PHYTOSOCIOLOGICAL RESEARCH OF THE PURE *BETULA PENDULA* FORESTS IN GREECE: RHODOPE MOUNTAIN RANGE (NE GREECE)

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ABSTRACT - The geographical distribution of the birch (*Betula pendula* Roth.) in Greece is limited to the northern mountains (Varnous, Voras, Vermio, Paiko, Beles, Orvilos, Lailias, Pangeo, Phalakro and Rhodope). The unique extensive pure *Betula pendula* – forest, which covers an area of about 1.755 ha, occurs in the western part of the Rhodope mountain range. The other appearances of birch in the Greek area are limited either to small stands or to individuals in mixture with other forest trees. The *Betula pendula* forests in western Rhodope have been studied using the Braun – Blanquet method with 36 phytosociological relevés. Two associations, *Querco dalechampii – Betuletum pendulae* (Quercetalia pubescentis) and *Fago sylvaticae – Betuletum pendulae* (Fagetalia sylvaticae), as well as further subdivisions, are distinguished. Their syntaxonomy as well as information about the site characteristics, structure and syndynamical position of the distinguished communities are given.

KEY WORDS - Syntaxonomy, Vegetation syndynamics, classification, pioneer forest.

INTRODUCTION

From about 65 species of the *Betula* genus of the northern temperate and arctic zone (Krüssmann, 1976; Hegi, 1981) only *Betula pendula* appears in Greece. Its distribution is limited to the northern mountains (Varnous, Voras, Vermio, Paiko, Beles, Orvilos, Lailias in Serres, Pangeo, Phalakro and Rhodope) (Pavlides, 1985; Athanasiadis, 1986; Boratyński *et al.*, 1992; Chochliouros & Georgiadis, 1997; Christensen, 1997).

A pure birch forest which covers an area of about 1.755 ha appears in the western part of the Rhodope range. The other appearances of birch in Rhodope, as well as in other areas of Greece, are limited and here birch appears either in the form of small stands, small and larger groups or in mixture with other forest trees.

In the pollen diagram from Elatia in Drama, Rhodope (Athanasiadis *et al.*, 1993) the pollen curve of *Betula* occurs continuous from about 4 thousand years before present. However, its proportion is extremely low, suggesting its limited frequency and probably also its smaller range than today. An exception is the lower part of the

diagram where the proportions of birch pollen are higher, the highest of which coincide with a period of intense anthropogenic destruction of the natural forests at about the last half of the second millenium B.C. and the expansion of the birch forests as pioneer species.

Betula pendula has a very broad ecological range as far as its demands on climate and soil are concerned (it can resist cold and high temperatures as well as drought). It is very light-demanding, with higher demands for light than all the broad-leaved, and a cold-tolerant species. It can grow on poor and dry but also on very moist soils. It shows its best development in fresh, deep, loamy sand soils (Athanasiadis, 1986).

It also expands fast and easily due to its many small two-winged nutlets (Hegi, 1981). These characteristics make it one of the most important pioneer species which alone or together with the scots pine (*Pinus sylvestris* L.) forms pioneer forest communities in bare areas, mainly in central and northern Europe. Its comparatively low germination capacity, of about 15-20%, and the slightly late beginning of fruition restrains the speed of its expansion. As a free - growing tree it gives seeds at the age of 10-11 years, while in a stand it fruits at the age of 20 (Lamprecht, 1979). Its further expansion and its occurrence are mainly restricted by its small competitive capability in comparison to other forest species. Fast and easy expansion, when there is no competition, is a general characteristic of all pioneer species but they are also fast and easily displaced by more competitive species of subsequent successinal stages.

From a silvicultural point of view it is an excellent pioneer species for frost-stricken areas. However, it is not suitable for the creation of permanent mixed stands due to its low competitive capability (Mayer, 1980).

The research area is situated in the forest stand Kalivia Kariotou in the western Rhodope, NE of the village Potami, near the evacuated village Mavrochori (Fig. 1). The area is under the forest administration of the Forest Service of Nevrokopi. Müller (1929) reports fires of a great extend in the wider area of the Rhodope. These were caused by nomad breeders (Sarakatsane) who lived in these forests. Today the area is only grazed by cows.

On the side of Nevrokopi, and after the village Potami, the present vegetation is differentiated according to altitude. Birch stands appear above the deciduous oak zone; above and among these stands expand forests of scots pine, while along streams of constant waterflow azonal stands of *Alnus incana* ssp. *incana* are dominant. Limited beech and Norway spruce stands can be observed as well as grasslands and partly forest-covered areas (<30% coverage) with oaks species, birch and scots pine.

Geologically the area belongs to the Rhodope massif (Mountrakis, 1985). The rocks are acid igneous rocks (granites, granodiorites, monzonites) (IGME, 1983) and the soil is sandy loam.

The climate of the Kalivia Kariotou area where the birch expands, could be classified in the Dfb climatic type according to Köppen's classification, that is humid continental climate with a harsh winter, a short hot summer and a rather uniform distribution of rainfall during the year (Athanasiadis *et al.*, 1992).

The bioclimate is of a temperate axeric character (this character does not belong to the mediterranean bioclimates but is close to or belongs to the bioclimates of Middle Europe) and the research area is classified in the humid bioclimatic layer with a harsh winter (specifically in a higher hyperhumid bioclimatic sublayer) and partly in the subhumid bioclimatic layer with a harsh winter (Mavrommatis, 1980).

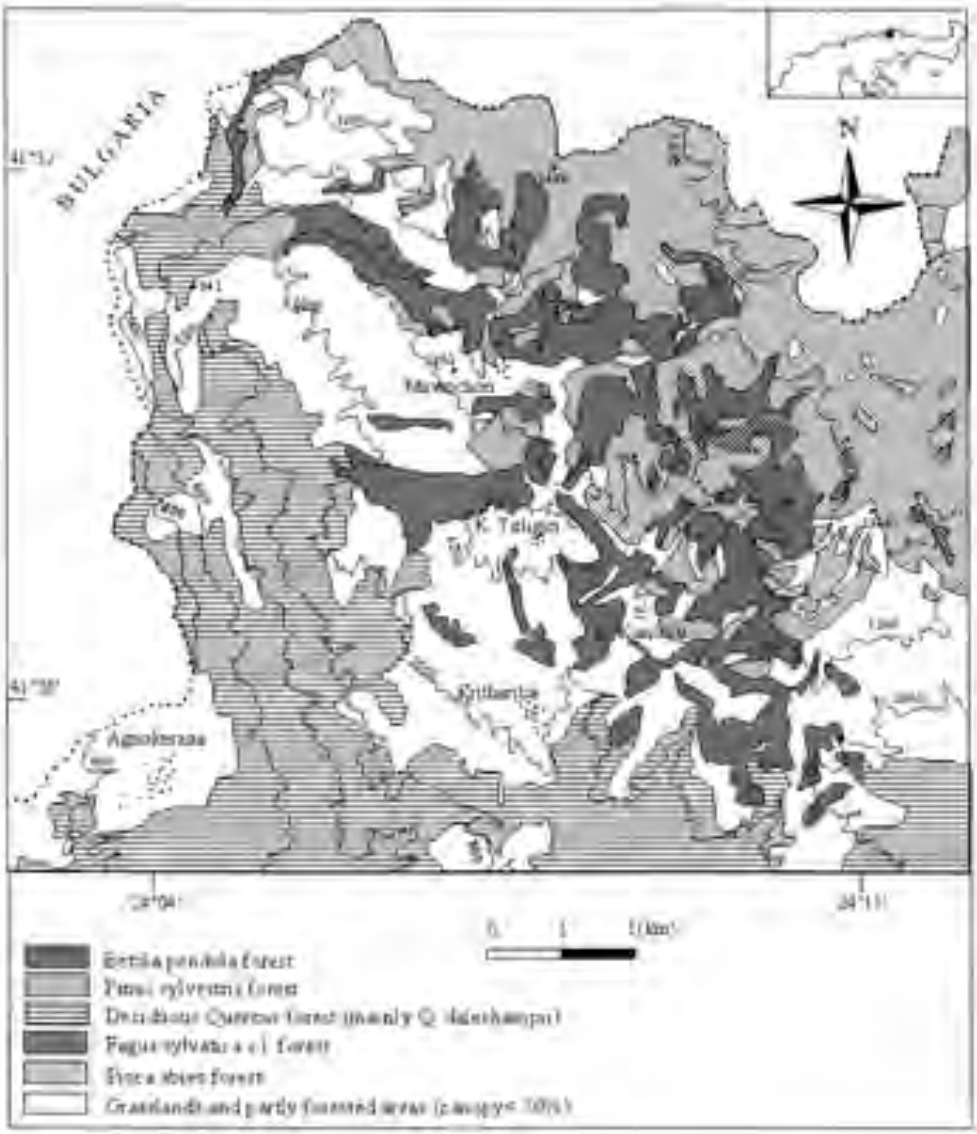


Fig. 1 - Vegetation map of the study area

MATERIAL AND METHODS

The birch stands in the research area are of an even age, because they naturally established at the same time in big areas.

Data from 36 sample plots were recorded in July 1990 and 1991 with the use of the Braun-Blanquet method (Braun-Blanquet, 1964; Westhoff & van der Maarel, 1973). Plot size was 300 m^2.

Physiographical data i.e. elevation, exposure, slope, macrorelief, were taken from each sample plot and the ground cover of the layer of the trees, shrubs and herbs was estimated. In representative sample plots five soil profiles were investigated with systematic description and with laboratory analyses for each soil horizon. The laboratory analyses included: a) mechanical analysis (siphon method), b) determination

of pH (electrometric method in soil: water suspension 1:5), c) content in organic carbon (C%) (method of liquid acidity with acidic medium $K_2Cr_2O_7$) and d) content of total nitrogen (N%) (Kjeldahl method). The description of the soil profiles and the soil analyses were conducted according to Papamichos & Alifragis (1988).

The identification and nomenclature of the taxa follows "Flora Europaea" (Tutin *et al.* 1968-1980; 1993). The species of genus *Galium* which were identified following Krendl (1988) are an exception. Species of the *Hieracium* genus were confirmed or identified by G. Gottschlich (Tübingen) a specialist on *Hieracium* genus.

Two-way indicator species analysis (Twinspan) (Hill, 1979) was applied, as the classification technique. In addition, hand sorting was found necessary to achieve the final phytosociological table.

The syntaxonomy (character species, distinctly defined vegetation units, nomenclature) was conducted on the basis of recent manuals and research papers such as those of Horvat *et al.* (1974), Ellenberg (1978), Barkmann *et al.* (1986), Bergmeier (1990), Oberdorfer (1992), Mucina *et al.* (1993), Pott (1995) and others.

Results

General site characteristics

The sample plots were made at altitudes between 1100 – 1350 m above sea level, at slopes with inclination of 5-68%, and at mainly northern exposures and mainly at the upper and lower part of slopes (Tab. 1).

The geological substrate consist of acid igneous rocks (granites, granodiorites, monzonites). The birch forests occur on shallow to very deep, sandy loam (SL), acid brown forest soils (Tab. 2) of fine, weak, subangular structure. They are poor in organic matter and nitrogen. In the soil there is skeletal material of a small rate (<20% per volume). At some positions the rate of skeletal material reaches even that of 50% per volume.

The canopy is dominated by *Betula pendula*, while *Pinus sylvestris* occurs in all layers. From the other forest species *Fagus sylvatica* s.l. raises to the tree layer only in a part of the birch forests, where establishment of *Pinus sylvestris* is less; while at low positions near the streams, in the tree layer a scattered presence of the following species can be detected: *Alnus incana, A. glutinosa, Populus nigra*. The tree layer has a height of 11-25 m and a cover degree of 30-70 (80%). The shrub layer has an average height of 2 m, covers 5-50% of the sample plot area and comprises: *Betula pendula, Quercus dalechampii, Fagus sylvatica* s.l., *Corylus avellana, Rosa canina, Crataegus monogyna* var. *monogyna, Picea abies* ssp. *abies, Chamaecytisus eriocarpus, Pinus sylvestris, Juniperus communis* ssp. *communis, Genista lydia* and others. The herb layer is rich in species with a cover degree of 80-95%. In this layer there is mainly regeneration of the following: *Quercus dalechampii, Fagus sylvatica* s.l., *Rosa canina, Crataegus monogyna* var. *monogyna, Rubus idaeus, Chamaecytisus eriocarpus, Pinus sylvestris* and others. The absence of natural regeneration of *Betula pendula* is worth mentioning.

TABLE 1 - PHYSIOGRAPHY OF THE SAMPLE PLOTS OF THE *FAGO SYLVATICAE-BETULETUM PENDULAE* AND OF THE *QUERCO DALECHAMPII-BETULETUM PENDULAE*.

	Betula pendula forests		Association *Fago sylvaticae - Betuletum pendulae*		Association *Querco dalechampii - Betuletum pendulae*		Subassociation *genistetosum carinalis*		Variant with *Galium aparine*	
EXPOSURE	Sample plots	%	Sample plots	%	Sample plots	%	Sample plots	%	Sample plots	%
NW	11	31	4	50	7	25	6(2+4)*	38(29+45)	1(0)**	8(0)
NNW	3	8	0	0	3	11	2(1+1)	13(14−11)	1(0)	8(0)
N	8	22	4	50	4	14	2(1+1)	12(14+11)	2(2)	17(29)
NNE	2	6	0	0	2	7	2(2+0)	12(29+0)	0(0)	0(0)
NE	3	8	0	0	3	11	1(0+1)	6(0+11)	2(0)	17(0)
ENE	1	3	0	0	1	4	0(0+0)	0(0+0)	1(1)	8(14)
SE	1	3	0	0	1	4	0(0+0)	0(0+0)	1(1)	8(14)
SSE	1	3	0	0	1	3	0(0+0)	0(0+0)	1(0)	9(0)
S	1	2	0	0	1	3	0(0+0)	0(0+0)	1(1)	8(14)
W	3	8	0	0	3	11	3(1+2)	19(14+22)	0(0)	0(0)
WNW	2	6	0	0	2	7	0(0+0)	0(0+0)	2(2)	17(29)
TOTAL	36	100	8	100	28	100	16(7+9)	100(100−100)	12(7)	100(100)
INCLINATION										
0-30%	17	47	0	0	17	61	10(6+4)	63(86+45)	7(4)	58(57)
31-60%	17	47	7	88	10	36	5(1+4)	31(14+44)	5(3)	42(43)
> 61%	2	6	1	12	1	3	1(0+1)	6(0+11)	0(0)	0(0)
TOTAL	36	100	8	100	28	100	16(7+9)	100(100−100)	12(7)	100(100)
ELEVATION										
1100 1200	22	61	0	0	22	78	12(5+7)	75(72+78)	10(5)	83(71)
1201 1300	7	19	4	50	3	11	3(1+2)	19(14+22)	0(0)	0(0)
1301 – 1350	7	20	4	50	3	11	1(1+0)	6(14+0)	2(2)	17(29)
TOTAL	36	100	8	100	28	100	16(7+9)	100(100+100)	12(7)	100(100)
MACRORELIEF										
UPPER SLOPE	20	56	2	25	18	64	14(5·9)	88(72+100)	4(3)	33(43)
MIDDLE SLOPE	5	14	3	38	2	7	1(1+0)	6(14+0)	1(0)	9(0)
LOWER SLOPE	11	30	3	37	8	29	1(1−0)	6(14+0)	7(4)	58(57)
TOTAL	36	100	8	100	28	100	16(7+9)	100(100+100)	12(7)	100(100)

* In the parenthesis the first column refers to var. with *Anthoxanthum odoratum* and the second column to species poor variant

** Numbers in parenthesis refer to the *Pteridium aquilinum* facies.

TABLE 2 - CHARACTERISTICS OF THE SOIL PROFILES OF THE SAMPLE PLOTS OF *QUERCO DALECHAMPII - BETULETUM PENDULAE* (PLOT 3,4,31,33) AND OF *FAGO SYLVATICAE - BETULETUM PENDULAE* (PLOT 29).

					Mechanical analysis								
1	2	3	4	5	6	7	8	9	10	11	12	13	14
3	A_{00}	2-1	-	-	-	-	-	-	-	-	-	-	-
	A_0	1-0	-	-	-	-	-	-	-	-	-	-	-
	A	0-9	10YR 4/3	4.1	66.9	9.2	23.9	SCL	0	2.08	3.59	0.16	13.0
	B	9-19	10YR 4/4	4.3	80.3	9.2	10.5	SL	0	0.63	1.09	0.10	6.3
	C	-	-	-	-	-	-	-	0	-	-	-	-
4	A_{00}	3-2	-	-	-	-	-	-	-	-	-	-	-
	A_0	2-0	-	-	-	-	-	-	-	-	-	-	-
	A	0-20	10YR 4/4	4.2	72.3	14.5	13.2	SL	0	1.32	2.28	0.11	12.0
	B_1	20-56	10YR 4/4	4.9	69.9	13.9	16.2	SL	0	0.87	1.50	0.06	14.5
	B	56-96	10YR 4/4	4.8	70.6	13.9	15.5	SL	0	0.83	1.43	0.07	11.86
	C	96-100+	-	-	-	-	-	-	-	-	-	-	-
29	A_{00}	5-3	-	-	-	-	-	-	-	-	-	-	-
	A_0	3-0	-	-	-	-	-	-	-	-	-	-	-
	A	0-8	10YR 3/2	5.3	77.4	11.3	11.3	SL	0	1.73	2.98	0.25	6.92
	B_1	9-50	10YR 4/4	4.9	77.0	12.5	10.5	SL	0	0.18	0.31	0.02	9.0
	B	50-100+	10YR 5/6	4.9	77.6	9.1	13.3	SL	0	0.63	1.09	0.07	9.0
33	A_{00}	4-2	-	-	-	-	-	-	-	-	-	-	-
	A_0	2-0	-	-	-	-	-	-	-	-	-	-	-
	A	0-8	10YR 3/2	5.4	71.3	17.8	10.9	SL	0	2.47	4.26	0.35	7.06
	B	8-29	10YR 4/3	5.0	70.0	13.7	16.3	SL	0	1.19	2.05	0.16	7.44
	C_1	29-56+	10YR 5/6	4.8	68.3	18.9	12.8	SL	0	0.78	1.34	0.06	13.0
31	A_{00}	4-2	-	-	-	-	-	-	-	-	-	-	-
	A_0	2-0	-	-	-	-	-	-	-	-	-	-	-
	A	0-38	10YR 4/4	4.8	68.1	17.4	14.5	SL	0	1.48	2.55	0.16	9.25
	B	38-70	10YR 4/3	5.0	74.9	14.2	10.9	SL	0	0.75	1.29	0.08	9.38
	C_1	70-75+	-	-	-	-	-	-	0	-	-	-	-

1= Plot number, 2= Soil horizon, 3= Soil depth (cm), 4= Soil colour, 5= pH (1:5 soil : water), 6= Sand (%), 7= Silt (%), 8= Clay (%), 9= Soil texture (SL= sandy loam, SCL= sandy clay loam soil), 10= $CaCO_3$ (0= no reaction in HCl), 11= Organic carbon (C%), 12= Organic matter (C% x1.724), 13= Total nitrogen (N%),14= C/N - ratio

Phytosociologically, two associations as well as inferior phytosociological units were distinguished after the working out of the relevés into a table following the Braun-Blanquet method (Tab. 3). The syntaxonomy, the structure, the synecology and the syndynamics of the distinguished phytosociological units are discussed.

SYNTAXONOMIC REVIEW

Quercetea pubescentis Oberd. 1948 ex auct. (in Oberdorfer 1948 non valid. publ.)
Quercetalia pubescentis Br.-Bl. 1931 ex auct. (in Braun-Blanquet 1931 non valid. publ.)
Quercion confertae Ht. ex Horvat 1958
Querco dalechampii-Betuletum pendulae ass. nov.
var. with *Galium aparine*
Pteridium aquilinum facies

genistetosum carinalis subass. nov.
var. with *Anthoxanthum odoratum*
species poor variant
Querco-Fagetea Br.-Bl. et Vlieger in Vlieger 1937
Fagetalia sylvaticae Pawl. in Pawl. *et al.* 1928
Fagion sylvaticae Luquet 1926
Fago sylvaticae-Betuletum pendulae ass. nov.

***Querco dalechampii-Betuletum pendulae* ass. nov. hoc loco (Tab. 3/9-36)**
Nomenclatural type: Table 3, type-relevé 14

The association is differentiated by the presence of *Quercus dalechampii* in the shrub and herb layer. Moreover, it is characterised by the existence of a group of local characteristic species (only for Rhodope mountains) which are also local differential species for *Fago sylvaticae-Betuletum pendulae*. This group comprises 11, mainly light - demanding species. The association was classified in the Quercion confertae (although there is small representation of the Quercion confertae species) and the Quercetea(-alia) pubescentis. The presence of the Querco-Fagetea and the Fagetalia sylvaticae species is also important. This can be explained by the development of the studied birch forests in the deforestated, transitional zone between the deciduous oak forests zone and that of the beech forests.

Querco dalechampii - Betuletum pendulae association is described phytosociologically for the first time. Its structure is characterised by a shrub layer with a cover degree of 5-50% in which *Betula pendula, Quercus dalechampii, Pinus sylvestris, Corylus avellana, Rosa canina, Crataegus monogyna* var. *monogyna, Chamaecytisus eriocarpus, Juniperus communis* ssp. *communis, Genista lydia* participate mainly, while other species participate at a lower degree. At the tree layer the appearance of *Pinus sylvestris* is characteristic; this with *Quercus dalechampii* determine the syndynamics of *Querco dalechampii - Betuletum pendulae* association, according to Fig. 2.

The *Querco dalechampii - Betuletum pendulae* association has been found in the Supra-Mediterranean zone of vegetation (1100 - 1350 m; 1100 - 1200: 78%, 1201-1300: 11%, 1301-1350: 11%), at different exposures (mainly NW + N + NE + NNW + NNE: 68%), at slopes of inclination 0-60% (0-30%: 61%, 31-60%: 36%, >61%: 3%), at the upper (64%), middle (7%) and lower (29%) part of slopes and at shallow to deep brown forest soils, characterized by moderate presence of subangular skeletal material. The soils are of a sandy loam texture, acid and poor in nitrogen and organic matter (Tab.2/plot 3,4,31,33).

It was distinguished in the *genistetosum carinalis* subassociation (Tab. 3/21-36) and the variant with *Galium aparine* (Tab. 3/9-20).

The *genistetosum carinalis* subassociation is mainly to be found at an altitude of 1100-1200 m a.s.l., mainly at northern exposures (NW+NNW+N+NNE+NE: 81%), at the upper part of slopes and inclinations of 5-62%. It is characterised by the intense presence of *Genista carinalis* and a group of 8 differential species which are light-demanding and indicators of dry sites. The subassociation was differentiated in a species poor variant (Tab. 3/28-36) and a variant with *Anthoxanthum odoratum* (Tab. 3/21-27). The variant with *Anthoxanthum odoratum* consists of a group of 16 differential species which have a low cover and most of them appear all over the forest, except where the species poor variant occurs. It can be found at an altitude of 1100-1200 m a.s.l., with northern exposures, mainly at the upper part of slopes and at inclinations of 5-35%. The species poor variant can be

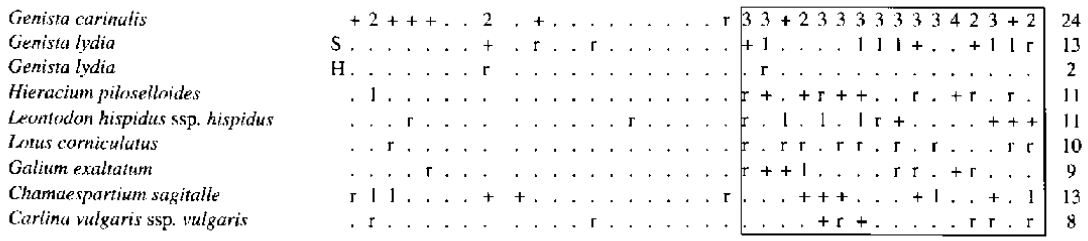
TAB. 3: *BETULA PENDULA* FORESTS IN WESTERN RHODOPE. 1-8: *FAGO SYLVATICAE-BETULETUM PENDULAE*, 9-36: *QUERCO DALECHAMPII-BETULETUM PENDULAE* (9-20: VARIANT WITH *GALIUM APARINE*; 9-15: *PTERIDIUM AQUILINUM* FACIES, 21-36: *GENISTETOSUM CARINALIS*; 21-27: VARIANT WITH *ANTHOXANTHUM ODORATUM*, 28-36: SPECIES POOR VARIANT).

Running number	1	2	3	4	5	6	7	8	9	1	1	1	1	1	1	1	1	1	1	2	2	2	2	2	2	2	2	2	2	3	3	3	3	3	3	3	
										0	1	2	3	4	5	6	7	8	9	0	1	2	3	4	5	6	7	8	9	0	1	2	3	4	5	6	
Plot number	2	3	3	8	1	1	1	2	2	1	2	3	6	1	2	1	7	2	2	3	5	9	1	3	3	3	4	1	1	1	1	2	2	2	2	3	
	9	4	5		6	7	9	8	7					8	3	4		0	2	3			5	0	1	6		0	1	2	3	1	4	5	6	2	
Elevation (m a.s.l. x 10)	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	
	2	3	3	2	3	3	2	2	3	1	1	1	1	3	1	1	1	1	1	1	1	2	2	2	1	3	1	1	1	1	1	1	1	2	2	2	
	7	5	1	6	5	4	8	9	1	0	0	1	6	5	6	8	7	5	2	8	5	0	0	6	8	4	1	4	0	2	5	5	9	0	2	4	
Exposition	N	N	N	N	N	N	N	N	W	E	W	N	S	N	S	N	N	S	N	N	N	W	N	N	N	N	N	N	N	W	W	N	N	N	N	N	
	W			W	W			W	N	N	N				E	E	N	S	W	E	W		W	N	N		N	N				W	W	W	W	E	
									W	E	W						W	E						E	E		W	W									
Inclination (%)	4	3	4	3	3	4	6	3	4	2	4	3	2	5	1	4	3	1	1	4	2	3	1	0	1	1	3	4	4	6	5	1	2	2	4	2	
	7	2	3	8	2	7	8	5	2	4	9	0	9	3	1	6	0	1	7	5	6	0	6	5	2	5	5	2	2	2	1	9	6	0	0	1	
Macrorelief (Upper, Middle, Lower)	M	L	L	M	M	U	L	U	U	L	L	L	U	U	L	L	L	L	U	M	U	U	L	U	U	U	M	U	U	U	U	U	U	U	U	U	
Cover of trees (%)	4	7	6	5	6	5	5	3	4	5	3	4	6	6	6	5	3	8	5	5	3	4	5	4	4	7	5	5	5	3	3	6	4	6	5	5	
	5	0	0	0	0	5	0	5	5	5	0	0	0	5	5	5	0	0	5	0	0	0	5	0	0	0	0	0	0	5	5	0	5	0	5	0	
Cover of shrubs (%)	0	3	2	1	0	1	1	1	3	0	2	5	3	1	1	0	1	1	0	3	3	1	1	3	5	5	3	1	2	1	1	1	2	2	2	3	
	5	0	5	0	5	0	0	0	5	5	0	0	0	5	0	5	5	0	5	5	0	5	5	0	0	0	0	0	0	0	0	5	0	5	0	0	
Cover of herbs (%)	9	9	9	9	9	8	9	9	9	9	9	8	9	9	9	9	9	8	9	9	9	8	8	9	9	8	8	9	9	9	8	9	9	9	8	9	
	5	5	5	0	0	5	0	0	5	5	5	0	5	0	5	0	5	5	5	5	5	0	0	5	5	5	5	0	5	0	5	0	0	0	5	5	
Height of trees (m)	2	1	1	2	1	1	1	1	1	2	2	2	1	1	2	1	2	1	2	2	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	
	0	8	6	2	6	9	7	1	5	0	5	2	6	9	3	8	1	7	0	0	7	5	5	6	9	3	4	4	4	3	6	4	3	3	5	5	
Diameter of trees (cm)	2	2	1	3	2	3	2	1	1	2	2	4	3	2	3	2	2	2	3	2	2	2	2	1	3	1	1	2	1	1	1	1	1	1	2	2	
	9	0	8	0	4	0	9	3	9	7	7	2	1	3	4	3	7	9	0	6	3	9	2	7	2	7	9	3	5	6	9	9	7	7	5	1	
Day	1	0	0	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0	1	1	1	1	0	0	1	1	1	1	1	1	1	1	1	0	P
	2	9	9	0	1	1	1	2	2	0	0	0	0	1	2	1	0	2	2	8	0	1	1	2	8	9	0	1	1	1	1	2	2	2	2	8	R
Month	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	E
	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	S
Year	9	9	9	9	9	9	9	9	9	9	9	9	9	9	9	9	9	9	9	9	9	9	9	9	9	9	9	9	9	9	9	9	9	9	9	9	E
	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	1	1	0	0	0	0	0	0	0	0	0	1	N
Number of species	4	5	7	5	5	3	4	3	4	7	6	7	5	4	4	3	5	5	4	7	6	6	6	5	8	5	6	4	4	4	4	4	4	4	4	6	C
	4	5	1	8	3	5	0	4	8	4	8	5	9	3	6	9	6	8	7	1	7	0	0	5	8	5	6	0	0	1	2	6	7	1	9	9	E

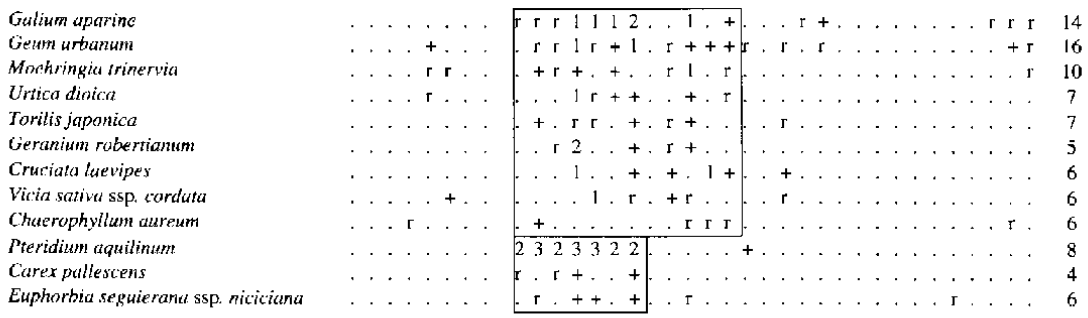
Local character-species of *Fago sylvaticae-Betuletum pendulae* (1-8) and of *Quercо dalechampii-Betuletum pendulae* (9-36)

Betula pendula	T	3	4	4	4	4	4	4	3	3	4	3	3	4	4	4	4	3	4	4	3	3	3	4	3	3	4	3	4	4	3	3	4	3	3	4	3	36
Betula pendula	S	+	+	+	1	.	1	1	1	1	.	.	+	2	+	+	.	1	+	.	.	2	1	1	1	3	+	1	1	1	1	1	+	+	+	+	2	30
Betula pendula	H	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	r	.	.	.	.	.	.	.	.	.	.	.	.	.	1
Fagus sylvatica s.l.	T	.	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	.	.	.	.	.	.	2
Fagus sylvatica s.l.	S	1	+	+	.	+	+	1	1	+	r	.	.	.	.	.	.	.	.	.	.	r	.	.	.	.	.	.	.	.	+	+	.	.	.	.	.	12
Fagus sylvatica s.l.	H	.	.	r	.	.	.	.	.	.	.	.	r	.	.	.	r	.	r	.	.	.	.	.	.	.	r	r	.	.	r	.	r	.	r	r	.	10
Vaccinium myrtillus		3	1	1	.	+	1	r	+	.	.	.	.	.	1	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	9
Hieracium erythrocarpum ssp. *leilae*		.	+	1	r	r	.	r	r	.	.	r	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	+	.	.	.	.	.	.	.	.	+	10
Pulmonaria rubra		.	+	r	+	.	r	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	r	.	.	.	.	.	.	.	.	.	.	.	5
Cirsium appendiculatum		r	r	r	.	.	r	.	.	.	.	.	.	.	r	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	5
Ajuga reptans		.	.	+	r	.	1	.	.	.	.	.	.	.	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	4
Campanula trachelium ssp. *athoa*		.	.	+	r	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	r	.	.	.	.	.	.	.	.	4
Quercus dalechampii	S	.	.	.	.	.	.	.	+	+	1	2	.	.	.	.	1	.	.	.	+	+	.	.	.	+	.	+	.	+	+	.	.	+	.	.	+	13
Quercus dalechampii	H	.	.	r	.	.	.	.	.	r	.	r	r	.	.	.	r	r	.	.	+	.	r	.	.	r	.	r	.	.	.	.	+	r	r	r	r	15
Crataegus monogyna var. *monogyna*	S	.	.	.	.	.	.	.	.	+	+	r	r	r	.	+	+	1	1	+	1	r	r	+	.	+	.	.	+	+	+	+	.	+	+	+	.	22
Crataegus monogyna var. *monogyna*	H	.	.	.	.	.	.	.	.	.	.	.	.	r	.	r	.	.	.	r	+	r	.	.	.	+	.	r	r	r	r	.	r	r	r	.	r	14
Teucrium chamaedrys		.	.	.	.	.	.	.	.	.	r	.	.	+	.	.	.	.	.	.	+	+	+	+	.	r	.	.	r	.	+	+	+	+	.	+	r	14
Galium verum ssp. *veram*		.	.	r	.	.	.	.	.	.	r	.	r	.	.	.	.	r	+	1	r	r	.	+	r	+	.	.	.	.	.	.	r	.	+	+	r	15
Dianthus cruentus ssp. *turcicus*		.	.	.	.	.	.	.	.	r	.	.	.	r	.	.	.	.	r	.	r	r	+	r	.	.	.	r	r	.	.	.	r	.	r	r	.	12
Vicia dalmatica		.	.	.	.	.	.	.	.	1	2	.	.	2	.	.	.	+	r	+	1	+	.	.	+	.	.	.	+	r	.	.	.	.	.	+	.	12
Thymus degenii		.	.	.	.	.	.	.	.	+	r	.	.	.	.	.	.	.	.	.	+	1	.	+	+	.	.	+	.	.	+	.	+	1	.	+	r	12
Cirsium ligulare		.	.	.	.	r	.	.	.	.	.	.	r	r	.	r	.	+	.	r	.	r	.	r	.	+	.	.	r	.	.	.	.	r	.	.	.	11
Astragalus glycyphyllos		.	r	.	.	+	.	.	.	+	.	.	r	1	.	.	.	.	.	.	.	r	1	+	+	.	.	r	+	.	.	.	.	.	.	.	1	12
Ranunculus polyanthemos ssp. *polyanthemos*		.	.	r	.	.	.	.	.	.	.	r	r	.	.	r	.	.	r	.	r	.	.	r	.	+	.	.	.	.	.	.	r	.	.	.	r	10
Thymus ocheus		.	.	r	.	.	.	.	.	.	r	.	.	+	.	.	.	.	.	.	.	.	+	.	.	r	.	.	.	r	.	+	.	.	1	.	.	8

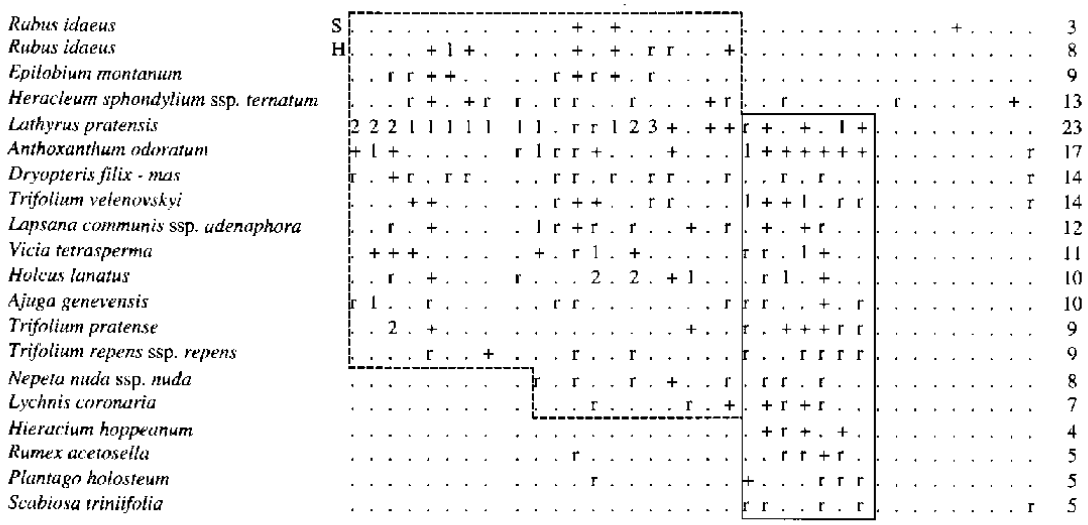
***Querco dalechampii-Betuletum pendulae, genistetosum carinalis* (21-36)**



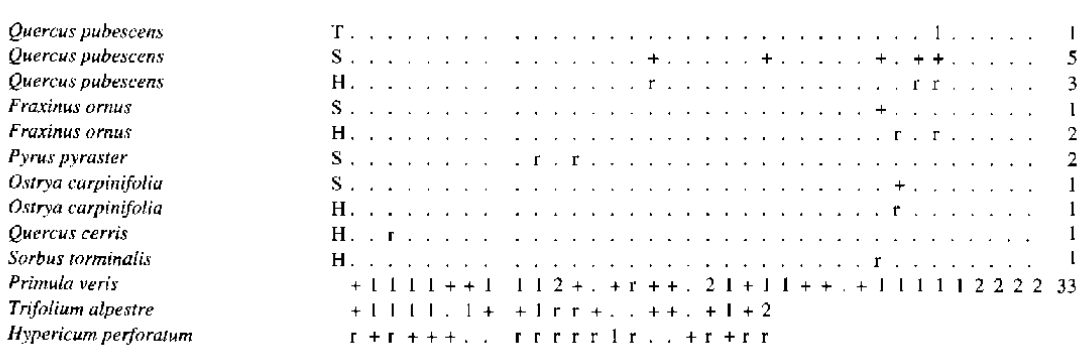
Querco dalechampii-Betuletum pendulae, variant with _Galium aparine_ (9-20), _Pteridium aquilinum_ facies (9-15)



Querco dalechampii-Betuletum pendulae, variant with _Anthoxanthum odoratum_ (21-27), species poor variant (28-36)



Character-species of _Quercetea pubescentis_ Oberd. 1948 ex auct. (in Oberdorfer 1948 non valid. publ.), of _Quercetalia pubescentis_ Br.-Bl. 1931 ex auct. (in Braun-Blanquet 1931 non valid. publ.) and of _Quercion confertae_ Ht. ex Horvat 1958.



Brachypodium sylvaticum ssp. *sylvaticum*	1 + + . . 1 . . 1 2 + + 2 1 1 1 + + 3 + 1 1 + + . . + + . . 1 + . + 1 +	27
Aremonia agrimonoides ssp. *agrimonoides*	+ 1 1 . + 1 + . r + + r . 1 r r r r + + r r . . . + r + r . r . . r . +	26
Clinopodium vulgare ssp. *vulgare*	. . . + + . r + + + + . + + + + + 1 + 1 . + + + . + . . r r + + r . + .	25
Campanula persicifolia ssp. *persicifolia*	1 r r r . . r + + . r . . r r . r . r . . + r r r r . . . + + + r + . .	22
Filipendula vulgaris	. . . . . r r . . . . . 1 . . . . . r	4
Luzula forsteri	. . . . . + . r . . . . . + ...	3
Trifolium medium ssp. *balcanicum*	. 1 . r . . . . . + ...	3
Agrimonia eupatoria ssp. *eupatoria*	. . r . . . . r	2
Silene italica ssp. *italica*	. . . . . r . . . . . r .	2
Tanacetum corymbosum ssp. *corymbosum*	. . . . . + . . . r	2
Potentilla micrantha	. . . . . r	1

Character-species of *Fagetalia sylvaticae* Pawl. in Pawl. *et al.* 1928 and of *Fagion sylvaticae* Luquet 1926

Corylus avellana	S . . + + + . . + . 1 2 3 . . . . . 1 + . . + 2 + + . + ... r + +	17
Corylus avellana	H . . . . . r . . . . . r . r . . . r . r r	6
Rosa arvensis	S . . . . . r	1
Rosa arvensis	H . . . . . r . . . . . r . . . . r	3
Prunus avium	T . . . . . + ...	1
Prunus avium	S . . . . . + ...	1
Prunus avium	H . . . . . r	1
Carpinus betulus	S 1	1
Luzula luzuloides	2 3 3 3 2 2 3 2 2 + 3 1 + 1 . 2 4 + . 1 2 . 2 2 3 3 2 3 2 r r . + + 1 3	32
Deschampsia flexuosa	2 2 1 1 1 1 + 1 1 + + + r + . 1 2 + . . 2 1 1 1 2 1 2 1 1 2 2 1 2 2 2 3	33
Viola riviniana	1 2 2 1 1 1 1 1 1 2 2 . . 1 1 1 1 . + 1 + . . 1 + + 1 + + + + . 1 + . 2	29
Euphorbia amygdaloides ssp. *amygdaloides*	1 1 1 1 1 2 1 . 1 + + r . 1 . 1 1 . . 1 . . . 1 2 + . + . 1 + ... +	22
Digitalis viridiflora	. . . + . . r r . . r r . + . . . r + r 1 1 r r + . r + + + . + . . . 1	20
Epipactis helleborine	. r . + ... r r . r . . + ... + . + . . .	8
Salvia glutinosa	. . . + ... + + + ... 1 + + ...	7
Bromus benekenii	. . . r . . . . r . . . . r .	3
Platanthera chlorantha	. r . . . r	2
Campanula rapunculoides	. . . . . r	1
Carex digitata	. . . . . r	1
Festuca cf. *drymeja*	. . . . . + ...	1
Paris quadrifolia	. . . . . r	1
Milium effusum	. . . . . r	1
Melica nutans	. . . . . + ...	1
Stachys sylvatica	. . . . . + ...	1

Character-species of *Querco-Fagetea* Br.-Bl. et Vlieger in Vlieger 1937

Rubus hirtus	S . . . . . + ... + ...	2
Rubus hirtus	H . . . . . r r	2
Lonicera hylosteum	S . . . . . + ...	1
Poa nemoralis	. 1 1 + + . + . 1 1 + 3 3 + + r + + + 2 + 2 1 1 + 2 + + + + r 1 1 1 1 1	33
Fragaria vesca	2 2 1 2 2 . 2 1 1 2 1 1 1 1 2 1 1 . + 1 + + + 1 1 1 1 1 2 1 1 . 1 2 1 2	33
Veronica chamaedrys ssp. *chamaedrys*	+ 1 1 r 1 + r + + + r r r + . . . + + + r r + + + 1 . . . . . + . . + +	26
Mycelis muralis	. r . . + r . . . . r + . . . r . . . . . . r . . . . r . . .	8
Agrostis capillaris	. . . . . 1	1

Character-species of *Rhamno-Prunetea spinosae* Rivas Goday et Borja Carbonell 1961 and of *Prunetalia spinosae* R. Tx. 1952

Rosa canina	S + r . 1 + . . . + 1 + 1 r . 1 + 1 1 + 1 + 1 1 . + . . + . . + 1 + 1 1 +	26
Rosa canina	H . . r . . . r . . . . . . + r . r r r . . r . . . . r r r r r . r r r	16
Rubus sanctus	S . . . . r . + . 1 . . . . r . . . . + .	5
Rubus sanctus	H . . . . + ... r . . . . . r . . . . . r . r .	5
Malus sylvestris	T . . . . + ...	1
Malus sylvestris	S . . . . + ... + + ...	3
Malus sylvestris	H . . . . r	1
Rubus candicans	S . . . . + + . + ...	3
Rubus candicans	H . . . . r + ... r	3
Prunus spinosa	S . . . . r r r	3
Prunus spinosa	H . . . . r . . . . r	2

Prunus cerasifera	T 1	1
Prunus cerasifera	S . . . . . + ...	1
Prunus cerasifera	H . . . . . r	1
Rubus saxatilis	H . . r . . . . . 2 . . . . . r	3
Clematis vitalba	H . . . . . r	1
Rosa cf. *agrestis*	H . . . . . r	1

Character-species of *Vaccinio-Piceetea* Br.-Bl. in Br.-Bl. *et al.* 1939, of *Piceetalia excelsae* Pawlowski in Pawlowski *et al.* 1928 (=*Vaccinio-Piceetalia* Br.-Bl. in Br.-Bl. *et al.* 1939) and of *Piceion excelsae* Pawlowski in Pawlowski *et al.* 1928 (=*Vaccinio-Piceion* Br.-Bl. in Br.-Bl *et al.* 1939)

Picea abies ssp. *abies*	T . 1 + ... + ... + ... +	5
Picea abies ssp. *abies*	S . + + + . . + ... + ... + r + ... + . . +	10
Orthilia secunda ssp. *secunda*	. 1 . . . . . 1 + ...	3
Pyrola minor	. . . . . r + ...	2

Companion species

Pinus sylvestris	T . . 1 + ... 1 . . + 1 . . . . + . . 1 . . . 1 + 2 . 1 + . . . 1 . +	14
Pinus sylvestris	S r 1 + . + 1 + . + ... + ... 1 1 + 2 3 2 + . + . + 1 + 1 + +	22
Pinus sylvestris	H . . . r . . . . r . . . . r . . + 1 r r . r . . + . . r r	11
Chamaecytisus eriocarpus	S . r . + 1 . . . . + . r r . + + + + + r 1 1 1 2 1 + + 1 + . + + 1 1 1 +	27
Chamaecytisus eriocarpus	H . r r . . . . r . . r + . . . r . . . r . . r . r + r .	11
Juniperus communis ssp. *communis*	S 1 2 2 1 . 1 + 1 2 . r + + 1 . . . 1 . + . + 1 2 1 3 1 . . . . 1 1 1 1 +	25
Juniperus communis ssp. *communis*	H . r r . . . r . . . . r . . . . r	5
Salix caprea	S + ... + ... + . . 1	4
Salix caprea	H r . r . . . . . r . r	4
Alnus incana ssp. *incana*	T . . . . . + ...	1
Alnus incana ssp. *incana*	S . . . . . + ... + ... 1	3
Alnus incana ssp. *incana*	H . . . . . r . . . . . r	2
Alnus glutinosa	T . . . . . . + ...	1
Alnus glutinosa	S . . . . . r	1
Populus nigra	T 1	1
Acer hyrcanum	S . . . . . r	1
Prunus sp.	H . . . . . r	1
Sambucus nigra	S 1	1
Rosa sp.	S . . . . . r	1
Dactylis glomerata	. + + 1 1 + + + 1 2 1 + r 1 1 + 1 3 1 1 + + r 1 r 1 . + + . . 1 1 + 1 r	32
Briza media ssp. *elatior*	2 1 + 1 + 1 . 1 1 + r r . 1 . 2 . + 1 + 1 + 1 1 + 1 + + 1 + 1 + + 1 2 +	32
Calamagrostis arundinacea	3 2 1 2 3 2 3 2 1 . 3 r . 2 . 2 1 r + 1 + 1 + 3 . + + 2 3 3 3 . + 1 1 3	31
Knautia ambigua	r r . r . . . . r r r r . r . r r r r r r r r r r r r r r . r r r	28
Myosotis arvensis ssp. *arvensis*	+ + + r + 1 + r r + + 1 + + + r r + + + 1 . + . 1 + + . . . r . . . . +	27
Cruciata glabra	1 + + + + 1 + 1 + + + . . + + 1 r . + + . r + + . 1 + . . + 1 r . . . +	26
Helianthemum nummularium ssp. *nummularium*	1 1 + + + . . 1 + . + ... r + + + + + 1 + r r r r + + + + + 1	26
Stellaria graminea	+ + + r + + r + + + + r . . . r r r . 1 r . + r + . + + . . r . . . r 1	25
Euphorbia cyparissias	+ . + r + . . . r . r r . . . r . . + r 1 + . r + r r . . r r r + + r	22
Festuca valesiaca	. . r . . . . + + 2 . r + . + r . + + + 2 1 + + + + ... 1 + + 1 +	22
Campanula patula ssp. *patula*	. . r . + . . . r r r + + + r r . r r . + r + . r r + ... r . . r	20
Lysimachia punctata	. . 1 r . . + . . . r r . r . + + . r + r r 1 . 1 . r r + r . . . . . +	19
Achillea millefolium ssp. *millefolium*	r . + r r . . . r r r . r . . . + r . . . + + + . r . . . . . r . . r .	16
Centaurea stenolepis ssp. *stenolepis*	+ . + + ... r + + ... 1 + . + + . r . . . . r . r . 1 r	15
Festuca peristerea	+ + + + + . . + ... + . . + . . . + . . + 1 . . . . . 1 . . . +	13
Hypochaeris maculata	r + + . r . . r . . . . r r . r . . . . . r + ... r	11
Cystopteris fragilis	. . . r . . r . . r r r . r . . . . . r . . . r . . . . r . . +	11
Veronica officinalis	r + + . . . r . . . . + . r . . . + 1 + . . r . . . + . . .	11
Vicia sepium	. . 1 . . r + . . r . . + ... + . . r . . . . r	8
Brachypodium pinnatum ssp. *pinnatum*	. . + r . . . . . + ... + ... + ... + +	7
Valeriana officinalis	. . . . . + . r + ... + ... r r	6
Leontodon autumnalis ssp. *autumnalis*	. . . . . r r . . . . . r . . . r . . . . + . .	5
Hypericum cerastoides	. . . . . r . . + ... r . . . . . r . r	5
Hieracium pilosella	. . 1 r . . . . . + . 1 . . . . . +	5
Lychnis viscaria ssp. *atropurpurea*	. r r . . . . . r . . . . . r . r	5
Phleum phleoides	. . . . . 1 . . . . . r r 1 . . . . . + . . .	5
Aegopodium podagraria	. . . . . + ... 1 . . . r + . . + ...	5

Sanguisorba minor ssp. *muricata*	. . . . . r r . . r . . . . r .	4
Leontodon hispidus ssp. *danubialis*	. . . . . r . . . . . r . . r . r . .	4
Hieracium sparsum ssp. *paniculatisimum*	. . . . . + + r . . . . . r	4
Muscari comosum	. . . . . r r . . . . . r r	4
Luzula multiflora ssp. *multiflora*	. . . . . r . . . . . + . . . r . . . . . + . .	4
Listera ovata	r + ... r . . r	4
Hieracium hoppeanum ssp. *testimoniale*	. . . . . + ... + ... l . . r	4
Stachys alpina	. . . . . r r . . . . . + . . . r	4
Stachys betonica	. . . . . + ... + . r l	4
Trifolium hybridum ssp. *elegans*	. . . . r . . . . . r . . . . . + ...	3
Hieracium cf. *Jancae/osseum*	. . . . . + . . + . . r . . .	3
Symphytum ottomanum	. . . + . + ... + ...	3
Hieracium sparsum s.l.	. . . . . r . . . r . . . l	3
Prunella vulgaris	. . . . . r . . . . . + ... r	3
Asplenium trichomanes ssp. *trichomanes*	. . . r . . r . . . . . r	3
Polypodium vulgare	r . . . . . r . . . . . r	3
Bruckenthalia spiculifolia	+ . . . . . + + ...	3
Plantago lanceolata	. . . . . r . . r . . . . . r	3
Cerastium fontanum ssp. *triviale*	. . . . . r . r . . . . . l	3
Hieracium rechingeriorum	. . . . . r . . . . . + r	3
Dactyllorhiza sambucina ssp. *sambucina*	. . . . . r . . . . . r . . . . . r	3
Elymus repens ssp. *repens*	. . . . . r . . . . . r . . . . . + .	3

Species in two or one plots:

Anthemis tinctoria r(1), +(9), *Aristolochia pallida* r(2), r(1), *Armeria rumelica* r(5), r(31), *Asplenium onopteris* r(14), r(24), *Bellardiochloa violacea* r(4), 1(5), *Carduus* cf. *kerneri* r(1), r(21), *Carex flacca* ssp. *flacca* 1(31), +(36), *Danthonia decumbens* 1(31), r(4), *Dianthus superbus* ssp. *superbus* +(7), r(17), *Equisetum arvense* r(1), +(29), *Carex spicata* r(22), +(23), *Geranium macrorhizum* 1(33), 1(19), *Hieracium* cf. *pseudolympicum* +(36), +(10), *Hieracium olympicum* ssp. *olympicum* r(1), r(12), *Hieracium olympicum* ssp. *permulticeps* +(25), +(33), *Hieracium sparsum* ssp. *peninsulare* r(4), r(34), *Oxalis acetosella* 1(35), 1(18), *Potentilla detommasii* r(6), r(31), *Potentilla erecta* r(7), r(17), *Potentilla inclinata* r(24), r(20), *Rorippa pyrenaica* r(20), r(3), *Saxifraga bulbifera* r(31), r(32), *Taraxacum* sp. r(2), r(23), *Thalictrum aquilegifolium* +(31), r(33), *Thesium alpinum* +(31), r(34), *Verbascum glabratum* r(3), r(9), *Acinos alpinus* ssp. *majoranifolius* r(6), *Agrostis castellana* r(8), *Alchemilla bulgarica* r(2), *Alchemilla* sp. r(7), *Asperula purpurea* ssp. *purpurea* +(24), *Bilderdykia convolvulus* r(33), *Botrychium lunaria* r(33), *Bromus sterilis* +(20), *Campanula lingulata* r(6), *Carex* sp. r(31), *Centaurea affinis* ssp. *affinis* r(30), *Cerastium brachypetalum* ssp. *tenoreanum* r(1), *Cirsium* sp. r(32), *Colchicum* sp. r(22), *Compositae* sp1 r(6), *Compositae* sp2 r(30), *Crepis biennis* +(4), *Cynoglosum officinale* r(15), *Cynosurus echinatus* r(20), *Dianthus* sp. r(24), *Epilobium lanceolatum* r(26), *Euphrasia* sp. r(31), *Festuca panciciana & macedonica* 1(31), *Festuca* sp. +(2), *Galium* sp. r(31), *Geranium columbinum* r(23), *Geum rivale* (r) (18), *Herniaria glabra* r(3), *Hieracium bauhini* +(4), *Hieracium caespitosum* ssp. *brevipilum* r(20), *Hieracium* cf. *pyrgosense* r(19), *Hieracium hoppeanum* ssp. *pilisquamum* +(4), *Hieracium pilosissimum* +(32), *Hieracium* sp. +(31), *Hieracium umbellatum* ssp. *umbellatum* +(22), *Holcus mollis* ssp. *mollis* +(6), *Hypericum maculatum* ssp. *immaculatum* 1(7), *Hypochaeris radicata* r(4), *Leontodon crispus* ssp. *asperrimus* r(21), *Linaria genistifolia* ssp. *euxina* r(24), *Luzula luzulina* r(25), *Oenanthe silaifolia* r(3), *Orobanche* sp. r(9), *Pimpinella saxifraga* +(7), *Plantago media* r(31), *Poa compressa* +(20), *Poa trivialis* ssp. *sylvicola* r(31), *Poa* sp. r(31), *Prunella laciniata* r(13), *Ranunculus sartorianus* +(35), *Rumex* sp. r(8), *Salvia verticillata* r(1), *Solidago virgaurea* r(13), *Trifolium campestre* r(1), *Trifolium pseudomedium* r(8), *Vicia hirsuta* +(6), *Vicia* sp. r(33).

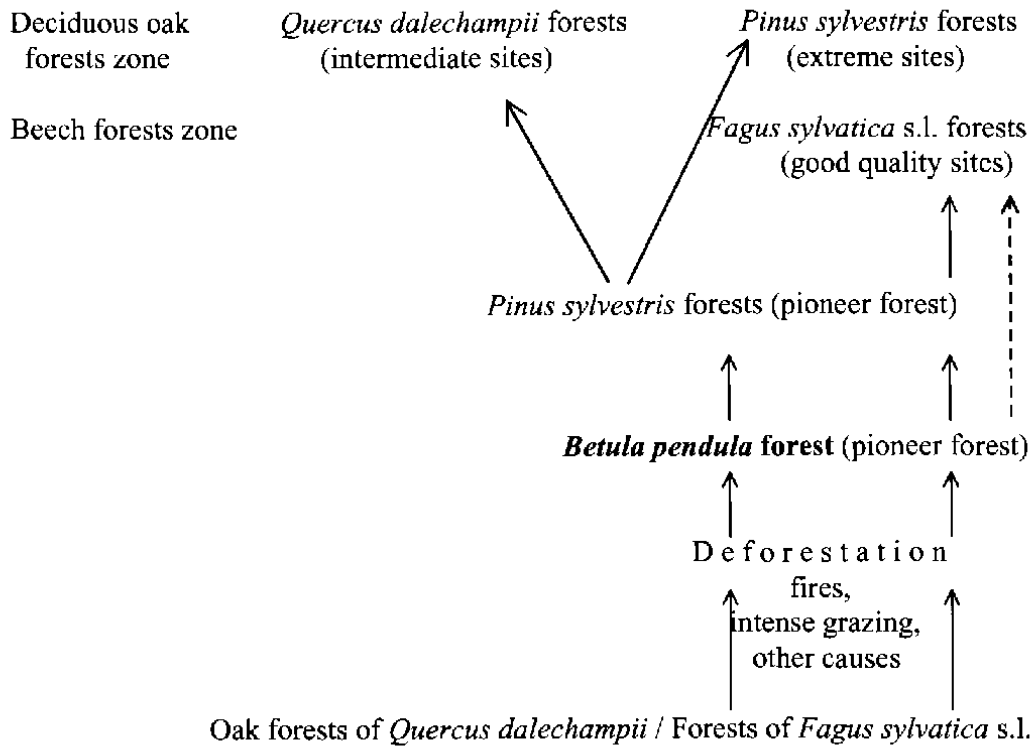


Fig. 2 - Syndynamics of the birch forests in the western Rhodope based on relevés data, physiography, soil and history of the area.

found mainly at an altitude of 1100-1200 m a.s.l., at northern exposures, at the upper part of slopes and at inclinations of 19-62% (Tab. 1).

The variant with *Galium aparine* can be found mainly at an altitude of 1100-1200 m a.s.l., at different exposures, at the lower (58%) and upper (33%) part of slopes and at inclinations of 11-53%. This variant can be identified by a group of 9 species which are indicators of rich in disposable nitrogen sites (nitrogen - demanding species). It was here that the *Pteridium aquilinum* facies (Tab. 3/9-15) which is accompanied at low cover by the species of *Euphorbia seguierana* ssp. *niciciana* and *Carex pallescens* was detected.The species of this facies are light - demanding.

***Fago sylvaticae - Betuletum pendulae* ass. nov. hoc loco** (Tab. 3/1-8)
Nomenclatural type: Table 3, type - relevé 34

The *Fago sylvaticae-Betuletum pendulae* association is characterized by the presence of *Fagus sylvatica* s.l., mainly at the shrub layer. It is also characterised by a group of 7 local characteristic species, which differentiate it from the *Querco dalechampii - Betuletum pendulae*. The association was classified in the Fagion sylvaticae and the Fagetalia sylvaticae, while the presence of species of Quercetea(-alia) pubescentis is also important. The *Fago sylvaticae-Betuletum pendulae* association is described phytosociologically for the first time.

The structure of *Fago sylvaticae - Betuletum pendulae* association is characterized by the weak presence of *Fagus sylvatica* s.l. at the tree layer and by a shrub layer with a cover degree of 5-30%, where the following species mainly participate: *Betula pendula, Fagus*

sylvatica s.l., *Rosa canina, Corylus avellana, Picea abies* ssp. *abies, Pinus sylvestris, Juniperus communis* ssp. *communis* and others. The syndynamics of *Fago sylvaticae - Betuletum pendulae* appears in Fig. 2. Its final apex must be a beech forest. The association is to be found in the Supra-Mediterranean vegetation zone (1200-1350 m; 1201 - 1300: 50%, 1301 - 1350: 50%), in north to north-western exposures and inclinations of >31% (31-60%: 88%, >61%: 12%), at the upper, middle and lower part of slopes (Tab. 1) and in deep brown forest soils which are characterized by moderate presence of subangular skeletal material. The soils are of sandy loam texture (SL), acid and poor in nitrogen and organic matter (Tab. 2/ plot 29).

Discussion

Although *Betula pendula* is widely expanded in Europe, in Greece it is limited to its northern borders (Meusel *et al.*, 1965; Jalas & Suominen, 1976; Hegi, 1981; Athanasiadis, 1986; Boratyn´ski *et al.* 1992; Tutin *et al.* 1993; Christensen, 1997). In Middle Europe and South-eastern Europe it is mainly found in the zones of Quercetalia roboris R. Tx. 1931, Fagetalia sylvaticae Pawlowski in Pawlowski *et al.* 1928, Erico - Pinetalia Horvat 1959 and Piceetalia excelsae Pawlowski in Pawlowski *et al.* 1928, where it mainly forms mixed forests or participates in the floristic composition of pure and mixed forests with the following main forest species: *Pinus nigra, Quercus petraea, Fagus sylvatica, Abies alba, Picea abies, Pinus sylvestris*. Although pure birch stands are common in Middle Europe and fragmentary in Southeastern Europe, they are not included in syntaxonomic reviews (Tüxen, 1937; Horvat *et al.*, 1974; Ellenberg, 1978; Oberdorfer, 1992; Mucina *et al.*, 1993; Pott, 1995).

There is no phytosociological or site research for pure and mixed birch stands neither for the middle-european nor the south-eastern european area.

This research paper contributes to the phytosociological and site research of the birch forests in the Greek area. Among the pioneer woody species (*Pinus sylvestris, Populus tremula* and *Picea abies)* the birch plays an important role in the dynamics of evolution of the vegetation of the research area. In its pioneer forests two associations were syntaxonomically distinguished, *Querco dalechampii - Betuletum pendulae* and *Fago sylvaticae - Betuletum pendulae,* together with their inferior units. The first association was classified in the Quercetalia pubescentis and the second in Fagetalia sylvaticae, with central point the forest character and on the basis of floristic - sociological and syndynamic characteristics of the distinguished associations.

On the basis of the relevés data, the physiography and the soil: a) *Querco dalechampii - Betuletum pendulae* will, in the best sites, develop into an oak forest with *Quercus dalechampii* (final zonal association) as a dominant species and in the worst sites into a pine forest with *Pinus sylvestris* (permanent azonal association) as a dominant species and b) *Fago sylvaticae - Betuletum pendulae*, which appears in the best sites of the birch expansion, will develop into a forest with *Fagus sylvatica* s.l. (final zonal association) as a dominant species. Both associations during their evolution will present a stage in which *Pinus sylvestris* will prevail.

The two associations appear in the western Rhodope where their geographical expansion is limited. The soils in which the birch forests develop are light, sandy loam brown forest soils, relatively new and eroded (genetically immature) because of previous land use.

Although the presence of birch in the remaining area of its geographical expansion in Greece is limited and in mixture with other forest species, the possibility of a small remaining amount of relevés that can be taken in the near future will complete the syntaxonomic position of the birch forests in the Greek area.

Riassunto

La diffusione della betulla (*Betula pendula* Roth.) in Grecia è limitata nelle montagne settentrionali (Varnous, Voras, Vermio, Paiko, Beles, Orvilos, Lailias, Pangeo, Phalakro e Rhodope). Nella parte occidentale della catena dei monti di Rhodope, esiste l' unico ampio puro bosco di betulle dell' ambiente greco, largo di 1.755 ha. Le altre presenze di betulla nell' ambiente greco si limitano in piccoli boschetti o betulle miste con altri alberi boscherecci.

I boschi di betulle della parte occidentale di Rhodope sono precursori, coetanei, e vengono da influenze intense dell' uomo (notevolmente incendi estensivi e pascolo a dismisura) nel passato recente. Si fondano su roccie acetose piriche (graniti, granodioriti, monzoniti) e si sviluppano in terreni boscherecci sabbiosi-melmosi, acetosi e scuri.

Il clima della regione è continentale umido, con inverni acuti, estati calorosi e corti e una relativamente uniforme ripartizione delle pioggie durante l' anno.

I boschi di betulle della parte occidentale di Rhodope sono stati studiati con il metodo di Braun-Blanquet con 36 relevés fitosociologici. Dal punto di vista tassonomico, sono individuate due unioni fitosociali nuove, *Querco dalechampii-Betuletum pendulae* e *Fago sylvaticae-Betuletum pendulae* insieme a unità inferiori. La prima unione fitosociale è stata inquadrata nella Quercetalia pubescentis (Quercion confertae) e la seconda nella Fagetalia sylvaticae (Fagion sylvaticae), con criterio principale il carattere del bosco, e basata sulle caratteristiche della flora e sociologiche nonchè dinamiche.

Basandosi sui dati dei relevés, la fisiologia, il clima ed il terreno: la *Querco dalechampii-Betuletum pendulae* deve svilupparsi, nelle stazioni migliori, in bosco di bettule, con varietà principale la *Quercus dalechampii* e, nelle stazioni peggiori, in bosco di pini della *Pinus sylvestris*, mentre la *Fago sylvaticae-Betuletum pendulae*, presentata nelle stazioni migliori della diffusione della betulla, deve svilupparsi in bosco di faggi. Durante il loro sviluppo, ambi le unioni fitosociali presenteranno una fase di predominanza della *Pinus sylvestris*.

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