Rhamnus catharticus	......2....................3..
Pyrus communis	...........................41...
Primula veris s.str.	...........................32...
Lathyrus niger	...........................25...
Trifolium medium	...........................52...
Buglossoides purpurocaerulea	...........................22...
Bupleurum falcatum	...........................11...
Galium sylvaticum	...........................21...
Viola hirta	...........................34...
Potentilla alba	...........................13...
Rubus sp.	...................................1..1...........
Tilia cordata	....24.......
Sambucus racemosa	....22.................
Galium odoratum	....12.................
Petasites albus	....32.................
Lamiastrum galeobdolon	....11.................
Neottia nidus-avis	....41.................
Luzula luzuloides	....34..............
Quercus x cerrioides	....12...
Tilia platyphyllos	...........................4...............1..
Clematis recta	...................................12...
Clematis vitalba	...........................3.......1..
Dictamnus albus	...................................12...
Euphorbia dulcis	...........................3.......1..
Thesium bavarum	...........................3..
Abies maroccana	....1..........................
Aquilegia pyrenaica	....1...
Cedrus atlantica	....1..........................
Viola mirabilis	...........................3..
Genista cephalantha demnatensis	....1..........................

Tab. 5. (continued)

Community number	3 527 93 411499 3 344432779999 6166666661441117777772441633231167342555252998888825888882552555
	37470796658001378261587899678012393601264572123475623415455801928990346012138455678949012342453678
Peucedanum cervaria	...........................5..
Melittis melissophylum	....1...
Fragaria viridis	............................1...
Rosa tomentosa	................1...
Crataegus sp.	...........................5..
Campanula trachelium	....1..
Pulmonaria angustifolia	............................5...
Rosa arvensis	....1..
Salix angustifolia	....2..
Helleborus niger	................1...
Rubus chamaemorus	....1..........................
Primula vulgaris	....3..................................
Anemone nemorosa	....1..
Genista falcata	.......2..
Euonymus verrucosus	....3........
Paeonia officinalis s.str.	....2..................................
Scilla lilio-hyacinthus	....1..
Cytisus striatus	........1...
Carex sylvatica	....1..................
Cotoneaster granatensis	....1...................................
Cotinus coggygria	.....1..
Luzula forsteri s.str.	.............1..
Cotoneaster nebrodensis	.............................4..
Lonicera periclymenum	....2...
Rosa stylosa	....2...................................
Rubus sect. Histrices	.............1..
Cyclamen purpurascens	.............................4..
Geum heterocarpum	....1...................................
Cephalanthera damasonium	....2..
Rosa micrantha	.............1..
Coriaria myrtifolia	...................................1..
Cephalanthera longifolia	....2..
Calluno-Ulicetea CL	
Veronica officinalis	.............4..1...........2..............1....1551235........................3421124..132.......
Calluna vulgaris	................1.............................1.234213.................1.5..1.........55555.2.144.
Genista pilosa	.............................5..................123..2................................41..........
Erica australis	................2...
Erica multiflora	....5...............................
Erica vagans	....1...
Quercetea ilicis CL	
Erica arborea	........2.11122.433114525...
Quercus rotundifolia	...................1.............121243...2................1.4....34321...........................
Juniperus oxycedrus	..................................11.3....................23.4....45221...........................
Juniperus phoenicea	.....................................3....3...............45.3..1143..1...........................
Rubia peregrina	.................................45353..4...1...................551...............................
Cytisus scoparius	.......2.3...1..................................1..............4...32..................2..........
Bupleurum rigidum	.................................1212...2.........................32..............................
Rhamnus alaternus	.................................12121............................33..............................
Quercus coccifera	.................................1212.............................54..............................
Daphne gnidium	....221.............................
Paeonia broteroi	.......1...2....1.............................
Rhamnus myrtifolius	....34......................................
Lonicera splendida	....1..1....................................
Aristolochia pistolochia	...................................24...
Pistacia terebinthus	...................................1..............................2...............................

Tab. 5. (continued)

Community number	3 527 93 411499 3 344432779999 6166666661441117777772441633231167334255252998888825888882552555
	37470796658001378261587899678012393601264572123475623415455801928990346012138455678949012342453678
Pistacia lentiscus	....42..............................
Smilax aspera	....41..............................
Phillyrea latifolia	....31..............................
Arbutus unedo	....21..............................
Lonicera implexa	....22..............................
Moehringia trinervia	....1....1...
Cytisus multiflorus	........1...
Ruscus aculeatus	....3...............................
Jasminum fruticans	....1................................
Viburnum tinus	....2...............................
Carex distachya	....1..............................
Osyris alba	....2..............................
Clematis flammula	....2..............................
Companions	
Solidago virgaurea	....1.....111..11....1212.143......24........1..122212.........................44325....535.......
Hieracium gr. murorum	.................................2323444.231.1122541344211..
Teucrium chamaedrys s.str.	.....1....................14.333.1223..355312.....................3...........................11.1
Oxalis acetosella	....112..3.35................135142..44555...1.14.......
Cruciata glabra	..........11.2.....................1333.12231.43..1211
Carex humilis	..........................232141.1212...2223............22..
Pteridium aquilinum	.......313...421...1..........14.............................3.3..2...................1..53.......
Valeriana montana	................................2.............131.11311................1.....33...............1...
Avenula sulcata s.str	.......3..1.11.212.142313...
Genista scorpius	.................................3423.34222.2.....................3.11............................
Aphyllanthes monspeliensis	.................................1224.22332..............1..........212...........................
Lotus corniculatus	.............................4454.....123.......124.42........................5...................
Epipactis atrorubens	.............................2555..11.3.................21...................2.31.................
Ranunculus tuberosus	....1..1.1111212........................332................
Sesleria albicans	.............................5235..........1..22.......................1.....55...............1...
Campanula rotundifolia	..........................1..443..............12.33.....11.......................4................
Rumex angiocarpus	..3....22.1111.312.1..
Lavandula latifolia	......................................35355....................2133.43............................
Koeleria vallesiana	......................................34245..............1....2.13..22............................
Gymnocarpium dryopteris	....2.1.................11314...22.52..............
Polygala calcarea	.....................................3.1.2.1..11..1.51..31..
Avenula pratensis ssp. iberica	..................................5.544244.1..1..........2..
Polypodium vulgare	....13211.32........................14.....1...........
Erinacea anthyllis	....23................23433....121...........................
Nardus stricta	2...2.....111.2........2..132.......................
Knautia arvensis	.................................1235.3.33.........121..
Tanacetum corymbosum	...........................52....111223.33..
Potentilla erecta	...............................4................1.11.1.................1...............1214.......
Hieracium pilosella	........1.1.1.111.............................1..422........
Arrhenatherum elatius s.l.	.4.....................31.............35452.......................3...............................
Rhamnus saxatilis	...................................12..23..1............21......13................................
Thymus vulgaris	..................................1.1....44.....................333.43............................
Anthoxanthum odoratum	............................5...................1211................................2.555.........
Galium glabra	....4553555.44..
Bromus erectus	...................................12.22242.1............2..
Senecio pyrenaicus carpetanus	21..3.....111.1.1......2..
Galium pumilum s.l.	....1..22.343522...
Coronilla emerus	...........................3.....23132.....111..
Carex hallerana	....211.34...22...2...........................
Halimium umbellatum viscosum	...............1.341145.5...
Ononis aragonensis	......................................2.232............1.1..1.3...................................

Tab. 5. (continued)

Community number	3 527 93 411499 3 344432779999 6166666661441117777772441633231167334255252998888825888882552555 37470796658001378261587899678012393601264572123475623415455801928990346012138455678949012342453678
Luzula pilosa	............................3..323..4.555.......
Maianthemum bifolium	....42533..2..44.......
Knautia dipsacifolia	...............................51..........2.................................2.335.2..............
Hieracium sylvaticum	...........................24..55555..............
Melica nutans	...........................31........................1.........................315.......3........
Carex flacca	.............................1.5.3.1................21.......................1....................
Phyteuma spicatum	....1..1.1.11.........................34.................
Festuca indigesta s.str.	....4..........1.....45251..
Calamagrostis villosa	....12211.55..............
Euphorbia cyparissias	...........................343244......................2..
Prunella grandiflora pyrenaica	....2321325...
Leucanthemum vulgare	...................................12..242..1.1.
Catananche caerulea	.................................12....42.......................4...32............................
Brachypodium pinnatum s.str.	..........................135.4111..
Conopodium pyrenaeum	..........11.3....1..2.13...
Leontodon crispus bourgaeanus	.1.12......11..........11...
Agrostis castellana	.......1.2.131.22...
Linaria nivea	122.......1.311...
Festuca indigesta aragonensis	2.21......121....1..
Carduus carpetanus	........1......111.1.12...
Koeleria crassipes	.......2.......1.1211..1................................
Leucanthemopsis pallida alpina	2.3.1.......1.1........2..2.....
Coronilla minima	..........................1......1211..3..
Teucrium montanum	.....1.......................43.3.........................24......................................
Genista hispanica	.................................23132............................3...............................
Galium ludicum	.............................3412..1............................1.................................
Avenula bromoides	....24.....................3232..............................
Euphorbia nicaeensis	......................................4444....................1..2................................
Helianthemum cinereum	....4.........................12.122...........................
Festuca eskia	....142....................143.
Calamagrostis arundinacea	............................1..11...............315.......
Lathyrus filiformis	.....................................31322.....................1..................................
Leuzea conifera	......................................2..32.........................322...........................
Biscutella valentina	......................................32.23.........................33............................
Thymus bracteatus	..................4..45................3.33...
Thymus serpyllum	.............................4234..11.

<u>Further do occur:</u>
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Table 6. References of the relevés of Table 5.

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81. Preising (1943). 'Dicrano-Pinetum eupteridetosum'. Poland

82. Preising (1943). 'Dicrano-Pinetum typicum'. Poland

83. Matuszkiewicz (1956b). 'Pino-Quercetum berberidetosum'. Poland

84. Matuszkiewicz (1954). 'Pino-Vaccinietum myrtilli'. Poland

85. Kuoch (1954). 'Abietetum festucetosum'. Alpes, Switzerland

86. Kuoch (1954). 'Abietetum melampyretosum Carex-Variante'. Alpes, Switzerland

87. Braun-Blanquet et al. (1954). 'Piceetum montanum galietosum'. Alpes, Switzerland

88. Braun-Blanquet et al. (1954). 'Piceetum subalpinum myrtilletosum Linnaea-Variante'. Alpes, Switzerland

89. Braun-Blanquet et al. (1954). 'Piceetum subalpinum vaccinietosum, Peltigera-Hylocomium-Variante'. Alpes, Switzerland

90. Knapp (1944), in Ellenberg (1996). 'Chamaebuxo-Pinetum nigrae'. Alpes, Switzerland

91. Braun-Blanquet et al. (1954). 'Erico-Pinetum'. Alpes, Switzerland

92. Etter (1947). 'Molinio-Pinetum'. Alpes, Switzerland

93. Braun-Blanquet et al. (1954). 'Carici-Pinetum engadinensis'. Alpes, Switzerland

94. Braun-Blanquet et al. (1954). 'Erico-Mugetum'. Alpes, Switzerland

95. Braun-Blanquet et al. (1954). 'Rhododendro hirsuti-Mugetum'. Alpes, Switzerland

98. Relevés of the authors. 'Junipero nanae-Cytisetum oromediterranei geographical race with *Senecio carpetanus* pinetosum sylvestris'. Ayllón Mountains, Sistema Central, Spain

Oak groves of Quercus pyrenaica. Pinus sylvestris Derived Community (DC)

The potential area of *Q. pyrenaica* in the Sistema Central extends below 1500 m and it has been used for a long time to favour *Pinus sylvestris* crops. There are several documents from the age of Philip the Second and even earlier (Bauer 1991, Mancebo et al. 1993), which speak about *P. sylvestris* used as construction wood, for heating, and to make glass; in the Gredos Mountains some *P. nigra* subsp. *salzmannii*, stripped to obtain resin, can be found.

The oak groves of *Q. pyrenaica* of the Sistema Central (Carpetano-Iberico-Leonesa phytogeographical province), can be grouped in 3 associations:

1. Luzulo forsteri-Quercetum pyrenaicae Rivas-Martínez 1963. Guadarrama Mountains and La Alcarria, siliceous, Supramediterranean, subhumid-humid.
2. Genisto falcatae-Quercetum pyrenaicae Rivas-Martínez in Penas & T. E. Díaz 1984. Plains of Salamanca, Zamora and Orense, Gredos Mountains, siliceous, Meso-Supramediterranean, subhumid-humid.
3. Festuco heterophyllae-Quercetum pyrenaicae Br.-Bl. 1967. Sistema Ibérico in the province of Soria and the Ayllón Mountains, siliceous, Supramediterranean, humid-hyperhumid.

Luzulo-Quercetum pyrenaicae and Genisto-Quercetum pyrenaicae are enriched with *P. nigra* subsp. *salzmannii* in the more thermic localities of the eastern Gredos Mountains and western Guadarrama Mountains. Thus, relic forms of oak groves between 1100 and 1300 m can be observed (Fig. 5). This is its most frequent altitudinal distribution in the Sistema Central. *P. nigra* subsp. *salzmannii* is a western Mediterranean tree that in the Pyrenees can be included in the Quercetea ilicis, in the Sistema Ibérico in the Querco-Fagetea, in the Sistema Central in Querco-Fagetea and Cytision oromediterranei, and in the Sistema Bético in the Cytision oromediterranei (Regato et al. 1995).

In Table 3 we can observe that the natural regeneration of natural pine groves begins with *Galium rotundifolium* and *Pteridium aquilinum*, which are indicators of humidity and depth of soil. If the forest has burnt, the most humid areas are enriched with *Arctostaphylos uva-ursi*. In both cases the crops of *Pinus sylvestris* change the attributes of the soil and a distribution of the characteristic plants of Querco-Fagetea, which means that *P. sylvestris* is favoured and becomes potential as opposed to *Q. pyrenaica*. On the other hand, *A. uva-ursi* contributes to the acidity of the soil, and so *Q. pyrenaica* cannot grow, but *P. sylvestris* can. In some places of the Sistema Central altered by man, *P. sylvestris* has become potential in the dominian of Querco-Fagetea, establishing a derived community (DC), according to Kopecký et al. (1995).

Conclusions

There are two different types of *Pinus sylvestris* communities in the Sistema Central:

Natural Pine groves: with boreal and prealpine origin.

* Junipero nanae-Cytisetum oromediterranei pinetosum sylvestris, sometimes with *Pinus nigra* subsp. *salzmannii*.

Crops of Pine groves: Since the Middle Ages.

* *Pinus sylvestris* DC, in previous potential places of *Quercus pyrenaica*.

Pinus nigra subsp. *salzmannii* is more frequent in the oak grove belt (Luzulo forsteri-Quercetum pyrenaicae and Genisto falcatae-Quercetum pyrenaicae), forming relic communities.

To sum up, we give the syntaxonomic scheme of the communities studied:

CL. VACCINIO-PICEETEA Br.-Bl. in Br.-Bl., Sissingh & Vlieger 1939
O. Pinetalia sylvestris Oberdorfer 1956
AL. Cytision oromediterranei R. Tx. in R. Tx. & Oberdorfer 1958 corr. Rivas-Martínez 1987 [Cytision europaei pro nom. mut., incl. Pino-Juniperetalia Rivas-Martínez 1964]. Siliceous Iberian Oromediterranean associations.
SAL. Cytisenion oromediterranei
AS. Junipero nanae-Cytisetum oromediterranei (Rivas Goday 1955) Rivas-Martínez 1963 <Sistema Central>
- Geographical race with *Senecio carpetanus* <Guadarrama Mountains>
- Geographical race with *Echinospartum barnadesii* <Gredos Mountains>
- pinetosum sylvestris Rivas-Martínez 1963
- Variant with *Linaria nivea*
- Variant with *Koeleria crassipes* and *Corynephorus canescens*
- Relic form with *Vaccinium myrtillus*
- Altitudinal form with *Pinus nigra* subsp. *salzmannii*

CL. QUERCO-FAGETEA Br.-Bl. & Vlieger 1937
O. Quercetalia roboris R. Tx. 1931
AL. Quercion robori-pyrenaicae (Br.-Bl., P. Silva & Rozeira 1956) Rivas-Martínez 1975
SAL. Quercenion pyrenaicae Rivas-Martínez 1975. Iberian Mediterranean oak groves.
AS. Luzulo forsteri-Quercetum pyrenaicae Rivas-Martínez 1963 <Carpetano-Iberico-Leonesa province, Alcarria>
- Relic form with *Pinus nigra* subsp. *salzmannii* <Western Guadarrama Mountain>
- *Pinus sylvestris* DC

AS. Genisto falcatae-Quercetum pyrenaicae Rivas-Martínez in Penas & T. E. Díaz 1984 <Salamanca, Orense, Zamora, Gredos Mountains>
- Relic form with *Pinus nigra* subsp. *salzmannii* <Eastern Gredos Mountains, Avila>
- *Pinus sylvestris* DC

AS. Festuco heterophyllae-Quercetum pyrenaicae Br.-Bl. 1967 <Sistema Ibérico, Soria, Ayllón Mountains>
- *Pinus sylvestris* DC

Floristic appendix

The nomenclature and authorship of the taxa in the text and in the Tables follow the Catalogue des plantes de Maroc (Jahandiez and Maire 1931–1934), Flora Europaea (Tutin et al. 1964–1980), Med-Cheklist (Greuter et al. 1984–1989) and Flora iberica (Castroviejo et al. 1986–1997); for the bryophytes and lichens we have followed the Flore des bryophytes (Augier 1966) and Les lichens (Ozenda and Clauzade 1970).

There are some subspecies taxa which can be maintained with difficulty, though the greater part of the taxa of the communities with *Pinus sylvestris* in the Iberian Peninsula are well differentiated. This is the case of the subspecies of *Juniperus communis* [subsp. *alpina* (Suter) Celak, subsp. *hemisphaerica* (K. Presl) Nyman, subsp. *nana* Syme, subsp. *sibirica* Burgsd.], which have also been considered by other authors to describe new syntaxa. The same occurs with the varieties of *P. sylvestris* (var. *nevadensis* Christ, var. *olivicola* Vayr., var. *iberica* Svob., var. *pyrenaica* Svob., var. *catalaunica* Gaussen), which are not well differentiated (Amaral Franco 1986). The studies with enzymatic markers made with *Pinus nigra* must be considered. A large part of the Iberian associations is based on the Iberian-North-african distribution of *P. nigra* subsp. *salzmannii* (Blanco et al. 1996), but Aguinagalde et al. (1997) clearly establish the presence of *P. nigra* subsp. *nigra* in Navarra (Spain).

Zusammenfassung

Die Zusammensetzung der Wälder des spanischen Zentralgebirges, in denen *Pinus sylvestris* und *P. nigra* subsp. *salzmannii* vorkommen, wird unter phytosoziologischen Gesichtspunkten analysiert und dabei mit 683 weiteren europäischen Koniferengemeinschaften verglichen. Durch Anwendung der Kriterien von Kopecký & Hejný (1974), Foucault (1981), Dierschke (1993) und Kopecký et al. (1995) auf die nach Braun-Blanquet (1964) aufgenommenen Inventare werden im Innern der Iberischen Halbinsel die Klasse Vaccinio-Piceetea sowie die Ordnung Pinetalia sylvestris identifiziert. Die Vergesellschaftungen mit *Echinospartum barnadesii* und *Senecio carpetanus* werden als geographische Rassen interpretiert, und weitere Aspekte von Junipero nanae – Cytisetum oromediterranei (Subassoziationen, Varianten, Reliktformen) werden kommentiert. Vorkommen von *Pinus nigra* subsp. *salzmannii* in *Quercus pyrenaica*-Wäldern sehen die Autoren als wärmeangepaßte Reliktformen, in Gemeinschaft mit *P. sylvestris* als höheliebende Formen an.

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