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PLANT COMMUNITIES IN THE BOATIN BIOSPHERE RESERVE ON
THE NORTHERN SLOPES OF THE STARA PLANINA MTS. (CENTRAL
BULGARIA)

ZBIOROWISKA ROŚLINNE REZERWATU BIOSFERY BOATIN NA
PÓLNOCNÝCH STOKACH MASYWU STAREJ PLANINY (ŚRODKOWA
BUŁGARIA)

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Abstract. The Boatin biosphere reserve, covering an area of 1280 ha, lies on the north-facing slopes of the Stara Planina mountain and safeguards the natural plant cover. In its territory there predominate beechwood associations (*Asperulo odoratae-Fagetum*, *Luzulo nemorosae-Fagetum*) covering 85% of its surface. Spruce forests (*Piceetum excelsae balcanicum*), typical of the upper mountain forest zone, occupy the upper part of the reserve ranging from 1590 to 1750 m above sea level. The reserve also includes a small part of subalpine thickets (*Juniperetum sibirici*), and grasslands.

Key words: plant communities, ecology, nature conservation, Stara Planina Mts., Bulgaria.

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Treść. Rezerwat biosfery Boatin, o powierzchni 1280 ha, położony na północnych stokach Starej Planiny, chroni naturalną szatę roślinną. Dominują na jego terenie zespoły lasów bukowych (*Asperulo odoratae-Fagetum*, *Luzulo nemorosae-Fagetum*) zajmujące 85% powierzchni. Bory świerkowe (*Piceetum excelsae balcanicum*), typowe dla wyższej górskiej strefy leśnej, zajmują górną część rezerwatu od 1590 do 1750 m n.p.m. Rezerwat obejmuje także niewielki fragment subalpejskich zarośli (*Juniperetum sibirici*) oraz muraw.

I. INTRODUCTION

Within co-operation with the Bulgarian Academy of Sciences, multi-directional research has been carried on in the biosphere reserves situated in a mountain range of the Stara Planina Mts. since 1978. Its aim is to compile a detail catalogue of the wilderness in the nature reserves and to estimate a threat impending over them from anthropogenic factors. The use of standardized and uniform investigating methods makes it possible to obtain results comparable with those gained for the nature reserves in the Carpathians Mts. and other mountain ranges of the Central Europe (Michalik 1984).

The present paper offers a brief phytosociological description of the Boatin biosphere reserve and a map of plant communities occurring there. This is a first attempt to classify plant communities in this nature reserve with the use of methods of the Central-European phytosociology (Michalik 1983a). In general, it corresponds with a classification accepted by Horvat, Glavač, and Ellenberg (1974). Terminology and taxonomy assumed in the present paper for some communities are still provisional. Their final denomination will be given in further papers when immense phytosociological data obtained for other nature reserves of the Stara Planina Mts. are considered.

Earlier studies on plant communities of the Central Stara Planina Mts.



Fig. 1. A general view of the Boatin reservation. A subalpine layer in the foreground; spruce forest and extensive complexes of beech-woods in the background (all photos by the Author)

Ryc. 1. Widok ogólny rezerwatu Boatin. Na pierwszym planie piętro subalpejskie, w głębi bory świerkowe i rozległe kompleksy lasów bukowych (wszystkie fotografie wykonał autor)

carried out by Bulgarian botanists (Ganchev, Kochev 1964, 1969, Garetkov 1967, Kochev 1967, 1969, 1977, 1982, Garetkov, Gueorguiev 1975, a. o.) were based on different research methods and on another classifying order.

II. TERRAIN OF RESEARCH

The Boatın biosphere reserve, 1280 ha in area, is situated on northern slopes of the Central Stara Planina Mts., a spring area of the Cherni Vit river, 10 km south of a town of Teteven. It spreads from 800 to 1800 m a.s.l., and



Fig. 2. A rocky ravine in the upper part of the reservation with thicket and grasslands communities of the subalpine zone

Ryc. 2. Skalisty wąwóz w górnej części rezerwatu ze zbiorowiskami zarośli i muraw strefy subalpejskiej

its relief is much diversified. The entire area of the reservation is dissected with deep stream valleys (fig. 1). Spring areas of streams are very steep and rocky (fig. 2). Mean inclination of slopes in this region approximates 40–50°.

III. METHODS AND SCOPE OF THE STUDY

Field phytosociological investigations were carried out in the nature reserve in 1978–1980. The methods used were those accepted in Central European phytosociology (Braun-Blanquet 1964, Pawłowski 1972). In total, 90 phytosociological records were taken from the entire reservation area with the Braun-Blanquet method. Most of them picture forest communities. Non-forest vegetation, which is less important for the nature reserve, was less carefully studied.

Distribution of plant communities is presented in a phytosociological map (fig. 3). Plant communities were mapped in the field and marked in a forest sketch-map in the scale of 1 : 10 000. The sketch-map was charted with each plant patch whose shorter side was at least 20 m long. In total, 18 units, such as complexes of communities, associations, subassociations and variants, were distinguished and mapped.

IV. CHARACTERISTICS OF PLANT COMMUNITIES

1. Fertile mountainous beech-woods *Asperulo odoratae-Fagetum*

High wood stands of this association are composed of *Fagus sylvatica* subsp. *sylvatica* (fig. 4). Occasionally *Acer pseudoplatanus*, and in upper stands also *Picea excelsa* can be met. An average height of trees in about 30 m; the



Fig. 4. High standing trees of fertile mountainous beech-woods (*Asperulo odoratae-Fagetum*)
Ryc. 4. Wysokopienny drzewostan żyznej buczyny górskiej *Asperulo odoratae-Fagetum*

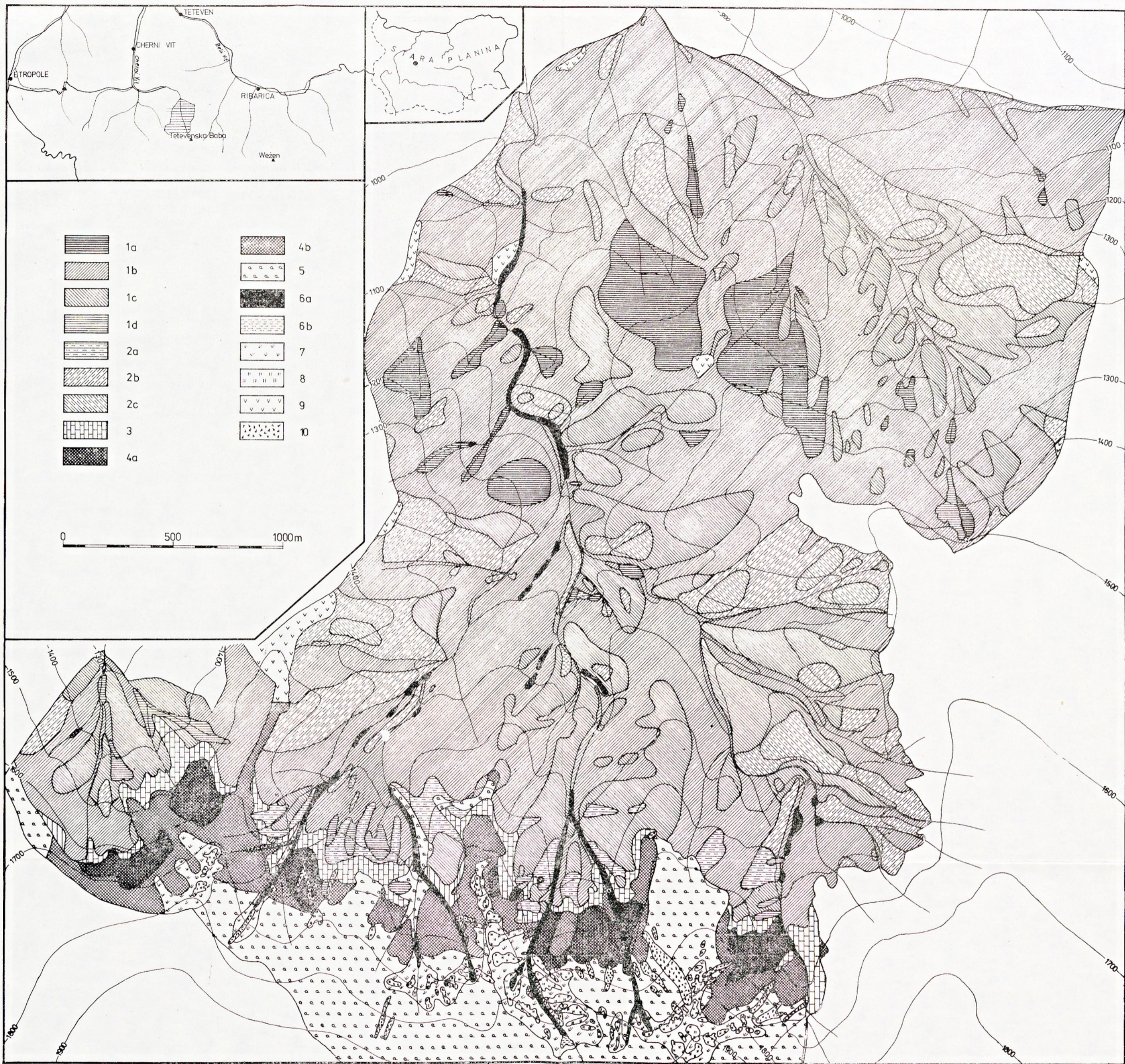


Fig. 3. A map of plant communities in the Boatin reservation: 1 — fertile mountainous beech-woods *Asperulo odoratae-Fagetum*, subassociations: a — wet *A. o.-F. lunarietosum*, b — typical *A. o.-F. typicum*, c — dry *A. o.-F. festucetosum*; d — scree *A. o.-F. geranietosum*; 2 — acidmountainous beech-woods *Luzulo nemorosae-Fagetum*, subassociations: a — fertile *L. n.-F. luzuletosum silvaticae*; b — typical *L. n.-F. typicum*; c — poor *L. n.-F. vacciniotosum*; 3 — forest communities of the transitional zone; 4 — mountainous spruce forests *Piceetum excelsae balcanicum* (variants: a — fertile one with ferns; b — poor one with *Vaccinium myrtillus*); 5 — subalpine thickets with *Juniperus sibirica*; 6 — herb communities (a — herbs on streams with *Heraclium verticillatum*; b — intraforest swamps with *Petasites albus*); 7 — subalpine grasslands with *Festuca valida*; 8 — mountainous saxicolous grasslands with *Sesleria comosa*; 9 — poor pasturages on intraforest glades with *Nardus stricta*; 10 — fertile pasturages of intraforest glades of the order *Arrhenatheretalia*

Ryc. 3. Mapa zbiorowisk roślinnych rezerwatu Boatin: 1 — żyzna buczyna górská *Asperulo odoratae-Fagetum*, podzespoły: a — wilgotny *A. o.-F. lunarietosum*, b — typowy *A. o.-F. typicum*, c — suchy *A. o.-F. festucetosum*, d — piargowy *A. o.-F. geranietosum*; 2 — kwaśna buczyna górská *Luzulo nemorosae-Fagetum*, podzespoły: a — żyzny *L. n.-F. luzuletosum silvaticae*, b — typowy *L. n.-F. typicum*, c — ubogi *L. n.-F. vacciniotosum*; 3 — zbiorowiska leśne strefy przejściowej; 4 — górski bór świerkowy *Piceetum excelsae balcanicum* (warianty: a — żyzny z paprociami, b — ubogi z *Vaccinium myrtillus*); 5 — subalpejskie zarośla z *Juniperus sibirica*; 6 — zbiorowiska ziólorośli (a — ziólorośla nadpotokowe z *Heraclium verticillatum*, b — mokradła śródleśne z *Petasites albus*); 7 — subalpejskie murawy z *Festuca valida*; 8 — wysokogórskie murawy naskalne z *Sesleria comosa*; 9 — ubogie pastwiska na polanach śródleśnych z *Nardus stricta*, 10 — żyzne pastwiska na polanach śródleśnych z rzędu *Arrhenatheretalia*

oldest woods in the lower part of the nature reserve reach 40 m in height and single beech trees are 50 m high (Kurzyński 1983, Michalik 1984). Fertile mountainous beech woods grow in soils of moderate fertility or rich in nutrients (Garelkov et al. 1976). Diversified edaphic conditions and frequently changing local climate are factors decisive of great variability of the undergrowth in which several subassociations have been distinguished (table I).

In soils rich in humus to a considerable depth, at places of water outflows, two small patches were found in the nature reserve, in which *Allium ursinum* predominated among undergrowing plants, and hygrophylous species, such as *Corydalis solida*, *Impatiens noli-tangere*, *Chrysosplenium alternifolium*, and *Adoxa moschatellina* were abundant. The patches were not marked in the map since they covered very small areas.

In sites of similar richness and wetness, a subassociation with *Lunaria rediviva*, characteristic of spring areas in lower parts of the nature reserve, can frequently be found.

A typical subassociation grows in sites with soils moderate in richness and wetness. *Asperula odorata* and *Dentaria bulbifera* are its predominating species. Only in drier ridges and slopes, and frequently close to glades, a poorer variant with *Oxalis acetosella* develops.

A dry subassociation with *Festuca drymeja* predominating in the undergrowth and with a substantial share of acidophylous species (such as *Luzula nemorosa* and *Gallium rotundifolium*) grows usually in ridges and upper parts of slopes with dry soils.

A subassociation with *Geranium macrorrhizum* is quite different in nature; it grows exclusively in screes, boulder fields and rubbly rocks. Floristic composition of the undergrowth in this subassociation is relatively poor in species characteristic of the association, alliance and order, but saxicolous species appear (cf. table I).

2. Acid mountainous beech-woods (*Luzulo nemorosae-Fagetum*)

Coppice, often dwarfish beech-woods (fig. 5) grow in poor dry soils in mountainous ridges or on southern slopes. They are rarely met in other sites. Floristic composition of the undergrowth is very changeable and depends on conditions prevailing in a given habitat.

On more shadowy slopes with wetter soils a mesophylous subassociation develops in which *Luzula silvatica* (table II) predominates in the undergrowth. The subassociation can be met only in the upper parts of the reservation. It is characterized by an admixture of mesophylous species (such as *Dryopteris filix-mas*, *Galeobdolon luteum*, *Rubus hirtus* and *Asperula odorata*), and may be considered as a transitional link to fertile beechwoods.

A typical subassociation, with *Luzula nemorosa* var. *albida* predominating in the undergrowth, grows in sites with medially poor and moderately dry soils, most frequently in ridges and upper parts of slopes. Participation of forest mesophylous species is here much shorter, only *Festuca drymeja* and *Rubus hirtus* occur abundantly.

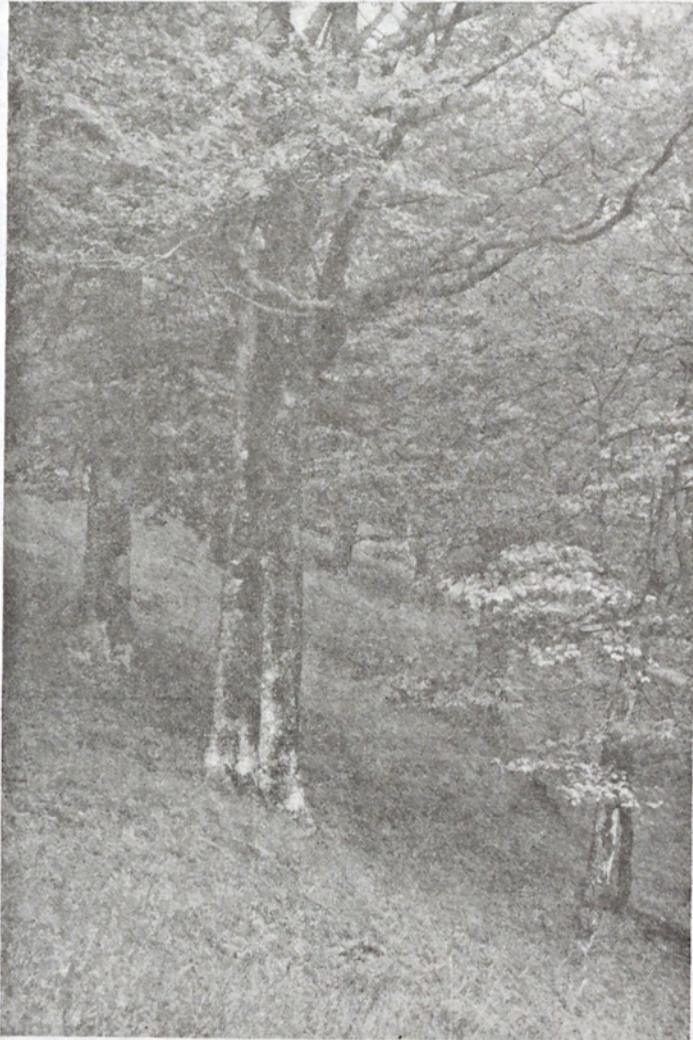


Fig. 5. Dwarfish trees of acid mountainous beech-woods (*Luzulo nemorosae-Fagetum*)
 Ryc. 5. Karłowaty drzewostan kwaśnej buczyny górskiej *Luzulo nemorosae-Fagetum*

In sites with extremely poor and dry soils, a subassociation with *Vaccinium vitis-idaea* and *Bruckenthalia spiculifolia* develops. Usually these sites appear to be steep rocky ridges or rocky southern or south-western slopes whose local climate is very dry and hot. Trees are most frequently dwarfish, sometimes shrubby. The undergrowth consists mainly of strongly acidophylous species, while mesophylous forest species are lacking (table II).

3. Communities of the transitional zone

They occur in contact sites between beech-woods and spruce forests. The zone of their occurrence is easily distinguishable and its width depends on a rate of change in habitat conditions due to the gradient of altitude. (Michalik 1983b). Among trees of the transitional zone, *Fagus sylvatica* and *Picea excelsa* should be mentioned. *Fagus sylvatica* is here dwarfish as this is an

TABLE II

Class (Klasa): *Quercu-Fagetea*
 Order (Rząd): *Fagetalia*
 Alliance (Związek): *Fagion*
 Sub Alliance (Podzwiązek): *Luzulo-Fagion*

Luzulo nemorosae-Fagetum (Du Rietz 1923) Markgr. 1932 cm. Meusel 1937

Subassociation Podzespół		<i>luzuletosum sylvaticae</i>					<i>typicum</i>					<i>vaccinietosum</i>					Presence degree (stałość)	V III I I	
Number of record Numer zdjęcia	Date Data	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15			16	17
09 1980 1520	09 1980 1520	09	09	07	09	09	09	07	09	07	09	09	09	09	09	09	07	09	09
		1980	1980	1979	1980	1980	1980	1979	1980	1979	1980	1980	1980	1980	1980	1980	1979	1980	1980
		1520	1540	1550	1580	1500	880	1130	1200	1200	1200	1250	1260	1270	1200	1400	1280	1350	1250
		NNE	NNE	NNE	N	NE	NE	SW	SSW	SW	N	SW	S	SW	S	SW	S	SW	SW
20	85	20	80	70	35	30	10	10	18	18	15	15	25	28	25	24	30	40	
85	80	80	80	80	80	80	80	80	80	75	90	85	70	85	85	65	75	75	
10	10	10	5	10	10	10	50	10	2	10	1	3	1	5	1	2	5	3	
81	71	70	75	80	75	80	70	60	80	80	85	85	65	70	50	75	60	45	
6	20	30	20	5	20	5	5	20	15	35	5	1	50	35	40	40	5	4	
200	200	100	200	100	100	100	100	200	150	200	250	150	150	150	200	150	150	150	
22	21	22	27	26	26	26	25	22	26	31	15	16	30	23	24	23	20	17	
1	2	1	+	1	+	1	3	1	3	3	3	5	1	1	1	1	1	1	
.	+	+	+	+	+	+	+	+	+	+	+	
.	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
.	1	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.

Ch. dif. *Luzulo nemorosae-Fagetum*:

Luzula nemorosa (Poll.) E. Mey var. *albida*

Prenanthes purpurea L.

Picea excelsa Lk. a

b

Table II, cont

Dif. subass. <i>Luzuletosum sylvaticae</i> :																			IV	
<i>Luzula sylvatica</i> (Huds.) Gand.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	III
<i>Asperula odorata</i> L.	+	+	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	III	
<i>Poa nemoralis</i> L.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Dif. subass. <i>vaccinietosum</i> :																			II	
<i>Bruckenthalia spiculifolia</i> (Sahsb.) Rechb.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	II
<i>Vaccinium vitis-idaea</i> L.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	1	II
<i>Hieracium pilosella</i> L.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	+	II
<i>Hieracium pratense</i> Tausch.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	+	II
<i>Hieracium sabaudum</i> L.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	II
<i>Hieracium bauchini</i> Schult.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	II
Ch. dif. <i>Luzulo-Fagion</i> :																			V	
<i>Deschampsia flexuosa</i> (L.) Trin.	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	V
<i>Vaccinium myrtillos</i> L.	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	V
<i>Polytrichum attenuatum</i> Menz.	1	2	2	1	1	1	2	1	1	2	1	1	2	1	1	1	1	1	1	V
<i>Dicranum scoparium</i> Hedw.	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	V
<i>Dicranella heteromalla</i> Schimp.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	III
<i>Senedo nemorensis</i> L.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	I
<i>Monotropa hipopitys</i> L. var. <i>glabra</i>	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	I
Ch. <i>Fagion</i> :																			V	
<i>Fagus sylvatica</i> L. a	5	5	4	5	5	5	5	5	5	5	5	5	5	5	5	5	5	4	4	V
b	2	1	+	1	1	1	1	1	+	1	+	1	+	1	1	1	1	+	+	V
c	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	II
<i>Festuca drymeia</i> Mert. et Koch	1	1	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	IV
<i>Rubus hirtus</i> W. K.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	II
<i>Veronica montana</i> L.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	I
Ch. <i>Fagetalia</i> :																			I	
<i>Dryopteris filix mas</i> (L.) Schott	+	.	.	1	+	+	.	.	.	.	.	.	.	.	.	.	.	.	.	I
<i>Galeobdolon luteum</i> Huds.	.	+	.	+	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	I
<i>Epilobium montanum</i> L.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	I
<i>Festuca gigantea</i> Vin.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	I
<i>Impatiens noli tangere</i> L.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	I
<i>Mercurialis perennis</i> L.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	I

Table II, cont

<i>Polygonatum verticillatum</i> (L.) All.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	I
<i>Sanicula europaea</i> L.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	I
<i>Viola silvestris</i> (Lam.) Rchb.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	I
Ch. <i>Quercus-Fagetea</i>:	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	I
<i>Anemone nemorosa</i> L.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	I
<i>Catharina undulata</i>	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	I
<i>Carpinus betulus</i> L. a	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	I
b	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	I
c	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	I
Others (inne):	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
<i>Calamagrostis arundinacea</i> (L.) Roth.	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	V	
<i>Hieracium murorum</i> L.	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	IV	
<i>Plantagothecium</i> sp.	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	IV	
<i>Polytrichum juniperinum</i> Willd.	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	IV	
<i>Leucobryum glaucum</i> Schimp.	III
<i>Oxalis acetosella</i> L.	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	III	
<i>Campanula patula</i> L.	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	III	
<i>Mycelis muralis</i> (L.) Dum.	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	III	
<i>Galium rotundifolium</i> L.	III
<i>Veronica officinalis</i> L.	II
<i>Athyrium filix femina</i> (L.) Roth.	II
<i>Agrostis vulgaris</i> With.	II
<i>Cladonia</i> sp.	II
<i>Festuca ovina</i> L.	II
<i>Lycopodium selago</i> L.	II

Sporadical species (gatunki sporadyczne): *Campanula rotundifolia* L. 1, 5, 14; *Cardamine impatiens* L. 4, 6, 10; *Galeopsis pubescens* Bess. 8, 9, 10; *Hieracium aevigatum* Willd. 13, 14, 15; *Hieracium racemosum* WK. 13, 14, 15; *Pirola secunda* L. 11, 12, 16; *Polypodium vulgare* L. 2, 3, 5; *Artemisia dioica* (L.) Gaertn. 14, 17; *Cladonia cornuta* (L.) Schaer. 13, 15; *Rubus* sp. 6, 8; *Brachythecium* sp. 9; *Entodon schreberi* (Willd.) Mnk. 12; *Chamaenon angustifolium* (L.) Scop. 9; *Cladonia furcata* (Huds.) Schrad. 12; *Cladonia pyxidata* (L.) Fr. 12; *Dryopteris spinulosa* (Müll.) O. Kunze. 5; *Euphrasia minima* Jacq. 16; *Fragaria vesca* L. 6; *Fragaria moschata* Duch. 8; *Geum urbanum* L. 6; *Hypochaeris radicata* L. 8; *Lapsana communis* L. 9; *Hieracium umbelatum* L. 15; *Jasione orbiculata* Grsb. 16; *Mniun affine* Bland. 6; *Moehringia pendula* Fenzl. 12; *Orchis* sp. 8; *Pitola rotundifolia* L. 12; *Polytrichum commune* L. 11; *Populus tremula* L. 17bc; *Rubus idaeus* L. 8; *Sambucus nigra* L. 9c; *Thymus balcanus* Borb. 6; *Tussilago farfara* L. 9; *Thuidium abietinum* Bt. eur. 7.

TABLE III

Forest communities of the transition zone
Zbiorowiska roślinne strefy przejściowej

		1	2	3	4	5	6	7	8	9	10	11	12	Presence degree (statość)						
Number of record														V	III	V	V	III	III	II
Numer zdjęcia																				
Date		09	09	09	09	09	07	07	09	09	07	07	09							
Data		1980	1980	1980	1980	1980	1979	1979	1980	1980	1979	1979	1980							
Altitude a.s.l.		1560	1580	1540	1560	1580	1510	1570	1600	1630	1580	1640	1580							
Wysokość n.p.m.																				
Exposure		NNE	NNE	NW	NW	NW	N	N	N	N	NNE	E	W							
Expozycja																				
Slope (degree)		20	25	30	30	30	16	18	20	25	25	35	35							
Nachylenie (w stopniach)																				
Cover of three layer (%)		65	75	75	75	80	75	70	70	84	65	80	85							
Zwarcie warstwy drzew (%)																				
Cover of shrub layer (%)		6	3	—	3	—	2	1	5 ²	—	5	5	5							
Zwarcie warstwy krzewów (%)																				
Cover of herb layer (%)		65	55	81	81	41	75	85	78	57	70	90	90							
Pokrycie warstwy zielnej (%)																				
Cover of moss layer (%)		10	35	2	13	2		3	10	13	10	1	1							
Pokrycie warstwy mszystej (%)																				
Area of record		200	200	200	200	200	150	100	150	200	200	200	150							
Powierzchnia zdjęcia																				
Number of species in the record		26	23	18	19	13	29	38	36	26	25	31	25							
Liczba gatunków w zdjęciu																				
Ch. <i>Vaccinio-Piceion</i> :		3	4	2	3	4	2	3	3	5	3	2	3							
<i>Picea excelsa</i> Lk. a		1	1	·	1	·	·	·	·	·	·	·	·							
b		3	3	1	2	1	1	1	2	1	2	2	1							
<i>Luzula silvatica</i> (Huds.) Gaud.		1	1	+	1	1	·	1	1	1	+	+	·							
<i>Homogyne alpina</i> (L.) Cass.		+	+	1	·	·	·	·	·	·	+	+	+							
<i>Galium rotundifolium</i> L.		·	·	·	·	·	·	·	·	·	·	·	·							
<i>Dryopteris austriaca</i> (Jacq.) Woytnar		·	·	·	·	+	1	2	2	1	·	·	·							
<i>Lycopodium selago</i> L.		·	·	·	·	·	·	+	+	1	·	·	·							

Table III, cont

Ch. <i>Vaccinio-Piceetea</i> ; <i>Vaccinio-Piceetalia</i> :																							V	II	I		
<i>Vaccinium myrtillus</i> L.																							+	.	.		
<i>Pirola secunda</i> L.																							+	+	.		
<i>Vaccinium vitis idaea</i> L.																							.	.	.		
Ch. <i>Fagion</i> :																											
<i>Fagus sylvatica</i> L. a	3	1	4	3	2	4	3	3	3	1	1	1	1	1	1	1	1	1	1	1	1	3	+	+	3	V	
b	1	.	.	.	.	1	1	.	1	.	+	.	+	.	.	+	.	+	.	.	.	.	+	+	+	III
<i>Luzula nemorosa</i> (Pol.) E. Mey. var. <i>albida</i>	1	1	2	2	2	+	1	+	1	1	1	1	1	1	1	1	1	1	1	1	1	2	+	+	+	V	
<i>Festuca drymeja</i> Mert. et Koch.	+	+	2	+	.	1	1	+	1	+	1	1	1	1	1	1	1	1	1	1	1	2	2	2	2	V	
<i>Prenanthes purpurea</i> L.	1	1	.	1	.	.	1	+	1	+	1	1	1	1	1	1	1	1	1	1	1	1	+	+	+	IV	
<i>Asperula odorata</i> L.	.	+	.	.	.	2	1	+	1	+	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	III	
<i>Galeobdolon luteum</i> Huds.	+	.	1	.	.	1	1	+	1	+	1	1	1	1	1	1	1	1	1	1	1	1	.	.	.	III	
<i>Rubus hirtus</i> W. K.	1	.	.	.	.	1	1	.	1	.	1	1	1	1	1	1	1	1	1	1	1	1	.	.	.	III
<i>Polystichum lobatum</i> (Huds.) Chev.	+	.	.	.	.	+	+	.	1	.	+	.	.	.	.	.	.	.	.	.	.	.	+	+	+	III
<i>Dentaria bulbifera</i> L.	.	.	.	.	.	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	.	.	.	II
<i>Polystichum setiferum</i> (Forsk.) Moore	.	.	.	.	.	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	.	.	.	II
<i>Sanicula europaea</i> L.	.	.	.	.	.	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	.	.	.	II
<i>Veronica montana</i> L.	.	.	.	.	.	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	.	.	.	II
Ch. <i>Fagetalia</i> :																											
<i>Dryopteris filix mas</i> (L.) Schott.	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	.	.	.	IV	
<i>Epilobium montanum</i> L.	+	I
<i>Scrophularia nodosa</i> L.	I
Ch. <i>Quercu-Fagetea</i> :																											
<i>Anemone nemorosa</i> L.	.	.	.	.	.	.	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	+	+	.	II
<i>Poa nemoralis</i> L.	I
Others (inne):																											
<i>Oxalis acetosella</i> L.	1	1	1	2	1	1	1	2	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	V	
<i>Calamagrostis arundinacea</i> (L.) Roth.	2	1	+	+	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	+	+	V
<i>Deschampsia flexuosa</i> (L.) Trin.	1	1	1	2	1	.	+	+	1	1	1	1	1	1	1	1	1	1	1	1	1	.	.	.	IV		
<i>Polytrichum attenuatum</i> Menz.	1	3	.	.	.	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	+	+	+	IV	
<i>Athyrium filix femina</i> (L.) Roth.	.	1	.	1	.	1	2	1	1	1	1	1	1	1	1	1	1	1	1	1	1	.	.	.	.	IV
<i>Dryopteris spinulosa</i> (Müll.) O. Kuntze	.	+	+	.	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	.	.	.	.	IV
<i>Senecio nemorensis</i> L.	1	+	1	.	.	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	.	.	.	.	IV
<i>Geranium macrorrhizum</i> L.	1	.	.	.	.	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	III
<i>Dicranum scoparium</i> Hedw.	+	1	.	.	.	.	+	2	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	III

Table III, cont

<i>Plagiothecium</i> sp.	1	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	III
<i>Campanula patula</i> L.	+	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	III
<i>Hieracium murorum</i> L.	+	.	+	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	III
<i>Cardamine impatiens</i> L.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	III
<i>Mycelis muralis</i> (L.) Dum.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	III
<i>Gentiana asclepiadea</i> L.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	II
<i>Rubus idaeus</i> L.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	II
<i>Veronica officinalis</i> L.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	II
<i>Adenostyles alliariae</i> (Gou.) Kern	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	II
<i>Phegopteris dryopteris</i> (L.) Feè.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	II
<i>Moehringia trinervia</i> (L.) Clairv.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	II

Sporadical species (gatunki sporadyczne): *Festuca rubra* L. 4, 11; *Geranium robertianum* L. 7, 8; *Hieracium sabaudum* L. 11, 12; *Myosotis silvatica* (Ehrh.) Hoffm. 8, 12; *Polypodium vulgare* L. 1, 10; *Solidago virga aurea* L. 1, 10; *Calamagrostis villosa* (Chaix.) Geml. 11; *Polytrichum juniperinum* Willd. 2; *Ajuga reptans* L. 6; *Entodon schreberi* (Willd.) Mnk. 9; *Galeopsis bifida* Boenn. 12; *Galeopsis tetrachit* L. 6; *Hypericum maculatum* Cr. 11; *Luzula forsteri* DC. 12; *Moehringia pendula* Fenzl. 11; *Polygonatum verticillatum* (L.) All. 8; *Stellaria nemorum* L. 6.

TABLE IV

Class (Klasa): *Vaccinio-Picetea*
 Order (Rząd): *Vaccinio-Picetalia*
 Alliance (Związek): *Vaccinio-Piceion*

Piceetum excelsae balcanicum

	1	2	3	4	5	6	7	8	9	10	11	Presence degree (stałość)
Number of record	07	07	09	07	07	09	09	09	09	09	09	11
Numer zdjęcia	1979	1979	1980	1979	1979	1980	1980	1980	1980	1980	1980	09
Date	1979	1979	1980	1979	1979	1980	1980	1980	1980	1980	1980	1980
Data	1660	1690	1720	1600	1600	1620	1640	1680	1680	1650	1620	1620
Altitude a.s.l.	N	N	N	NW	NNE	NNE	NW	NW	N	NNE	NNE	NNE
Wyokość n.p.m.	25	25	25	20	25	25	45	35	40	35	30	30
Ekspozycja	85	93	95	85	80	75	70	85	75	70	60	60
Slope (ć.grcc)	3	—	—	2	—	5	10	1	1	1	1	1
Nachylenie (w stopniach)	49	46	47	68	64	64	35	30	20	80	60	60
Zwarcie warstwy drzew (%)	46	35,5	40,5	25	21	23	40	15	20	40	30	30
Zwarcie warstwy krzewów (%)	100	150	200	150	150	150	150	150	150	150	200	200
Zwarcie warstwy zielonej (%)	28	26	32	18	15	15	21	22	24	25	24	24
Pokrycie warstwy mszystej (%)	5	5	5	5	5	5	5	5	5	4	4	4
Area of record	1	1	1	1	1	1	1	1	1	1	1	1
Powierzchnia zdjęcia	1	1	1	1	2	2	+	+	+	+	+	+
Number of species in the record	1	1	1	1	1	1	1	1	1	1	1	1
Liczba gatunków w zdjęciu	2	1	1	+	1	1	1	1	1	1	1	1
Ch. <i>Vaccinio-Piceion</i> :	1	1	1	1	1	1	1	1	1	1	1	1
<i>Picea excelsa</i> Lk. a	1	1	1	1	1	1	1	1	1	1	1	1
b	1	1	1	1	1	1	1	1	1	1	1	1
<i>Luzula silvatica</i> (Huds.) Gaud.	1	1	1	1	1	1	1	1	1	1	1	1
<i>Homogyne alpina</i> (L.) Cass.	1	1	1	1	1	1	1	1	1	1	1	1
<i>Dryopteris austriaca</i> (Jacq.) Woytnar	2	1	1	+	1	1	1	1	1	1	1	1
<i>Rhytidelphus triquetrus</i> (Hedlo.) Warnst.	1	1	2	2	1	1	1	1	1	1	1	1
<i>Lycopodium selago</i> L.	1	1	1	1	1	1	1	1	1	1	1	1
<i>Listera cordata</i> (L.) R. Br.	+	1	1	1	1	1	1	1	1	1	1	1

uppermost climatic zone of its occurrence. The undergrowth is a mixture of species characteristic of fertile beech-woods (e. g., *Dentaria bulbifera*, *Polystichum setiferum*, *Sanicula europaea*, *Asperula odorata*) and those typical of acidophyllous spruce forests (*Luzula silvatica*, *Homogyne alpina*, *Dryopteris austriaca*, a.o.) (table III).

4. Mountainous spruce forests (*Piceetum excelsae balcanicum*)

This association makes up an uppermost forest zone, which in the studied area is developed in the form of a narrow disrupted belt. It consists of monotonous unispecific forests of *Picea excelsa*, predominantly strongly compact (70–95%), and more loose only at the uppermost border of its occurrence.



Fig. 6. Mountainous spruce forests (*Piceetum excelsae balcanicum*: fertile variant with ferns)

Ryc. 6. Górski bór świerkowy *Piceetum excelsae balcanicum*, wariant żyzny z paprociami

TABLE V

Class (Klasa): *Vaccinio-Piceetea*
 Order (Rząd): *Vaccinio-Piceetalia*
 Alliance (Związek): *Vaccinio-Piceion*
 Sub Alliance (Podzwiązek): *Rhododendro-Vaccinion*

Juniperetum sibiricae

Number of record Number zdjęć	1	2	3	4	5	
1	2					3
Date	07	09	09	09	09	Presence degree (statość)
Data	1979	1980	1980	1980	1980	
Altitude a.s.l.	1650	1700	1710	1780	1750	
Wysokość n.p.m.						
Exposure	N	NE	NW	N	NW	
Ekspozycja						
Slope (degree)	15	30	20	20	12	
Nachylenie (w stopniach)						
Cover of three layer (%)	1	1	—	—	1	
Zwarcie warstwy drzew (%)						
Cover of shrub layer (%)	75	65	70	75	90	
Zwarcie warstwy krzewów (%)						
Cover of herb layer (%)	70	70	95	98	90	
Pokrycie warstwy zielnej (%)						
Area of record	150	150	200	150	150	
Powierzchnia zdjęć						
Number of species in the record	49	46	43	41	39	
Liczba gatunków w zdjęciu						
Ch., dif. <i>Juniperetum sibirici</i> , <i>Rhododendro-Vaccinion</i> :						
<i>Juniperus sibirica</i> Burgsd.	4	3	4	4	5	V
<i>Vaccinium uliginosum</i> L.	1	1	1	1	+	V
<i>Bruckenthalia spiculifolia</i> (Salisb.) Rchb.	1	+	+	1	+	V
<i>Cytisus supinus</i> L.	+	+	.	+	+	IV
<i>Salix silesiaca</i> Willd.	+	+	+	.	+	IV
<i>Rosa alpina</i> L.	.	+	.	+	+	III
<i>Genista sagittalis</i> L.	+	.	.	.	+	II
Ch. <i>Vaccinio-Piceion</i> , <i>Vaccinio-Piceetalia</i> , <i>Vaccinio-Piceetea</i> :						
<i>Vaccinium myrtillus</i> L.	2	3	3	3	2	V
<i>Vaccinium vitis idaea</i> L.	+	.	+	+	+	IV
<i>Picea excelsa</i> Lk. a	+	+	.	.	+	III
<i>Luzula silvatica</i> (Huds.) Gaud.	+	+	+	.	.	III
Ch. <i>Seslerietalia comosae</i> , <i>Caricetea curvulae</i> :						
<i>Agrostis vulgaris</i> With.	+	+	+	1	+	V
<i>Galium verum</i> Scop.	+	+	+	+	+	V
<i>Potentilla chrysocraspeda</i> Lehm.	+	+	+	+	+	V
<i>Crocus veluchensis</i> Herb.	+	+	+	.	+	IV
<i>Festuca varia</i> Hke.	+	+	.	+	.	III
<i>Hieracium hoppeanum</i> Shult.	+	+	.	.	+	III
<i>Sesleria comosa</i> Vel.	+	+	.	+	.	III
<i>Thlaspi alpinum</i> Jacq.	.	.	+	+	.	II
<i>Poa violacea</i> Bell.	.	.	+	.	.	I

Table V, cont

1	2					3
<i>Pedicularis orthantha</i> Grsb.	.	+	.	.	.	I
<i>Senecio carpaticus</i> Herb.	.	.	.	+	.	I
<i>Scabiosa lucida</i> Vill.	.	.	+	.	.	I
Others (inne):						
<i>Luzula nemorosa</i> (Poll.) E. Mey var. <i>cuprina</i>	1	1	1	1	1	V
<i>Deschampsia flexuosa</i> Trin.	+	+	+	1	+	V
<i>Athyrium filix femina</i> (L.) Roth.	+	+	+	+	+	V
<i>Cerastium banaticum</i> Heuff.	+	+	+	+	+	V
<i>Homogyne alpina</i> (L.) Cass.	+	+	+	+	+	V
<i>Nardus stricta</i> L.	+	+	+	+	+	V
<i>Potentilla erecta</i> Räuschel	+	+	+	+	+	V
<i>Senecio fuchsii</i> K. Gmel.	+	+	+	+	1	V
<i>Genista depressa</i> M. B.	+	+	+	.	+	IV
<i>Carex caryophyllea</i> La Taur	+	+	.	+	+	IV
<i>Dryopteris spinulosa</i> (Müll.) O. Kuntze	+	+	+	.	+	IV
<i>Festuca rubra</i> L.	+	+	+	+	.	IV
<i>Hypericum maculatum</i> Cr.	+	+	+	+	.	IV
<i>Viola dacica</i> Borb.	+	+	+	.	+	IV
<i>Rubus idaeus</i> L.	+	.	+	+	.	III
<i>Ajuga genevensis</i> L.	+	+	.	+	.	III
<i>Anthoxanthum odoratum</i> L.	+	+	.	+	.	III
<i>Calamagrostis arundinacea</i> (L.) Roth.	+	.	+	.	+	III
<i>Deschampsia caespitosa</i> P. B.	+	.	+	+	.	III
<i>Campanula sparsa</i> Friv.	+	.	+	.	+	III
<i>Carex leporina</i> L.	+	.	+	.	+	III
<i>Cystopteris fragilis</i> (L.) Bernh.	+	.	.	+	+	III
<i>Hypericum perforatum</i> L.	+	+	.	.	+	III
<i>Minuartia scitacca</i> (Thuill.) Hayek.	+	+	.	+	.	III
<i>Rumex acetosa</i> L.	+	.	+	+	.	III
<i>Stelaria graminca</i> L.	.	+	+	.	+	III
<i>Thymus balcanicus</i> Borb.	+	+	.	.	+	III
<i>Anemone nemorosa</i> L.	+	.	.	.	+	II
<i>Gentiana bulgarica</i> Vcl.	.	+	+	.	.	II
<i>Leontodon hispidus</i> L.	.	.	+	+	.	II
<i>Luzula campestris</i> Lam.	.	+	.	+	.	II
<i>Polygonum bistorta</i> L.	.	+	.	.	+	II
<i>Parnassia palustris</i> L.	+	.	.	+	.	II
<i>Ranunculus montanus</i> Willd.	.	.	+	.	+	II
<i>Silene roemerii</i> Friv.	.	.	+	.	+	II
<i>Trifolium pratense</i> L.	.	+	.	+	.	II
<i>Arctostaphylos uva-ursi</i> (L.) Sprengl.	.	+	.	+	.	II
<i>Juniperus depressa</i> Stev.	.	+	.	+	.	II

Sporadical species (gatunki sporadyczne): *Achillea grandifolia* Friv. 5; *Asperula odorata* L. 1; *Calamintha alpina* (L.) Lam. 3; *Centaurea napulifera* Rochel. 4; *Campanula rotundifolia* L. 2; *Geum montanum* L. 4; *Geum coccineum* S. S. 1; *Galium cruciatum* (L.) Scop 2; *Gnaphalium silvaticum* L. 3; *Hypericum alpinum* Kit. 3; *Ornithogallum tenuifolium* Guss. 3; *Plantago lanceolata* L. 4; *Silene inflata* Sm. 2; *Trifolium repens* L. 3; *Viola tricolor* L. 1; *Verbascum pannosum* Vis. 1.

TABLE VI

Class (Klasa): *Betulo-Adenostyletea*
 Order (Rząd): *Adenostyletalia*
 Alliance (Związek): *Adenostylon*

Heracleum verticillatum-Cirsium appendiculatum community

Number of record Numer zdjęcia	1	2	3	4	5		
	1					2	3
Date Data	07 1979	09 1980	09 1980	09 1980	07 1979		Presence degree (stałość)
Altitude a.s.l. Wysokość n.p.m.	1750	1750	1800	1650	1700		
Exposure Ekspozycja	N	NE	N	N	N		
Slope (degree) Nachylenie w stopniach	35	25	20	45	50		
Cover of herb layer (%) Pokrycie warstwy zielnej (%)	95	95	95	100	95		
Cover of moss layer (%) Pokrycie warstwy mszystej (%)	15	15	15	15	30		
Area of record Powierzchnia zdjęcia	100	100	150	100	150		
Number of species in the record Liczba gatunków w zdjęciu	23	18	34	34	39		
Ch. Adenostylon:							
<i>Heracleum verticillatum</i> Panč.	4	3	3	2	3	V	
<i>Cirsium appendiculatum</i> Grsb.	1	2	3	3	2	V	
<i>Chaerophyllum hirsutum</i> L.	.	1	+	2	+	IV	
<i>Veratrum album</i> L.	+	+	+	+	.	IV	
<i>Doronicum columnae</i> Ten.	+	.	.	+	1	III	
<i>Angelica panicii</i> Vand.	.	.	.	1	1	II	
<i>Adenostyles alliariae</i> (Goz.) Kern,	.	.	.	1	+	II	
<i>Doronicum austriacum</i> Jacq.	.	.	+	.	+	II	
<i>Petasites albus</i> (L.) Gärt.	.	.	.	.	1	I
<i>Aconitum lamarckii</i> Rchb.	.	.	+	.	.	I	
<i>Mulgedium alpinum</i> Cass.	.	.	.	+	.	I	
Ch. Adenostyletalis, Betulo-Adenostyletea:							
<i>Senecio nemorensis</i> L.	1	.	+	+	+	IV	
<i>Alchemilla xanthochlora</i> Rothm.	.	+	+	+	.	III	
<i>Geranium sylvaticum</i> L.	.	.	+	+	+	III	
<i>Rumex arifolius</i> All.	.	.	+	+	+	III	
<i>Calamagrostis villosa</i> (Chaix.) Mut.	+	.	.	.	+	II	
<i>Crepis conyzifolia</i> (Gou.) D. T.	.	.	.	+	+	II	
<i>Poa ursina</i> Vel.	.	.	.	+	+	II	
<i>Ranunculus plataniifolius</i> L.	.	.	.	+	+	II	
<i>Geum rivale</i> L.	.	.	+	.	.	I	
<i>Milium effusum</i> L.	.	.	.	.	+	I
<i>Polygonatum verticillatum</i> (L.) All.	.	.	.	+	.	I	
<i>Thalictrum aquilegifolium</i> L.	.	.	.	.	+	I
<i>Valeriana officinalis</i> L.	.	.	.	.	+	I

Table VI, cont

1	2					3
Others (inne):						
<i>Saxifraga rotundifolia</i> L.	+	2	2	+	+	V
<i>Caltha palustris</i> L.	1	+	1	+	1	V
<i>Alchemilla glabrata</i> Neygenfeld	+	+	1	+	+	V
<i>Deschampsia caespitosa</i> (L.) P. B.	+	+	+	+	+	V
<i>Saxifraga stellaris</i> L.	+	+	+	+	+	V
<i>Cardamine amara</i> L.	+	1	2	.	+	IV
<i>Luzula spadicca</i> (All.) DC.	.	+	+	2	1	IV
<i>Urtica dioica</i> L.	1	+	.	+	+	IV
<i>Heliosperma quadrifidum</i> Rchb.	+	+	.	+	+	IV
<i>Barbarea vulgaris</i> R. Br.	+	+	2	.	.	III
<i>Rumex alpinus</i> L.	.	1	+	+	.	III
<i>Chrysosplenium alternifolium</i> L.	+	.	+	.	+	III
<i>Epilobium alsinifolium</i> Vill.	+	.	+	+	.	III
<i>Stellaria nemorum</i> L.	+	.	.	+	+	III
<i>Athyrium filix femina</i> (L.) Roth.	.	.	+	+	.	II
<i>Luzula silvatica</i> (Huds.) Gaud.	+	.	.	.	+	II
<i>Myosotis palustris</i> (L.) Lam.	.	.	+	+	.	II
<i>Parnasia palustris</i> L.	.	.	.	+	+	II
<i>Rumex obtusifolius</i> L.	+	+	.	.	.	II
<i>Rubus idaeus</i> L.	+	.	.	+	.	II
<i>Veronica beccabunga</i> L.	.	.	+	.	+	II

Sporadical species (gatunki sporadyczne): *Hypericum perforatum* L. 1; *Prenanthes purpurea* L. 1; *Geum coccineum* S. S. 2; *Achillea grandifolia* Friv. 3; *Crepis paludosa* Mch. 3; *Filipendula ulmaria* Max. 3; *Poa palustris* L. 3; *Poa trivialis* L. 3; *Primula officinalis* (L.) Hill. 3; *Stellaria uliginosa* Murr. 3; *Teraxacum palustre* (Willd.) DC. 3; *Campanula sparsa* Friv. 4; *Geranium macrorrhizum* L. 4; *Hypericum maculatum* Cr. 4; *Alchemilla acutiloba* Op. 5; *Alchemilla crinita* Bus. 5; *Dryopteris spinulosa* (Müll.) O. Kuntze 5; *Primula elatior* (L.) Hill. 5; *Pulmonaria rubra* Schott 5; *Rorippa palustris* (Leyss.) Bess. 5; *Thaspis alpinum* Jacq. 5.

In less compact forests and in wetter soils, a more fecund variant develops. Its undergrowth is very exuberant and characterized by a large participation of ferns: *Dryopteris austriaca*, *D. spinulosa*, *Athyrium filix femina* (table IV, fig. 6).

In plant patches of this association situated in dry ridges the undergrowth is poorly developed and belongs to a poorer variant with predominating *Vaccinium myrtillus*, *Calamagrostis arundinacea* and *C. villosa*.

5. Subalpine thickets with *Juniperus sibirica*

They grow above the uppermost borderline of forests and in zones of thinned spruce forests. Low groundling shrubs of *Juniperus sibirica* cover in places over 50% of the surface. Most frequently, however, they concur with other predominating species: *Bruckenthalia spiculifolia*, *Vaccinium myrtillus*, *V. vitis-idaea*, *Cytisus supinus* and *Genista depressa* (table V). Herbaceous species are numerous but their role is ulterior. Thickets with *Juniperus sibirica* occur mainly in mosaic arrangements with subalpine greenswards and, frequently, they make up transitory stages.

6. Herb communities on streams

They grow in narrow belts in sites adjoining streams or at outflows of water. In patches of this community situated in upper parts of the nature reserve (table VI) *Heracleum verticillatum* (fig. 7) and *Cirsium appendiculatum* are predominating species, and several very rare mountainous species occur. On streams strongly shadowed by old forest trees in the lower part of the nature reserve, herb communities differ slightly in their floristic composition as most frequently, *Angelica pancicii*, *Chaerophyllum hirsutum* and *Telekia speciosa* are predominating species there.

In wetted sites in beech-woods small patches of herb communities can also be met. *Petasites albus* is a predominating species, and hygrophylous forest plants, such as *Chrysosplenium alternifolium*, *Carex remota*, *Veronica montana*, *Impatiens nolitangere* and *Cardamine amara* are abundant.

7. Subalpine grasslands with *Festuca valida*

These communities are floristically rich and abundant in mountainous species; they occur only in the uppermost parts of the nature reserve on steep slopes close to large massifs and rocky bassets. The following species are predominating in them: *Festuca valida*, *Deschampsia flexuosa*, *Agrostis vulgaris*, *Sesleria comosa*, *Juncus trifidus*. Shrubs participate in these communities to large extent (table VII).



Fig. 7. Herb communities with predominating *Heracleum verticillatum*

Ryc. 7. Zbiorowiska ziolorośli z panującym *Heracleum verticillatum*

TABLE VII

Class (Klasa): *Caricetea curvulare*
 Order (Rząd): *Seslerietalia comosae*
 Alliance (Związek): *Poion violaceae*

Festuca valida — *Agrostis vulgaris* community

Number of record Powierzchnia zdjęcia	1	2	3	4	5		
	2					3	
Date	07	09	07	07	07	Presence degree (stałość)	
Data	1979	1980	1979	1979	1979		
Altitude a.s.l. Wysokość n.p.m.	1750	1800	1820	1750	1700		
Exposure Ekspozycja	N	SN	NW	W	NE		
Slope (degree) Nachylenie (w stopniach)	25	20	30	10	15		
Cover of shrub layer (%) Zwarcie warstwy krzewów (%)	10	5	5	10	5		
Cover of herb layer (%) Pokrycie warstwy zielnej (%)	100	100	100	100	95		
Cover of moos layer (%) Pokrycie warstwy mszystej (%)	2	3	2	2	2		
Area of recor Powierzchnia zdjęcia	150	100	150	200	150		
Number of species in the record Liczba gatunków w zdjęciu	59	61	60	62	50		
Ch. <i>Poion violaceae</i>:							
<i>Festuca valida</i> Penzes.	3	1	2	3	1		V
<i>Anthoxanthum odoratum</i> L.	+	+	+	+	+		V
<i>Calamintha alpina</i> (L.) Lam.	+	+	+	+	+		V
<i>Carex caryophyllea</i> La Tour.	+	+	+	+	+		V
<i>Crocus veluchensis</i> Herb.	+	+	+	+	+	V	
<i>Galium verum</i> Scop.	+	+	+	+	+	V	
<i>Poa violacea</i> Bell.	+	+	+	+	+	V	
<i>Scabioza lucida</i> Vill.	+	+	+	+	+	V	
<i>Carduus scardicus</i> (Grsb.) Wettst.	.	+	+	+	+	IV	
<i>Festuca valida</i> Penzes.	+	+	+	+	.	IV	
<i>Sedum daryphyllum</i> L.	.	+	+	+	+	IV	
<i>Veratrum album</i> L.	+	.	+	+	.	III	
<i>Verbascum pamosum</i> Vis.	.	+	.	+	.	II	
Ch. <i>Seslerion comosae</i>:							
<i>Sesleria comosa</i> Vel.	+	+	+	+	+	V	
<i>Pedicularis orthantha</i> Grsb.	+	.	+	+	+	IV	
<i>Cetraria islandica</i> (L.) Ach.	+	.	+	+	.	III	
<i>Poa alpina</i> L.	+	.	+	+	.	III	
<i>Avenastrum versicolor</i> Fritsh.	+	.	.	.	+	II	
<i>Pedicularis verticillata</i> L.	.	+	.	+	.	II	
<i>Carex laevis</i> Kit.	+	.	.	.	.	I
<i>Festuca supina</i> Shur.	.	+	.	.	.	I	
<i>Gnaphalium supinum</i> L.	.	.	.	+	.	I	

Table VII, cont

1	2					3
Ch. <i>Seslerietalia comosae</i> , <i>Caricetea curvulae</i> :						
<i>Potentilla chrysocraspeda</i> Lehm.	+	1	+	+	+	V
<i>Genista depressa</i> M. B.	.	+	+	+	+	IV
<i>Senecio carpaticus</i> Herb.	+	+	+	.	+	IV
<i>Thlaspi alpinum</i> Jacq.	+	+	.	+	+	IV
<i>Hieracium hoppeanum</i> Shutt.	.	+	+	.	.	II
<i>Jasione orbiculata</i> Grsb.	.	+	.	+	.	II
<i>Euphrasia minima</i> Lam.	.	.	.	.	+	I
<i>Luzula spicata</i> Lam. et DC.	.	+	.	.	.	I
Others (inne):						
<i>Agrostis vulgaris</i> With.	1	2	2	1	2	V
<i>Luzula nemorosa</i> (Poll.) E. Mey. var. <i>cuprina</i>	1	1	1	2	1	V
<i>Deschampsia flexuosa</i> Trin.	1	1	1	2	+	V
<i>Calamagrostis arundinacea</i> (L.) Roth.	2	+	+	1	1	V
<i>Vaccinium myrtillus</i> L.	1	+	1	1	+	V
<i>Potentilla erecta</i> Rauschel	1	+	1	+	+	V
<i>Bruckenthalia spiculifolia</i> (Salisb.) Rchb.	+	+	.	+	+	V
<i>Festuca rubra</i> L.	+	1	+	+	+	V
<i>Nardus stricta</i> L.	+	+	+	+	1	V
<i>Campanula sparsa</i> Friv.	+	+	+	+	+	V
<i>Cerastium banaticum</i> Heuff.	+	+	+	+	+	V
<i>Hypericum perforatum</i> L.	+	+	+	+	+	V
<i>Homogyne alpina</i> (L.) Cass.	+	+	+	+	+	V
<i>Minuartia setacea</i> (Thuill.) Hayek.	+	+	+	+	+	V
<i>Trifolium repens</i> L.	+	+	+	+	+	V
<i>Achillea grandifolia</i> Friv.	+	1	+	1	.	IV
<i>Deschampsia caespitosa</i> P. B.	1	+	+	+	.	IV
<i>Juniperus sibirica</i> Burgsd.	1	+	.	1	+	IV
<i>Luzula campestris</i> Lam.	+	+	+	+	.	IV
<i>Gnaphalium silvaticum</i> L.	+	.	+	+	+	IV
<i>Gentiana bulgarica</i> Vel.	+	+	+	.	+	IV
<i>Plantago lanceolata</i> L.	.	+	+	+	+	IV
<i>Ranunculus montanus</i> Willd.	+	+	+	.	+	IV
<i>Stellaria graminea</i> L.	+	.	+	+	+	IV
<i>Trifolium pratense</i> L.	.	+	+	+	+	IV
<i>Viola dacica</i> Borb.	+	+	+	+	.	IV
<i>Vaccinium uliginosum</i> L.	+	+	+	+	.	IV
<i>Veronica officinalis</i> L.	+	+	+	+	.	IV
<i>Geum montanum</i> L.	+	.	+	+	.	III
<i>Galium mollugo</i> L.	+	.	+	+	.	III
<i>Hypericum alpigenum</i> Kit.	.	+	.	+	+	III
<i>Leontodon hispidus</i> L.	+	+	.	.	+	III
<i>Leontodon autumnalis</i> L.	.	+	+	+	.	III
<i>Myosotis sparsiflora</i> Mik.	+	.	+	+	.	III
<i>Poa ursina</i> Vel.	+	1	.	+	.	III
<i>Polygonum bistorta</i> L.	.	+	+	.	+	III
<i>Prunella vulgaris</i> L.	+	.	+	+	.	III
<i>Rumex acetosa</i> L.	+	+	.	+	.	III
<i>Silene roemerii</i> Friv.	+	.	+	.	+	III
<i>Viola tricolor</i> L.	.	.	+	+	+	III
<i>Polytrichum attenuatum</i> Menz.	.	+	+	.	+	III
<i>Campanula rotundifolia</i> L.	+	.	+	.	.	II

Table VII, cont

1	2					3
<i>Centaurea napulifera</i> Rochel.	.	+	.	+	.	II
<i>Cytisus supinus</i> L.	+	.	.	.	+	II
<i>Hieracium pannosum</i> Bois.	+	.	.	+	.	II
<i>Lotus corniculatus</i> L.	+	.	+	.	.	II
<i>Meum mutellina</i> Gärtn.	.	+	.	.	+	II
<i>Ornithogallum tenuifolium</i> Guss.	.	+	.	.	+	II
<i>Rhinanthus minor</i> L.	.	.	+	.	+	II
<i>Thymus balcanus</i> Borb.	+	.	..	+	.	II
<i>Thesium alpinum</i> L.	.	+	+	.	.	II

Sporadical species (gatunki sporadyczne): *Soldanella carpatica* Vierch. 2; *Vaccinium vitis idaea* L. 2.

8. Mountainous saxicolous grasslands with *Sesleria comosa*

They grow on walls or shelves of rocky massifs occurring in the uppermost parts of the nature reserve above the uppermost forest borderline. Their floristic composition is highly changeable; its characteristic feature is that species typical of rocky fissures, such as *Saxifraga cymosa*, *S. sizoon*, *Silene lerchenfeldyana*, *Helianthemum nummularium*, *Aster alpinus*, *Carex laevis*, *Luzula spicata*, *Juncus trifidus* (table VIII) participate in this community.

9. and 10. Communities of poor and fertile pasturages

They occur in the nature reserve in a few small intraforest glades.

In highly sour soils, in glades situated on mountainous ridges, a poor pasturage community of the order *Nardetalia* develops. Low greenswards are composed of *Nardus stricta* with an admixture of *Deschampsia flexuosa*, *Agrostis vulgaris*, *Carex pilulifera*, a.o. Tufts of *Bruckenthalia spiculifolia* and *Juniperus sibirica* are common here. (Fig. 3, ×9).

In glades situated in lower parts, with richer and wetter soils, fertile pasturages of the order *Arrhenatheretalia* occur. Exuberant plant growth is composed of *Agrostis vulgaris*, *Dactylis glomerata*, *Anthoxanthum odoratum*, *Trifolium pratense*, *T. repens*, *Crepis blennis*, *Leontodon hispidus*, a.o. (Fig. 3, ×10).

V. VERTICAL DISTRIBUTION OF PLANT COMMUNITIES

In the Boatın biosphere reserve, there are three vegetation vertical zones out the six occurring in Bulgaria (Bondev, Kochev 1983).

1. A zone of mesohygrophylous latifolious forests of the Central European type covers about 78% of the nature reserve area and ranges from its foot (800 m a.s.l.) to 1590 m a.s.l. on average. Its upper borderline is very diversified and its run depends on relief of the terrain (Michalik 1985). Its highest

TABLE VIII

Class (Klasa): *Caricetea curvulae*
 Order (Rząd): *Seslerietalia comosae*
 Alliance (Związek): *Seslerion comosae*

Sesleria comosa — *Juncus trifidus* community
 Zbiorowisko *Sesleria comosa* — *Juncus trifidus*

Number of record Numer zdjęcia	1	2	3	4	5		
	1					2	3
Date	09	09	09	09	07	Presence degree (statość)	
Data	1980	1980	1980	1980	1979		
Altitude a.s.l.	1800	1850	1790	1760	1800		
Wysokość n.p.m.							
Exposure	W	N	W	NW	S		
Ekspozycja							
Slope degree	45	50	40	30	60		
Nachylenie (w stopniach)							
Cover of shrub layer (%)	3	2	2	5	2		
Zwarcie warstwy krzewów (%)							
Cover of herb layer (%)	60	45	50	6	65		
Pokrycie warstwy zielnej (%)							
Cover of moss layer (%)	15	10	10	20	15		
Pokrycie warstwy mszystej (%)							
Area of record	100	150	100	100	150		
Powierzchnia zdjęcia							
Number of species in the record	57	44	47	42	37		
Liczba gatunków w zdjęciu							
Ch. <i>Seslerion comosae</i>:							
<i>Sesleria comosa</i> Vel.	2	2	1	2	2	V	
<i>Carex laevis</i> Kit.	1	1	1	1	2	V	
<i>Cetraria islandica</i> (L.) Ach.	1	1	+	2	1	V	
<i>Festuca supina</i> Shur.	+	1	+	+	+	V	
<i>Avenastrum versicolor</i> Fritsch.	+	+	+	+	+	V	
<i>Campanula alpina</i> Jacq.	+	+	+	+	+	V	
<i>Gnaphalium supinum</i> L.	+	+	+	+	+	V	
<i>Pedicularis orthantha</i> Grsb.	+	+	+	+	+	V	
<i>Hieracium alpicola</i> Schleich.	+	+	.	+	+	IV	
<i>Agrostis rupestris</i> All.	+	+	.	+	.	III	
<i>Pedicularis verticillata</i> L.	.	+	+	.	+	III	
<i>Veronica bellidioides</i> L.	+	+	+	.	.	III	
<i>Poa alpina</i> L.	+	.	.	+	.	II	
<i>Antennaria dioica</i> (L.) Gärtch.	.	+	.	.	.	I	
<i>Pedicularis oederi</i> Vahl.	.	.	.	+	.	I	
Ch. <i>Poion violaceae</i>:							
<i>Carex caryophyllea</i> La Tour.	+	.	+	.	+	III	
<i>Scabioza lucida</i> Vill.	+	.	+	.	.	II	
<i>Anthoxanthum odoratum</i> L.	.	.	+	.	.	I	
<i>Crocus veluchensis</i> Herb.	.	.	.	.	+	I
<i>Galium verum</i> Scop.	.	+	.	.	.	I	
<i>Poa violacea</i> Bell.	+	.	.	.	.	I
<i>Scorzoea rosea</i> W. K.	+	.	.	.	.	I

Table VIII, cont

1	2					3
Ch. <i>Seslerietalia comosae</i> , <i>Caricetea curvulare</i> :						
<i>Juncus trifidus</i> L.	2	1	2	1	2	V
<i>Hieracium hoppeanum</i> Shutt.	+	+	+	+	+	V
<i>Luzula spicata</i> Lam. et DC.	+	+	+	+	+	V
<i>Senecio carpaticus</i> Herb.	+	+	+	+	+	V
<i>Scleranthus perennis</i> L.	+	+	+	+	.	IV
<i>Thlaspi alpinum</i> Jacq.	.	+	+	+	+	IV
<i>Euphrasia minima</i> Lam.	+	.	+	.	+	III
<i>Cetraria nivalis</i> (L.) Ach.	+	.	.	+	+	III
<i>Thamnia vermicularis</i> (Sm.) Ach. ex Schaer.	.	+	+	.	+	III
<i>Genista depressa</i> M. B.	+	.	+	.	.	II
<i>Alectoria ochroleuca</i> (Hoffm.) Massal.	+	.	.	.	.	I
<i>Jasione orbiculata</i> Schleich.	+	.	.	.	.	I
<i>Potentilla chrysocraspeda</i> Lehm.	+	.	.	.	.	I
Others (inne):						
<i>Bruckenthalia spiculifolia</i> (Salisb.) Rchb.	1	+	+	1	+	V
<i>Deschampsia flexuosa</i> Trin.	1	+	+	+	+	V
<i>Sedum dasyphyllum</i> L.	+	+	+	+	+	V
<i>Silene lerchenfeldiana</i> Baumg.	+	+	+	+	+	V
<i>Thymus balcanus</i> Borb.	+	+	+	+	+	V
<i>Vaccinium vitis idaea</i> L.	+	+	+	+	+	V
<i>Dicranum scoparium</i> Hedw.	+	+	+	+	+	V
<i>Polytrichum juniperinum</i> Willd.	+	+	+	+	+	V
<i>Cytisus supinus</i> L.	+	+	.	+	+	IV
<i>Geum montanum</i> L.	+	+	+	.	+	IV
<i>Juniperus sibirica</i> Burgsd.	+	+	+	+	.	IV
<i>Lycopodium selago</i> L.	+	.	+	+	+	IV
<i>Saxifraga aizoon</i> Jacq.	.	+	+	+	+	IV
<i>Thesium alpinum</i> L.	+	+	+	+	.	IV
<i>Vaccinium myrtillus</i> L.	+	+	.	+	+	IV
<i>Agrostis vulgaris</i> With.	+	+	.	+	.	III
<i>Allium victoralis</i> L.	.	+	+	.	+	III
<i>Campanula rotundifolia</i> L.	+	+	+	.	.	III
<i>Calamagrostis arundinacea</i> (L.) Roth.	+	.	+	+	.	III
<i>Helianthemum nummularium</i> (L.) Mill.	.	+	.	+	+	III
<i>Homogyne alpina</i> (L.) Cass.	.	+	+	.	+	III
<i>Ranunculus montanus</i> Willd.	+	.	+	+	.	III
<i>Saxifraga cymosa</i> W. K.	+	+	.	.	+	III
<i>Thymus toszvi</i> Vel.	+	.	.	+	+	III
<i>Aster alpinus</i> L.	+	.	+	.	.	II
<i>Festuca rubra</i> L.	+	.	+	.	.	II
<i>Gentiana bulgarica</i> Vel.	+	.	.	+	.	II
<i>Nardus stricta</i> L.	.	+	.	+	.	II
<i>Vaccinium uliginosum</i> L.	+	.	.	+	.	II
<i>Cladonia cornuta</i> (L.) Schaer.	.	+	.	+	.	II

Sporadical species (gatunki sporadyczne): *Cerastium banaticum* Heuff. 1; *Centaurea napulifera* Rochel. 1; *Erigeron alpinus* L. 3; *Hieracium pannosum* Bois. 1; *Hypericum alpigenum* Kit. 1; *Hypericum perforatum* L. 2; *Luzula campestris* Lam. 3; *Leontodon hispidus* L. 4; *Leontodon autumnalis* L. 3; *Mimuraria setacea* (Thuill.) Hayek 2; *Ornithogalum tenuifolium* Guss. 1; *Soldanella Carpatica* Vierch. 3; *Polytrichum attenuatum* Menz. 3.

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reach can be traced on hot western slopes (up to 1680 m a.s.l.), and the lowest one (up to 1440 m a.s.l.) at bottoms of deep cold valleys on northern slopes. In the zone of latifolious forests, fertile mountainous beech-woods predominate; *Asperulo odoratae-Fagetum* develops in much diversified sites. Another forest association typical for this vertical zone is that of acid mountainous beech-woods *Luzulo nemorosae-Fagetum*. The latter association occurs in less numerous sites with poor rocky soils where particularly dry and warm climate prevails. Among non-forest communities, swamps with *Petasites albus* and pasturages are characteristic of this zone. However, herb communities on streams occur in each vegetation vertical zone in the Boatin nature reserve.

2. A zone of mesohygrophyllous coniferous forests of the subarctic type makes up a narrow, disrupted belt of spruce forests (*Piceetum excelsae balcanicum*) ranging on average from 1590 to 1750 m a.s.l. A potential uppermost borderline of coniferous forests in this part of the Stara Planina Mts. may reach up to 1950–2000 m a.s.l.

3. A subalpine vegetation zone with predominating thicket and shrub communities covers the uppermost part of the nature reserve, on average above 1750 m a.s.l. Apart from thickets with *Juniperus sibirica*, grasslands, herb communities on streams and patches of screes with initial stages of overgrowth are numerous there.

The Boatin biosphere reserve protects mainly forest communities of the zone of latifolious forests which unquestionably predominate there. Percentage shares of particular plant communities in the nature reserve are as follows:

fertile mountainous beech-woods (<i>Asperulo odoratae-Fagetum</i>)	68.4%
acid mountainous beech-woods (<i>Luzulo nemorosae-Fagetum</i>)	17.0%
forest communities of the transitional zone	2.9%
mountainous spruce forests (<i>Piceetum excelsae balcanicum</i>)	6.7%
subalpine thickets with <i>Juniperus sibirica</i>	2.8%
herb communities on streams	0.7%
subalpine grasslands with <i>Festuca valida</i>	0.8%
mountainous <i>saxicolous</i> grasslands with <i>Sesleria comosa</i>	0.3%
pasturages in intraforest glades	0.2%
screes with initial stages of vegetation	0.2%

VI. EFFECT OF ANTHROPOGENIC FACTORS ON VEGETATION IN THE NATURE RESERVE

Biocenoses of beech-woods of the nature reserve belong to those most perfectly preserved in the entire area of the Stara Planina Mts. They seem to be natural and, in places, almost primeval over-mature stands. They may serve as a classical example of relationships between diversified conditions of particular habitats and floristic composition of the undergrowth and characters of a wood.

However, the zone of spruce forests has been strongly destroyed and changed in result of long-lasting shepherding and fires connected with this activity. The present upper border of forests is considerably lowered. The layer of subalpine thickets and greenwards is artificial in the nature reserve



Fig. 8. Impact of shepherding on vegetation in the reservation. 1 — borderline of the reservation; 2 — grazing grounds adjoining the reservation; 3 — damages caused by grazing in forests (a — undergrowth injured in 15–50%, b — undergrowth injured in 50–95%, according to scrutiny of September of 1980); 4 — a site of *Pinus mughus* threatened by grazing and fires; 5 — main centres of occurrence of flora and synanthropic communities at borders of the reservation; 6 — larger concentrations of synanthropic plants within the reservation; 7 — borders and numbers of forest districts

Ryc. 8. Oddziaływanie pasterstwa na szatę roślinną rezerwatu. 1 — granica rezerwatu; 2 — tereny wypasowe w sąsiedztwie rezerwatu; 3 — zniszczenia spowodowane przez wypas w lasach (a — runo zniszczone w 15–50%, b — runo zniszczone w 50–95%, według stanu z IX. 1980 r.); 4 — stanowisko *Pinus mughus* zagrożone przez wypas i wypalanie; 5 — główne centra występowania flory i zbiorowisk synantropijnych przy granicach rezerwatu; 6 — większe zgrupowania roślin synantropijnych na terenie rezerwatu; 7 — granice i numery oddziałów leśnych

area and covers grounds formerly overgrown with coniferous forests. Of primeval origin are in this layer only communities of greenswards with *Sesleria comosa* growing on large rocky massifs. Succession of spruce trees above the present upper borderline of the forest is limited by still practised intense shepherding. Harmful effect of grazing can be observed also in the zone of beechwoods, particularly close to glades at the borders of the nature reserve. On the occasion of mapping it could be noticed that about 5% of the forest area of the nature reserve were under intense grazing which resulted in almost complete extermination of the undergrowth and eliminated natural restoration of standing timber (fig. 8). In about 40% of the forest area damages caused by shepherding are less severe but still annoying.

Translated into English by Aldona Sidorenko

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STRESZCZENIE

Przedstawiona w pracy charakterystyka fitosocjologiczna rezerwatu Boatin nawiązuje w ogólnych zarysach do klasyfikacji przyjętej przez Horvata, Glavača i Ellenberga (1974). Nazwy niektórych zbiorowisk i ich pozycja taksonomiczna są jeszcze prowizoryczne i zostaną ostatecznie sprecyzowane w dalszych publikacjach po uwzględnieniu obszernych materiałów z innych rezerwatów Starej Płaniny, w których kontynuowane są badania fitosocjologiczne.

Rezerwat Boatin, o powierzchni 1280 ha, położony jest na północnych stokach Starej Płaniny na obszarze źródłowym rzeki Czarny Wit. Rozciąga się od 800 do 1800 m n.p.m. i ma silnie zróżnicowaną rzeźbę (ryc. 1, 2). Na badanym terenie stwierdzono i przedstawiono kartograficznie 18 jednostek w randze kompleksów zbiorowisk, zespołów oraz wariantów (ryc. 3). Najbardziej rozpowszechniona jest żyzna buczyna górską *Asperulo odoratae-Fagetum* (ryc. 4 tab. I) zajmująca siedliska żyzne, wilgotne i umiarkowanie wilgotne. Gleby ubogie i zazwyczaj suche porasta kwaśna buczyna górską *Luzulo nemorosae-Fagetum* (ryc. 5, tab. II). Na kontakcie lasów bukowych i borów świerkowych wykształca się wąski pas zbiorowisk o charakterze pośrednim (tab. III) tworzący strefę przejściową między piętrami roślinnymi. W górnej części rezerwatu panują bory świerkowe *Piceetum excelsae balcanicum* (tab. IV, ryc. 6). Ponad górną granicą lasu i w strefie rozrzedzonych drzewostanów występują subalpejskie zarośla z *Juniperus sibirica* (tab. V), murawy z *Festuca varia* var. *balcana* (tab. VII) oraz murawy naskalne z *Sesleria comosa* (tab. VIII). Wzdłuż potoków, na całym obszarze rezerwatu, rozwijają się bujne zbiorowiska ziołorośli (tab. VI, ryc. 7).

Rezerwat Boatin obejmuje trzy piętra roślinne z sześciu wyróżnianych w Bułgarii (Bondev 1973, Kochev 1983).

1. Piętro mezohigrofilnych lasów szerokolistnych typu środkowoeuropejskiego obejmuje około 87% powierzchni rezerwatu i sięga od jego podnóży (800 m n.p.m.) średnio po 1590 m n.p.m. (Michalik 1985). Typowymi zespołami roślinnymi są: panująca tu żyzna buczyna górską, kwaśna buczyna górską, a ze zbiorowisk nieleśnych młaki z *Petasites albus* oraz żyzne pastwiska.

2. Piętro mezohigrofilnych lasów szpilkowych typu subarktycznego tworzy obecnie wąski, porożrywany pas borów świerkowych rozciągający się średnio od 1590 do 1750 m n.p.m. Potencjalna górna granica borów szpilkowych w tej części Starej Płaniny wynosi około 1950–2000 m n.p.m.

3. Piętro subalpejskie, z przewagą zbiorowisk zaroślowych oraz udziałem muraw i ziołorośli, zajmuje tereny położone przeciętnie powyżej 1750 m n.p.m.

Biocenozy lasów bukowych rezerwatu należą do najlepiej zachowanych w całej Starej Płaninie. Natomiast strefa borów świerkowych została silnie zniszczona i zniekształcona w wyniku długotrwałego wpływu pasterstwa i związanych z nim pożarów. Obecna górna granica lasów jest znacznie obniżona. Piętro subalpejskich zarośli i muraw na terenie rezerwatu rozwinęło się na miejscu dawnych lasów. Jedynie murawy z *Sesleria comosa*, porastające wielkie masywy skalne, mają charakter naturalny. Sukcesja świerka ponad obecną górną granicą lasu jest ograniczana przez utrzymujący się stale intensywny wypas. Niekorzystny wpływ wypasu obserwuje się także w strefie lasów bukowych, zwłaszcza w sąsiedztwie polan przy granicy rezerwatu (ryc. 8).

Praca została wykonana w ramach problemu międzyresortowego MR II/15, w grupie tematycznej 06.