The oak forest *Quercetum frainetto-cerris* on the foothills of the mountain range Galičica (Macedonia)

ANNA MEDWECKA-KORNAŠ*,

RADE DRENKOVIŠ** LJUPCO GRUPEŠ** MILE MULEV**

* Institute of Botany, Jagiellonian University, ul. Lubicz 46, 31-512 Kraków, Poland

** Institute of Botany, University of Skopje, Gazibaba, 91000 Skopje, Yugoslavia

(Received: January 3, 1986, Accepted: January 22, 1986)

Abstract

The xerothermic oak forests with *Quercus frainetto* and *Q. cerris* on the eastern slope of Mt. Galičica in Macedonia were investigated in connection with the Yugoslavian contribution to the International Programme "MAB". Twenty field records were interpreted from the phytosociological and the phytogeographical points of view. The forests under discussion represent the regional association *Quercetum frainetto-cerris macedonicum* Oberd. 1948 emend. Horvat 1959, which belongs to the *Quercion frainetto-cerris alliance*. The considerable share of Balkan and Submediterranean species in their composition is particularly significant.

Key words: Galičica, Macedonia, phytogeographical spectrum, *Quercetum frainetto-cerris*, *Quercetalia pubescentis*

INTRODUCTION

The xerothermic oak forests with *Quercus frainetto* Ten. (synonyms: *Q. farnetto* Ten., *Q. conferta* Kit.) and *Q. cerris* L. belong to the most important Balkan plant communities. They have a relatively wide natural range of distribution and zonal character, chiefly on the uplands of the eastern, more continental part of the peninsula (Horvat 1958, Horvat et al. 1974, Mayer 1984). Various kinds of human impact (grazing by domestic animals, timber exploitation and agriculture) which for millenia have taken place in the Balkan countries limited the actual distribution of oak forests and, in many cases, changed their structure and their floristic composition (Adamović 1909, Turrill 1929, Tomašević 1960). In spite of this, the forests on the eastern Galičica foothills are relatively well preserved. Owing to protection in the National Park (since 1958) and great distance from larger settlements, industrial centres and sources of air pollution,

they are especially suitable for studies on natural ecosystems. That is why the *Quercus frainetto* forests of Mt. Galičica (which represent the association *Quercetum frainetto-cerris macedonicum* Oberd. 1948, em. Horvat 1959) have become the object of investigations carried out by biologists of the University of Skopje and connected with the Yugoslavian participation in the International Programme "Man and the Biosphere" (MAB). Various ecological problems have been taken into consideration, such as e.g. tree layer structure and tree increment, ground layer production, nutrient cycles, litter fall and decomposition, etc. The investigations are carried out on the enclosed experimental area of 1 ha and in its surroundings. The general information about this project, as well as some of its results, have been already published (Grupče 1983, Grupče et al. 1983 a, b, c, Mulev et al. 1983).

The aim of the present paper is to characterize the investigated forests from the phytosociological and the phytogeographical points of view and to provide documentation about the current state of the study plots which will be used as basis for further, more detailed ecological research.

A considerable part of the phytosociological records was taken during a visit of Anna Medwecka-Kornaš in Macedonia and the stay of the present authors at the field station "Galičica" near Carina, in June 1983. The basic phytosociological table (Table 3) was compiled during a visit of Rade Drenkovski in Cracow. The scientific cooperation was possible owing to the agreement between the Jagiellonian University of Cracow and the Cyril and Metody University of Skopje.

STUDY AREA

The mountain range Galičica (planina Galičica) is situated between two lakes: the Prespa Lake (853 m a.s.l.) and the Ohrid Lake (695 m a.s.l.), on the border between Yugoslavian Macedonia and Albania (Fig. 1) and extends in meridional direction. The mountain pass Gavato separates

Table 1

pH values in the soils of *Quercetum frainetto-cerris*
on Mt. Galičica

Record no.	9	9	9	10
Depth	1 cm	5-10 cm	25-30 cm	5-10 cm
pH in H ₂ O	6.37	5.07	4.80	4.05
pH in KCl	5.23	3.65	4.04	3.50

the northern part "Mala Galičica" from the higher southern part "Stara Galičica" with one summit of 2075 m in Macedonia and the other of 2288 m outside Yugoslavia.

Fig. 1. A — general map of the mountain range Galičica, B — distribution of localities with climatic measurements: 1 — political borders, 2 — roads, 3 — steep slopes, 4 — border of Galičica National Park (after Wojterski 1971, modified)

The geological structure of Mt. Galičica is quite differentiated owing to the presence of noncalcareous (silicate) and calcareous formations (Marković-Marjanović 1955). To the former belong the Paleozoic sandstones conglomerates and schists, to the latter triassic limestones and dolomites, occurring mainly in the middle and upper parts of the mountain, on its ridges and summits. In the relief of eastern foothills up to the

altitude of 980 m some Pliocene terraces can be recognized, covered by sandy and loamy deposits. A part of the lake shore is formed of steep cliffs.

Quercetum frainetto-cerris occurs on Mt. Galičica chiefly on noncalcareous formations, on relatively flat sites and on easy slopes. Its soils are skeletal with slightly acid reaction (Table 1) and most probably belong to brown leached soils. In the absence of more detailed studies it is worth mentioning that in a similar forest (*Quercetum frainetto-cerris serbicum*) on Mt. Avala near Beograd distinct processes of leaching (lessivage), low saturation of

Table 2

Mean sums of precipitation in mm in various seasons of the year
(data for 1971-1980)

Stations	Altitude (m)	Winter Dec.-Febr.	Spring March-May	Summer June-Aug.	Autumn Sept.-Nov.	Total annual
Ohrid	700	197	208	96	242	744
Resen	860	185	181	86	250	702

the absorbing complex and relatively rich humus content were found (Stefanović 1982). On calcareous soils on Mt. Galičica the floristic composition of the association becomes less typical and elements from other communities are present (Table 3, record 20 on rendzina, with *Quercus pubescens* and *Asphodeline liburnica*).

The general climate of southern Macedonia shows Submediterranean and subcontinental features (type IV(VI) of Walter and Lieth 1960, 1964). This is illustrated by data from the stations situated near the study area: Struga and Ohrid on the Ohrid Lake, Resen in the valley of the Prespa Lake and Pelister on the slopes of Mt. Pelister (Figs. 1 and 2). The climatic conditions of the *Quercetum frainetto-cerris* stands are rather similar to those at the lower laying stations (Struga, Ohrid and Resen), but modified by the mountain influence. The winter is not very cold and only extreme temperatures fall below 0°C, sometimes even to about -20°C. During the hot summer rainfall is scarce and a dry period of 2-3 months occurs. The precipitation is concentrated in autumn and winter (like at Ohrid and Resen, Table 2).

The vegetation of the eastern part of Mt. Galičica consists chiefly of forests and thickets. They cover the slopes above the deforested flat area near the Prespa Lake up to the timberline, reaching in more favourable places 1900 (2000) m a.s.l. Two main zones can be distinguished in the forest belt: the more varied lower zone with several species of trees, among them oaks, and the upper forest zone (on the eastern and northern slopes from 1200 m upwards), dominated by *Fagus moesiaca*. In some

No of record	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20				
Date	06 1983	06 1983	06 1984	06 1984	06 1983	05 1981	10 1982	10 1982	06 1983	06 1983	06 1983	06 1983	05 1981b	06 1983	05 1981	05 1981	05 1981	06 1983	06 1983	06 1983				
Locality	LR	LR	CA	CA	PL	PL	PL	PL	PL	PL	PL	PL	PL	PL	PL	LS	CU	TO	CR	CR				
Altitude (m)	950	980	900	900	940	940	890	910	910	930	900	930	930	925	900	890	1020	10 0	950	1080				
Exposure	NE	SE	E	NE	S	S	NE	NE	E	NW	N	N	N	N	NW	S	NE	E	NE	SE				
Slope degree	30	25	0	0	20	20	25	15	10	15	5	10	10	25	15	5	25	25	5	10				
Canopy cover %	70	70	90	90	60	70	75	80	65	55	70	80	80	80	80	80	80	80	75	65				
Undergrowth cover %	60	40	-	-	35	25	20	35	10	30	10	5	35	20	30	20	30	40	35	40				
Field layer cover %	25	40	80	80	65	40	40	35	90	70	85	75	70	65	75	70	45	40	70	60				
Height of trees m	5-6	5-6	...	...	12	12	15	15	18	14	18	25	25	16	18	20	15	10-12	13	12				
Area of sample plot m ²	150	150	...	...	200	200	250	250	250	200	250	200	200	250	250	200	250	250	250	250				
Number of species	39	28	29	44	43	40	38	43	49	35	45	50	63	62	68	40	64	30	47	43				
Trees	Lembotropis (Cytisus) facies										typical facies													
Al. Quercion frainetto:																								
Quercus frainetto a	4.3	3.2	5.2	3.3	4.3	5.5	4.4	4.4	4.4	3.2	4.3	5.4	4.5	5.5	4.4	4.4	3.2	5.5	4.3	2.1	V	Ba (Ap, An)		
" b	3.3	3.2	.	.	3.2	2.2	2.2	1.1	.	2.2	1.1	.	2.2	2.2	2.1	2.1	1.1	3.2	3.2	2.2				
" c	.	+	.	.	2.2	1.1	1.1	1.1	+	3.2	1.1	1.1	+	1.1	+	+	.	2.2	3.2	1.1				
Ord. Quercetalia pubescentis (subord Orno-Cotinentalia ^x):																								
*Quercus cerris a	1.1	1.1	.	.	.	.	1.1	1.1	1.1	.	+	+	1.2	+	1.1	1.1	1.1	+	+	3.1	V	ESm		
" b	1.1	.	1.1	2.2	.	.	+	1.1	.	.	.	.	.	.	+	+	+	+	+	2.2				
" c	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1.1	.	.	.				
*Acer obtusatum a	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1.1	.	.	.	II	Ba (Ao)		
" b+c	+	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.				
Sorbus torminalis b	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.				
" c	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.				
Shrubs and shrublets																								
Ord. Quercetalia pubescentis:																								
Cornus mas b/c	+	+	.	+2	.	.	.	.	.	.	+	.	+	+	+	+	+	.	.	.	II	Sm		
Cl. Querco-Fagetea:																								
Crataegus monogyna b	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.				
" c	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.				
Rosa arvensis b	+	+2	+	+2	.	.	.	.	.	.	.	.	.	.	.	.	+2	.	.	.	III	Atl-Sm		
" c	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.				
" c	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.				
Rubus canescens b	.	.	.	.	.	+2	.	.	.	.	.	.	.	.	.	.	.	.	.	.	III	Sm-CeEu		
" c	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.				
" c	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.				
Others:																								
Chamaecytisus supinus c	.	.	3.3	1.2	1.2	+2	1.2	+2	+2	2.3	.	.	1.2	.	+2	.	.	+2	+2	.	V	Sm-Po		
Lembotropis nigricans b/c	1.1	1.1	3.3	3.3	4.4	2.2	3.2	1.2	.	+2	.	.	.	.	.	.	.	.	.	.				
Juniperus oxycedrus b	.	.	.	+2	.	.	+2	.	.	.	.	.	.	.	.	.	.	.	.	.				
Rosa canina b+c	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	III	Sm-CeEu		
Rubus ulmifolius b	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.				
" c	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.				
Herbaceous plants																								
Ass. char. and diff. sp.:																								
*Galium pseudaristatum	1.1	1.1	+	+2	+	+2	+	+2	2.1	1.1	+	1.1	2.2	1.1	1.1	1.1	+2	+	1.1	+	V	Ba-Po		
Cyclamen hederifolium	.	.	.	.	.	+2	1.1	1.1	+	+	1.1	1.1	1.2	1.1	+2	1.2	1.2	.	+	+				
Crocus pulchellus (autumn ^{xx})	2.1	.	.	.	.	2.1	+	1.1	2.1	1.1	1.1	+	2.1	2.1	2.1	.	2.1	+	1.1	+				
*Geranium asphodeloides	.	.	.	.	.	.	.	1.1	1.1	.	.	1.1	2.1	1.1	1.1	2.1	.	.	.	.	III	Ba (Ap, An)		
*Crocus veluchensis (spring ^{xx})	.	.	.	.	.	1.1	.	.	.	2.1	.	.	1.1	2.1	.	3.1	.	.	.	.				
*Helleborus cyclophyllus	.	.	.	1.2	.	.	.	1.1	.	.	.	.	+2	+	+2	.	+2	.	.	.				
Al. Quercion frainetto:																								
Trifolium pignatarii	+	.	.	2.3	2.2	+2	1.2	1.2	3.3	3.3	1.2	2.2	2.3	2.2	1.1	+2	1.2	+	1.2	.	V	Ba		
Lathyrus laxiflorus (reg)	+	.	+2	+2	1.1	+2	+2	1.1	1.1	1.1	2.1	1.1	1.1	1.1	2.1	+2	+2	1.1	2.1	1.1				
Lycchnis coronaria (reg)	+	.	+2	.	.	.	.	.	1.1	.	.	.	.	.	.	+2	+2	.	.	.				
Potentilla micrantha	+	.	.	+2	+2	+2	.	.	.	1.1	.	.	.	.	.	+2	+2	.	1.1	+	IV	Med-Sm (An)		
Silene viridiflora	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.				
Ord. Quercetalia pubescentis (subord. Orno-Cotinentalia ^x):																								
*Clinopodium vulgare	.	.	.	+2	1.1	.	.	.	.	1.2	.	.	.	.	.	+2	+2	.	.	.	V	EuAs (Af)		
Lathyrus venetus	1.1	1.1	.	1.2	1.2	1.1	+2	1.2	2.1	1.1	2.1	1.1	2.1	1.1	2.1	+2	1.1	+	2.1	+				
Luzula forsteri	+	1.1	.	+2	1.1	1.2	.	.	+	1.1	.	.	+2	1.1	1.2	.	1.1	+2	1.1	1.1				
Melilotis melissophyllum	+	.	.	.	.	+2	1.1	1.1	2.1	+	1.1	1.1	1.1	1.1	2.1	+	.	.	.	.	IV	Atl-Sm		
Vicia grandiflora	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.				
*Campanula spatulata	.	.	.	+2	.	1.1	.	.	.	.	.	.	.	.	.	.	.	.	.	.				
subsp. sprunerana (loc)	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	II	Ba		
Lathyrus niger	+2	+	2.4	1.2	.	.	.	1.1	.	.	.	.	.	.	.	.	.	.	.	.				
Silene italica	.	.	?	?	.	.	.	.	+2	.	.	.	.	.	.	.	1.1	.	.	.				
Trifolium alpestre	.	.	.	+2	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	II	Eu		
Trifolium medium	.	.	2.2	1.2	.	.	.	.	.	+2	+2	.	.	.	.	.	.	.	.	.				
subsp. balcanicum	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.				
Trifolium ochroleucon	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	II	SmWAs		
Cl. Querco-Fagetea:																								
Geum urbanum	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.			IV	EuAs
Melica uniflora	+2	.	.	1.2	.	.	1.1	1.2	2.2	.	2.1	1.2	1.2	1.1	+2	.	+2	.	.	1.2				
Poa nemoralis	+2	.	1.2	1.2	.	+2	+2	+2	.	+2	.	.	1.2	1.2	1.2	.	+2	1.1	+2	.				
Primula vulgaris	+	.	.	+2	.	.	1.2	1.2	2.2	.	1.2	2.2	1.1	1.1	1.2	1.2	.	.	.	.	IV	Cirr		
Symphytum bulbosum	.	1.1	.	1.2	1.1	2.2	.	.	1.1	1.1	1.1	2.1	2.2	2.1	1.2	.	+2	2.1	1.1	1.1				
Arenaria agrimonoides	.	.	.	+2	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.				
Astragalus glycyphyllos	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	III	Sm		
Brachypodium sylvaticum	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.				
Euphorbia amygdaloides	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.				
Geranium nodosum	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	III	EuAs		
Physospermum cornubiense	1.1	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.				
Ranunculus polyanthemus	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.				
Cephalanthera rubra	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	III	Sm		
Doronicum orientale	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.				
Knauria drymeia	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.				
Others:																								
Dactylis glomerata	.	1.2	+2	1.2	+	+2	.	.	.	1.2	+	+2	+2	+2	+2	+2	+2	.	+	3.2	V	EuSib		
Festuca heterophylla	1.2	1.2	+2	.	2.2	1.1	1.2	1.1	2.2	2.2	2.2	2.2	2.2	3.2	1.1	1.1	1.2	1.2	3.2	2.2				
Veronica chamaedrys	.	.	+2	.	.	+2	+2	+2	.	.	.	.	.	.	.	.	.	.	1.1	.			.	
Fraxinus vesca	.	.	.	.	.	.	.	.	.	1.1	.	1.1	.	.	.	.	.	.	.	.	IV	EuAs		
Platanus chlorantha	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.				
Poa trivialis subsp. sylvicola	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.				
Crucifera laevipes	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	IV	EuAs		
Ptilostemon strictus	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.				
Pteridium aquilinum	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.				
Ajuga reptans	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	III	Ba (Ap)		
Bellis perennis	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.				
Carex brizoides	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.				
Hieracium murorum	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	II	EuAs		
Holcus lanatus	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.				
Prunella vulgaris	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.				
Vicia cfr. dalmanica	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	II	Eu (Af)		
Vicia cfr. sibthorpii	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.				
Vicia cfr. sibthorpii	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.

Fig. 2. Climatic diagrams for the stations situated near Mt. Galičica (after Walter and Lieth 1964, and Wojterski 1971, supplemented)

places there occur xerothermic grasslands or meadows and pastures, especially extensive in the Leskovec valley (Fig. 3).

Quercetum frainetto-cerris macedonicum dominates on non-calcareous soils in the lowest part of the forest belt, on the Galičica foothills between ca. 860 and 1000 (1100) m a.s.l. In nearby localities with calcareous soils other forest communities, mostly more or less disturbed, occur. They belong—according to the preliminary reconnaissance—to the association of *Quercus (cerris) — Ostryetum carpinifoliae* (at lower altitudes) and *Ostryo-Quercetum pubescentis* (at higher elevations, chiefly on south-facing slopes). Some stony and dry places on mountain slopes and lake bordering cliffs are overgrown with the association of the evergreen oak *Quercetum trojanae macedonicum*. There are also stands of *Carpinetum orientalis macedonicum*, situated above 1100 m a.s.l. and replacing—in all probability—the previously devastated *Fagus* stands.

The transition to the mountain and high mountain beech forests consists of a belt with *Aceri obtusati-Fagetum* (on skeletal soils) and "*Fagetum submontanum*" (which is not a clearly defined phytosociological unit). Higher up beech forests *Fagetum montanum* (*F. moesiacum* or *F. macedonicum*) and a beech-fir forest with *Abies borisii-regis* appear. Near the timberline on Stara Galičica, *Fagetum subalpinum* was distinguished. This community, in which fir is also found, is very much influenced by avalanches and forms a transition belt to the high-mountain thickets. On the highest ridges and summits of Galičica, in the alpine zone, low shrubby and herbaceous vegetation dominates with *Juniperus communis* subsp. *nana*, *Sesleria wettsteinii*, *Festuca varia*, *Stipa pulcherrima* etc. (Horvat et al. 1974, p. 615).

General information on the vegetation of the whole Galičica National Park was published by Wojterski (1971).

METHOD OF INVESTIGATION. LOCATION OF PHYTOSOCIOLOGICAL RECORDS

In the investigations the methods of the Central-European phytosociological school Braun-Blanquet (1951) were followed in regard to both the field records (relevés) and the distinction and classification of phytosociological units, based on floristic criteria, with special emphasis on characteristic and differential species. The phytosociological position of particular species was established according to Horvat et al. (1974), with the help of other publications (e.g. Jakucs 1961, Medwecka-Kornaš et al. in Szafer 1966) and according to the authors own field observations; the nomenclature of species follows "Flora Europea" (Tutin et al. 1964-1980).

The distribution of nearly all phytosociological records is indicated on

Fig. 3. Scheme of distribution of forest and thicket communities in the eastern part of Mt. Galičica near Leskovec (compiled by R. Drenkovski): 1—*Quercetum frainetto-cerris macedonicum* Oberdorfer 48 em. Horvat 59, 2—*Quercus-Ostryetum carpinifoliae* Horvat 38 (= *Ostryo-Quercetum cerris macedonicum* sensu Em), 3—*Quercetum trojanae macedonicum* Em 58 em. Horvat 59, 4—*Ostryo-Quercetum pubescentis* Trinaistić 74, 5—*Carpinetum orientalis macedonicum* Rudski ap. Horvat 46, 6—*Aceri obtusati-Fagetum* Em 67, *Fagetum "submontanum"* sensu Em 65, 7—*Fagetum montanum* Rudski 49, 8—*Abieti-Fagetum macedonicum* Em 62 and *Fagetum subalpinum* Horvat 38, 9—*Fagetum subalpinum* and thickets of *Genista radiata*, 10—nonforested areas, 11—localities and numbers of phytosociological records

the map (Fig. 3). Their localities and symbols (used in Table 3) are listed below.

The foothills of the Ilinska planina:

LR — Leva reka, near the road from Ohrid to Resen (records situated outside the map).

The foothills of the planina Galičica, eastern side, near the Prespa Lake:

CA — Carina (Em 1964 — records situated outside the map);

PL — Pluska, near the village Leskovec, forest compartment no. 31 (records 10 and 12 on the MAB experimental area);

LS — Leskovečka reka, forest compartment no. 31;

CU — Crni Ulište, south-east of Leskovec, forest compartment no. 18;

TO — Toljaniva, near the road to Ohrid, forest compartment no. 33;

CR — Crkvište, near the road to Ohrid, above the letovalište Carina, forest compartment no. 32.

STRUCTURAL, FLORISTICAL AND PHYTOGEOGRAPHICAL FEATURES OF *QUERCUS FRAINETTO* FORESTS ON MT. GALIČICA

STRUCTURE AND PHENOLOGY

Some of the study plots (for instance records 1-4) represent the degraded low form of the oak forest called "šikara". In other plots with typical forest structure the trees reach a height of 25 m, their breast height diameter being usually less than 20 (25) cm. Older trees, with larger trunks are found only occasionally, which is a proof of timber exploitation before establishment of the national park. The tree crowns are rather loose and enable light penetration to the ground flora. The density of the shrub layer is not homogeneous, in the ground layer there grow mainly herbaceous perennial plants, relatively low as e.g. *Trifolium pignatii* or taller as *Pteridium aquilinum* and *Lychnis coronaria*. Besides them there are also small shrubs, e.g. *Rosa arvensis*, and shrublets. Mosses are practically absent, and the soil is covered with litter.

The oaks *Quercus frainetto* and *Q. cerris* are deciduous trees, leafless during winter. Early in spring *Crocus veluchensis* begins to bloom on the forest floor. In May the ground flora is fully developed and suitable for phytosociological records (Table 3). At the end of June some plants, which developed flowers and fruits earlier are no more visible (e.g. *Crocus veluchensis*) or begin to turn yellow (e.g. *Symphytum bulbosum*, which however, has young seedlings at that time). Other plants (*Lychnis coronaria*, *Rosa arvensis*, *Trifolium pignatii*, *Lembotropis nigricans*) are then in full bloom. Blossoming prolonged to early summer distinguishes the xerothermic oak forests from more shady deciduous formations. This phenomenon was pointed out in studies concerning *Quercetum frainetto-cerris serbicum* on Mt. Avala near Beograd (Borisavlević et al. 1974) and

Potentillo albae-Quercetum in southern Poland (Kaźmierczakowa 1971). During the summer dry period the development of the ground flora is reduced in some degree. In September, when precipitation is higher, the delicate flowers of *Crocus pulchellus* and *Cyclamen hederifolium* appear. Autumnal blossoming is considered by Em (1964) as an indication of Mediterranean influence.

FLORISTIC COMPOSITION (TABLE 3)

On the 20 plots of *Quercetum frainetto-cerris* studied in the Galičica foothills 153 species of vascular plants were recorded. More than one half of them belong to the group of sporadic species. Such a relatively rich floristic composition does not seem to result from the general richness of the Balkan flora, because e.g. in 18 records from the xerothermic forest *Potentillo albae-Quercetum* in Poland even a higher number of species was noted. It is rather the result of some ecological conditions, first of all the possibility of penetration of plants from meadows and pastures, owing to former forest clearing and grazing. Some species are also common with those of beech forests which grow not far from the study area.

Sporadic species¹ (to Table 3)

Trees

Ord. *Quercetalia pubescentis* (subord. *Orno-Cotinenalia**): **Carpinus orientalis* 1b. ESm(An); *Juglans regia* 7c. 11b. 19c. BaWAs; *Ostrya carpinifolia* 8b. ESm(An); *Quercus pubescens* 20a (1.1). b. Sm; **Sorbus domestica* 8b. 14b. Sm.

Cl. *Quercu-Fagetea*: *Acer campestre* subsp. *marsicum* 7c. 17b. BaPa; *A. heldreichii* 15a. Ba; *Carpinus betulus* 1b. CeEu; *Fagus moesiaca* 5b. 9b. 14b. 17a. Ba(Ap); *Malus dasycphylla* 4b. 17b. Ba-Pa; *M. florentina* 17b. SBa(Ap); *Prunus avium* 17a. CeEu; *P. cerasifera* 11c. 12c. 16b. 20b. c. WAs; *Pyrus pyraister* 2b. 11b. 17b. Sm-Po.

Others: *Quercus petraea* 1a. b. (1.1). 2a. b. c. CeEu.

Shrubs and shrublets

Ord. *Quercetalia pubescentis*: *Dorycnium pentaphyllum* subsp. *herbaceum* 5c. 20c. Sm; *Rosa gallica* 18c. Sm.

Cl. *Quercu-Fagetea*: *Clematis vitalba* 7. Atl-Sm; *Corylus avellana* 1b. 2b. 14b. c. 17b. Eu; *Lonicera caprifolium* 1c. ESm; *Prunus spinosa* 7c. 8b. 14c. 16c. Sm-Po.

Others: *Acanthus balcanicus* 7. Ba.

Herbaceous plants

Ord. *Quercetalia pubescentis* (subord. *Orno-Continentalia**):

* *Asphodeline liburnica* 20. Ba(Ap.An); *Coronilla elegans* 1. Ba-WPo; *Digitalis lanata* 17. Ba-Pa; *Geranium sanguineum* 17 Sm-CeEu; *Inula hirta* 4. Po; *Lithospermum purpureocaeruleum* 4. 16. 19. Sm(An); *Scutellaria columnae* 7. 11. 15. 19. Ba(Ap)Pa; *Tanacetum corymbosum* 6. 13. 15. SEuAs; *Vincetoxicum hirundinaria* 17. SEuAs.

¹ For abbreviations indicating the geographical character of species see p. 332.

Cl. *Quercu-Fagetea*: *Anemone nemorosa* 1. CeEu; *Calamintha grandiflora* 15. Sm; *Cephalanthera longifolia* 5 9 14 18. Eu-WAs; *Epipactis bellchiorine* 6 12. EuSWAs; *Lapsana communis* 13, 14, 15, 17. Cirp; *Listera ova*, 14, 16. EuSib; *Moehringia trinervia* 7. EuSWAs; *Neottia nidus-avis* 14. EuWSib; *Pulmonaria officinalis* 13, 15. Eu; *Ranunculus ficaria* subsp. *calthifolius* 15. Sm-Pa; *Sanicula europaea* 14. SCirp; *Saxifraga bulbifera* 15. ESm; *Stellaria holostea* 6. EuWSib; *Tamus communis* 17. Subatl-Med; *Viola odorata* (and *V. suavis*) 5. 12. 14. 16. SCeEu; *V. reichenbachiana* 1. 9. 11. CeEu.

Cl. *Festuco-Brometea*: *Agrimonia eupatoria* 20 (1.1). EuSWAs; *Brachypodium pinnatum* 4. 17. EuWSib; *Carex caryophylla* 17. EuWSib; *Euphorbia cyparissias* 2. Eu; *Poa bulbosa* 3. 4. 6. 17. Med-SWAs; *Potentilla recta* 17. Sm-Po; *Teucrium chamaedrys* 2 7. Med-Sm.

Cl. *Molinio-Arrhenatheretea*: *Phleum pratense* 8. EuAs; *Rumex acetosa* 11. 16. Cirp; *Trifolium patens* 3. Subatl-Subm; *T. pratense* 17. 19. EuWAs; *T. repens* 19. EuAs.

Others: *Aira elegantissima* 13. Sm; *Calamagrostis* sp. 18; *Carex* sp. 12. 14; *Crepis setosa* 3. Sm; *Cystopteris fragilis* 15. Cosm; *Digitalis grandiflora* 1. 13. 15. CeEu; *Festuca ovina* coll. 3. 4. 20 (1.2). EuSib; *Galium aparine* 3. 15. EuAs; *G. lucidum* 17. Sm; *Hieracium praealtum* subsp. *bauhinii* 13. 15. EuAs; *H. umbellatum* 5. 10. 12. 14 (1.1). EuAs; *H. piloselloides* 5. 6. 14. CeEu; *H. argillaceum* group 5 (1.2). 14 (1.1). CeEu; *Huetia cynapioides* 5. 11. 12. Ba(Ap); *Hypericum perforatum* 8. 9. 12. 19. Eu; *Lactuca* sp. 20; *Lathyrus grandiflorus* 3. 4. SBa(Ap); *Origanum vulgare* 13. 15. 17. EuAs; *Poa* cfr. *hybrida* 19. EuSib; *Prunella laciniata* 20. Sm; *Stachys scardica* 17. Ba; *Stellaria media* 15. Cosm; *Torilis japonica* 3. EuAs; *Verbascum glabratum* subsp. *bosnense* 7. 15. 19 (1.2). Ba; *Leronic officinalis* 5. 12. 13. EuWAs; *Vicia tetrasperma* 14. 19. EuWAs.

To the components of the association which occur most often and most abundantly belong *Quercus frainetto*, *Trifolium pignatii*, *Lathyrus venetus* and *Festuca heterophylla*. In some marginal plots near the forest edge *Carex brizoides* was found in abundance (record 11)—a species very expansive in disturbed forests in central Europe, e.g. in Poland. The simultaneous presence of neutrophilous plants, e.g. *Euphorbia amygdaloides*, and acidophilous ones, such as *Pteridium aquilinum* and *Lembotropis nigricans*, is also worth noting.

In spite of the floristic diversity it is quite difficult to point out the species exclusively connected with the association *Quercetum frainetto-cerris*, and even with the alliance *Quercion frainetto*. Plants endemic to the Balkan Peninsula exhibit usually a relatively wide ecological scale and occur also in other associations of various phytosociological affiliation (e.g. *Helleborus cyclophyllus*). On the other hand, plants which in the Galičica region are limited to *Quercetum frainetto-cerris* (e.g. *Lychnis coronaria*) grow in other areas in different associations. Therefore, the diagnostic role should be first of all ascribed to the local characteristic species and to the differential species (Table 3). In this regard some suggestions of other authors as to the phytosociological position of particular plants could not be accepted. For instance *Physospermum cornubiense* (*Danaë cornubiensis*), mentioned usually as the species characteristic of the association *Quercetum frainetto-cerris* grows commonly in Macedonia also in beech forests, therefore, in the present paper it has been considered as a species characteristic of the whole class *Quercu-Fagetea*.

GEOGRAPHICAL ELEMENTS

The floristic composition of Balkan plant communities is especially interesting from the phytogeographical point of view, because of the high percentage of endemics in this area and the existence of contacts of various phytochoria, first of all the Mediterranean and Submediterranean Regions (Turrill 1929, Oberdorfer 1948, Horvat 1954). Also important are connections with Central Europe (especially in the mountain vegetation) and with temperate Asia (chiefly in the subcontinental part of the peninsula). For these reasons the phytogeographical spectra, i.e. estimates of the share of particular geographical elements in the Balkan plant associations have often been compiled and discussed (Em 1964, Jovanović 1954, Pop 1967, Rizovski msc.). This is, however, not an easy task because the geographical elements of the local flora have not been univocally defined in the literature. The classification used in the present paper was established after several sources (Browicz 1982, Em 1969, Gajewski 1937, Jakucs 1961, Meusel 1943, Meusel et al. 1965, 1978, Walter and Straka 1970) and with reference to the maps of the phytogeographical division of Europe and adjacent parts of Asia (Medwecka-Kornaś in Szafar 1966, Walter and Straka 1970).

The abbreviations used for particular geographical groups of species, indicated in Tables 3 and 4, are listed below. Combined symbols are used for "connective elements" occurring in two or more phytogeographical areas.

Geographical groups of species:

Ba — Balkan endemics (without distinction between Mediterranean, Illyrian and other local types of distribution);

Ba(An), Ba(Ap) etc. — Subbalkan species, growing chiefly on the Balkan Peninsula, but also in some localities in other regions;

BaAs — Balkan-Asiatic species;

CeEu — Central-European species;

Cirp — Circumpolar species occurring in Europe, Asia and North America;

Cosm — Cosmopolitan species;

Eu — European species, widely distributed, but (with few exceptions) not reaching far to the North;

EuAs — Euro-Asiatic species, growing in Southern Siberia, in the Irano-Turanian Region and/or also further to the East;

EuSib — Euro-Siberian species;

Med — Mediterranean species, not limited to the Balkan Peninsula;

Pa — Pannonian species;

Po — Pontic species;

Sm — Submediterranean species, not limited to the Balkan Peninsula;

Subatl — Subatlantic species.

Geographical names and symbols of quarters used for additional information:

(Af) — Africa (not indicated for the Mediterranean species);

(An) — Anatolian Province (Asia Minor);

(Ap) — Appenine Peninsula;

E, N, S, W — eastern, northern, southern and/or western part of a given geographical area, respectively.

In the geographical spectrum of *Quercetum frainetto-cerris* (Table 4) particularly interesting is the relatively high number of Balkan, Subbalkan as well as Submediterranean species. Together they form about 50% of the

Table 4

Geographic groups of species in the association *Quercetum frainetto-cerris macedonicum* from Galiciča

Geographical groups of species ¹	Species with constancy				Total			
	I		II-V		I-V			
	n	%	n	%	n	%	n	%
Balkan — Ba	4	4.6	6	9.0	10	6.5	30	19.6
Subbalkan — Ba(An), Ba(Ap) Ba-Pa, Ba-Po, BaAs	11	12.7	9	13.5	20	13.1		
Mediterranean — Med (incl. Med-Sm, MedAs)	2	2.3	2	3.0	4	2.6	51	33.3
Submediterranean — Sm	11	12.7	11	16.0	22	14.4		
Atlantic-Submediterranean — Atl-Sm (and Subatl-Sm, Subatl-Med)	3	3.4	5	7.6	8	5.2		
Submediterranean more continental — Sm(An), SmAs, SmCeEu, Sm-Pa, Sm-Po	8	9.3	9	13.5	17	11.1	62	40.5
Pontic — Po	1	1.2	—	—	1	0.6		
Central-European — CeEu (incl. CeEu-Po)	10	12.5	3	4.5	13	8.5		
European — Eu (incl. Eu(Af))	4	4.6	5	7.5	9	5.9		
Eurasiatic — EuAs (incl. EuSib and EuAs(Af))	23	26.4	15	22.4	38	24.8		
West Asiatic — WAs	1	1.2	—	—	1	0.7	7	4.6
Circumpolar — Cirp	3	3.4	1	1.5	4	2.6		
Cosmopolitan — Cosm	2	2.3	1	1.5	3	2.0		
Unidentified species	3	3.4	—	—	3	2.0	3	2.0
Total	86	100	67	100	153	100	153	100

¹ For abbreviations see text p. 332.

whole floristic composition. Very significant is also the share of Euro-Asiatic species with area of distribution extended into the continental parts of temperate Asia. On the contrary, Pontic and Pannonian species do not play any important role.

Constancy of selected species in the associations of Quercion frainetto alliance Horvat 1954
(after Horvat et al., rearranged and supplemented; farther explanation in the text)

	A				B				C				D	E	F	G				H	I					
Plant association	Q.f.c.thr.				Q.f.c.moes.				Q.f.c. maced.				Qf	CaQ	C-Q	Q.mont.moes.				O-Q	ass. of Q.petr.					
Country	Bulgaria				Serbia				Ma	Ma,Gr,Bu	Gr	Ma	Ru			N Serbia				Ma	Ma	Bul	Al	Gr		
Tab.no. after Horvat et al. 1974	47				46				-	-	46	46	-	46			48				-	48				
Ass.no. after Horvat et al. 1974	1	2	3		1	2	3	4	Em	Ge	6	7	8	Riz	9	4	5	6	7	Em	8	9	10	11		
Trees and shrubs:																										
Quercus frainetto	III	V	IV		V	V	V	V	V	V	V	V	V	V	I	I	I	I		II	III	I	.	II		
Q. cerris	V	V	V		V	V	V	V	III	V	V	V	.	.	I	V	II	IV		I	III	II	.			
Sorbus torminalis	.	.	.		II	I	III	I	IV	II	.	.	IV	IV	II	I	I	IV		III	II	I	I	III		
Cornus mas	II	II	I		I	II	.	III	II	II	II	V	I	I	V	V	I	.	II	III	III	.	I	I		
Fraxinus ornus	.	.	.		II	II	IV	IV	IV	.	.	V	II	IV	V	V	I	I	I	IV	II	I	I	IV		
Quercus petraea	.	.	.		III	II	I	III	III	I	II	II	I	III	I	V	V	V	V	V	V	V	V	V		
Fagus moesiaca + F. orientalis	.	.	.		I	.	.	.	.	.	.	.	III	I	.	I	II	II	II	II	II	II	II	.		
Rosa arvensis	.	.	.		IV	.	.	IV	IV	II	I	III	V	IV	.	II	IV	IV	II	II	.	.	.	I		
Carpinus orientalis	I	I	.		V	I	I	V	II	I	.	IV	I	.	IV	.	II	.	I	II	.	.	.	.		
Pyrus amygdaliformis	.	.	.		I	.	.	I	.	II	I	I	.	.	.	.	.	.	.	.	.	.	.	.		
Sorbus domestica	.	.	.		IV	.	IV	IV	IV	I	I	III	II	III	.	.	.	.	.	I	.	.	.	.		
Quercus pedunculiflora	IV	II	I		.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.		
Q. virgiliana	I	I	V		.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.		
Paliurus spina-Christi	I	II	V		.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.		
Cotinus coggygria	II	II	III		.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.		
Viburnum lantana	.	.	.		II	IV	IV	II	.	.	.	.	.	.	I	.	.	.	I	.	.	I	.	.		
Pyrus pyraeaster + P. communis	.	.	.		III	V	II	IV	II	I	.	II	.	.	I	II	I	II	I	II	III	I	.	.		
Lambetropis nigricans	.	.	.		.	.	.	.	.	III	I	.	.	.	.	.	.	.	.	.	.	.	.	.		
Acer obtusatum	.	.	.		.	.	.	.	.	II	.	.	.	.	.	.	.	.	.	II	II	.	I	.		
Herbaceous plants:																										
Dactylis glomerata	I	I	I		V	IV	II	IV	V	V	IV	IV	V	V	IV	V	I	IV	IV	V	IV	IV	I	V		
Brachypodium sylvaticum	IV	II	I		III	III	IV	IV	V	III	IV	V	V	III	III	V	IV	IV	II	I	III	II	.	IV		
Geum urbanum	I	I	I		II	II	IV	II	II	IV	II	IV	I	.	II	I	I	II	II	II	II	.	.	I		
Festuca heterophylla	II	I	I		III	III	V	III	V	V	I	IV	III	IV	.	I	II	III	V	V	V	V	.	IV		
Lathyrus niger	I	I	II		II	V	.	III	III	II	II	III	III	V	IV	IV	I	.	I	III	III	III	I	I		
Trifolium alpestre	I	I	II		II	V	.	I	II	II	III	I	I	I	.	I	I	II	I	II	III	.	I	I		
Physospermum cornubiense	II	I	II		II	V	IV	II	IV	III	.	.	IV	V	.	III	.	.	III	II	IV	.	III	I		
Potentilla micrantha	.	.	I		III	.	.	III	IV	IV	IV	V	II	V	I	IV	II	II	IV	V	V	I	.	.		
Lychnis coronaria	I	I	.		III	I	I	II	IV	IV	.	II	.	II	.	.	.	.	III	III	.	.	.	.		
Asparagus tenuifolius	II	III	I		I	I	.	II	III	.	.	.	.	III	.	.	.	.	I	I	.	.	.	.		
Lathyrus venetus	.	.	.		II	.	.	III	IV	V	I	III	I	II	.	II	I	II	II	IV	III	.	III	I		
Aremonia agrimonoides	.	.	.		I	II	.	II	III	III	IV	III	IV	.	.	.	III	II	III	V	I	.	II	.		
Luzula forsteri	.	.	.		II	.	.	II	IV	V	V	V	V	III	.	II	.	II	III	III	III	I	.	V		
Pteridium aquilinum	.	.	.		I	.	I	II	.	IV	II	.	IV	I	.	.	I	IV	II	I	V	I	II	III		
Euphorbia amygdaloides	.	.	.		III	.	.	III	IV	III	II	V	II	V	.	III	I	IV	IV	IV	IV	III	II	IV		
Symphytum tuberosum + bulbosum	.	.	.		I	III	.	.	III	IV	III	II	.	IV	.	II	.	.	III	II	.	I	I	.		
Helleborus odoratus	.	.	.		III	IV	V	IV	.	.	.	.	.	.	.	V	V	III	V	V	I	III	I	.		
Asparagus officinalis	I	II	II		.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.		
Cynodon dactylon	I	I	I		.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.		
Arum orientale	I	I	.		.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.		
Inula hirta	.	.	.		I	V	III	II	.	I	.	.	.	II	.	.	.	.	.	.	.	.	.	.		
Primula vulgaris	.	.	.		I	.	.	II	II	IV	II	III	.	I	.	.	.	.	III	III	.	.	.	.		
Euphorbia cyparissias	.	.	.		I	V	IV	I	III	I	.	.	.	.	.	.	.	.	.	I	.	.	.	.		
Trifolium pignanti	.	.	.		.	.	.	.	.	II	V	.	II	I	IV	.	.	.	IV	II	.	.	III	II		
Lathyrus laxiflorus	.	.	.		.	.	.	.	.	V	V	IV	V	V	IV	.	.	.	IV	IV	.	.	.	.		
Galium laconicum	.	.	.		.	.	.	.	.	.	II	III	V	.	.	.	.	.	.	.	.	.	.	.		
Cyclamen hederifolium	.	.	.		.	.	.	.	.	IV	IV	I	III	.	II	.	.	.	.	.	.	.	.	.		
Galium pseudaristatum	.	.	.		.	.	.	.	.	IV	V	.	.	IV	.	.	.	.	.	.	.	.	.	.		
Crocus pulchellus	.	.	.		.	.	.	.	.	.	.	.	III	.	.	.	.	.	.	.	.	.	.	.		
Geranium asphodeloides	.	.	.		.	.	.	.	.	.	.	.	III	.	.	.	.	.	.	.	.	.	.	.		
Crocus veluchensis	.	.	.		.	.	.	.	.	.	.	.	II	.	.	IV	.	.	.	.	.	.	.	.		
Helleborus cyclophyllus	.	.	.		.	.	.	.	.	II	.	.	.	.	.	.	.	.	.	.	.	.	.	.		

SYNTAXONOMICAL POSITION OF *QUERCUS FRAINETTO* FORESTS ON
MT. GALIČICA

Analysis of the floristic composition of the studied plots and their comparison with other related communities point to their adherence to the regional association *Quercetum frainetto-cerris macedonicum* Oberd. 1948 em. Horvat 1959, in its typical subassociation mentioned from the Galičica area by Em (1964). Em, moreover, called attention to the separate facies with *Lembotropis nigricans*, also observed by the present authors.

Quercetum frainetto-cerris macedonicum represents the Balkan alliance *Quercion frainetto-cerris* Horvat 1954, traditionally included in the order *Quercetalia pubescentis* Br.-Bl. 1931 and in the class *Quercio-Fagetalia* Br.-Bl. and Vlieg. 1937. The same classification was adopted also by Horvat et al (1974). Jakucs (1961) proposed to transfer the alliance *Quercion frainetto-cerris* to a new, East-European order *Orno-Cotinetalia*. In consequence the order *Quercetalia pubescentis* was raised to the rank of a separate class: *Quercetalia pubescentis*. This seems to be inadequate, because *Quercetum frainetto-cerris* and other similar xerothermic associations have much in common with mesic deciduous forests of the *Fagetalia* order. On the other hand, their specific geographical character should be stressed. Therefore, in the present paper the unit "*Orno-Cotinetalia*" is accepted, but only in the rank of sub-order *Orno-Continentalia*.

The forests of *Quercion frainetto-cerris* alliance are found in southern and western Rumania, in Bulgaria, Yugoslavia (Serbia and Macedonia), in some parts of Albania, Greece and European Turkey (cfr. maps of Glavač et al. 1972, Horvat et al. 1974, Donița and Roman 1976). The east-central part of the Balkans (Moesia) is the main area of their development. They occur there mostly in uplands and in the foot-hills zone of the mountains, between 600 and 700 m a.s.l., the altitude of their sites increasing towards the south (Em 1968, Horvat 1950).

Because of their wide geographical distribution the forests under consideration were studied in various countries and their relatively numerous variants, subassociations or associations were described (Horvat 1959). Some of them were compared by Rizovski (msc.) and — with the use of more extensive materials — by Horvat et al. (1974). To point out more important floristic features of at least a part of those associations and throw some light on the position of the *Quercetum frainetto-cerris macedonicum* at Galičica, Table 5 was compiled. It is based on the synthetic lists of Horvat et al. (1974), rearranged and supplemented by the records of Em (1964), Rizovski (msc.) and of the present authors. (The fact, that Horvat et al. have omitted in their lists some sporadic species seems to be insignificant for general conclusions).

The table contains a list of selected species and the degree of their constancy in the following phytosociological units (rec. = records, subass. = subassociation, * = papers referred to by Horvat et al. 1974, not included in the list of references in the present paper).

A. *Quercetum frainetto-cerris thracicum* (= *bulgaricum*) from Bulgaria. 1: subass. *quercetosum pedunculiflorae*, 18 rec.; 2: subass. *typicum*, 19 rec.; 3: subass. *quercetosum virgilianae*, 11 rec. (*Gančev 1965).

B. *Quercetum frainetto-cerris moesiicum* (= *serbicum*) from Serbia. 1: 20 rec. (*Jovanović 1956); 2: subass. *typicum*, 8 rec. (*Rudski 1949); 3: 24 rec. (*Veljović 1967); 4: subass. *carpinetosum orientalis*, 13 rec. (*Jovanović 1955).

C. *Quercetum frainetto-cerris macedonicum* from Macedonia and other regions. Em: subass. *carpinetosum orientalis* and *typicum*, 13 rec. from various parts of Macedonia, excluding data from Galičica (Em 1964); Ga: 20 rec. from Galičica according to Table 3 in the present paper; 6: subass. *typicum*, 8 rec. and 7: subass. *fraxinetosum orni*, 6 rec. — both subassociations from northern Greece, Macedonia and southern Bulgaria (*Oberdorfer 1948 msc.).

D. *Quercetum frainetto* from northern Greece, 83 rec. (*Dafis 1966).

E. *Carici caespidatae* — *Quercetum frainetto*, 30 rec. from Vardar region, Southern Macedonia (Rizovski msc.).

F. *Carici-Quercetum frainetto* from Dobruja in Rumania, 22 rec. (*Donița 1970). (The associations/subassociations related with *Quercetum frainetto-cerris* Georgescu 1945 described from Rumania by Coldea 1971, Pop 1967 and Boșcaiu 1971 are not included in Table 5 because they have only few species in common with the units mentioned there).

G. *Quercetum montanum moesiicum* (= *serbicum*) from Serbia. 4: subass. *ornetosum* from Mt. Avala, 5 rec. (*Borisavljević et al. 1955); 5: Rudnik Mts., 22 rec. (*Gaić 1961); 6: Suva Planina 22 rec. (*Jovanović 1955); 7: Kapaonik Mts., 20 rec. (*Raievski and Borisavljević 1956).

H. *Orno-Quercetum petraeae* from Macedonia, 25 rec. (Em 1968).

I. *Quercetum petraeae* from Macedonia. 8: Rudoka Mts., 6 rec. (*Nikolovski 1959); 9: *Quercus petraea* ass. from Bulgaria, Lozen Mts., 8 rec. (*Grančev 1961); 10. 11: *Quercus petraea* forest from Albania, 5 rec. (*Markgraf 1932) and from northern Greece, 19 rec. (*Dafis 1966).

As shown in Table 5 the associations of the alliance *Quercion frainetto-cerris* have many species in common, which grow in all or nearly all of them and can attain a high degree of presence. *Quercetum frainetto-cerris thracicum* from Bulgaria has the most distinct floristic position. Among others the following species were indicated only from this unit: *Quercus pedunculiflora*, *Paliurus spina-christi* and *Cotinus coggygia*. Simultaneously there are some species which do not grow in *Q.f.-c. thracicum*, but are present in other geographically separated associations.

The differences between *Quercetum frainetto-cerris moesiicum* from Serbia and *Q.f.-c. macedonicum* are of a lower rank. The species *Galium laconicum*, *Cyclamen hederifolium*, *Trifolium pignanii* and *Lathyrus laxiflorus* recorded in *Quercetum frainetto-cerris macedonicum* distinguish these two associations (they occur in Serbia but in *Quercetum montanum moesiicum*). Both *Q.f.-c. moesiicum* and *Q.f.-c. macedonicum* have many species in common with forests of more marked mountain character (as shown by Em 1968 with relation to *Q.f.-c. macedonicum*).

Quercus frainetto forests, phytosociologically investigated and situated nearest to Galičica, were recently described from the region of the Vardar river. Rizovski (msc. and 1974) distinguished there a new association *Carici cuspidatae-Quercetum frainetto*, which occurs at the altitude of 660-1130 m. Some plants connected especially with *Quercetum frainetto-cerris macedonicum*, such as *Galium pseudaristatum* and *Crocus veluchensis*, were found there.

Thus *Quercetum frainetto-cerris* of Mt. Galičica foothills has only few distinct floristic features. Its best distinguishing species seem to be *Geranium asphodeloides*, *Crocus pulchellus* and *Helleborus cyclophyllus* — the latter two of these species limited to the southern part of the Balkan peninsula. Thereafter a separate geographical variant on the study area could be distinguished: *Quercetum frainetto-cerris macedonicum*, *Helleborus cyclophyllus* variant.

It seems interesting to compare the *Quercetum frainetto-cerris* of Macedonia with the similar vegetation types in Central Europe, especially in Poland. There are 88 species which grow both in the oak forest on Galičica and in Poland, but some of them are very rare north of the Carpathians. A comparison of the association *Potentillo albae-Quercetum* from the Małopolska Upland (18 records of Kaźmierczakowa 1971) revealed 38 species in common with the *Quercus frainetto* forests on Galičica, for example *Clinopodium vulgare*, *Lathyrus niger*, *Melittis melisophyllum*, *Trifolium alpestre* and *Festuca heterophylla*, which play an important role in the ground flora of both associations.

REFERENCES

- Adamović L. 1909. Die Vegetationsverhältnisse der Balkanländer. In: Die Vegetation der Erde II. Engler E., Prude O. (ed.), W. Engelmann, Leipzig.
- Borisavljević L., Dinić A., Mišić V. 1974. Annual dynamics of plant species in the community of Hungarian Oak and Turkish Oak (*Quercetum farnetto-cerris serbicum*) in the Stationary on Avala. Arh. Biol. Nauka (Beograd) 26 (1-2): 69-86.
- Boşcaiu N., 1971. Flora și vegetatia muntilor Iarcu, Godeanu și Cernei. Acad. Rep. Soc. Romania, Bucuresti.
- Braun-Blanquet J. 1951. Pflanzensoziologie, II. Aufl. Springer, Wien.
- Browicz K., Chorology of trees and shrubs in south-west Asia and adjacent regions I. PWN, Warszawa-Poznań.
- Coldea G. H., 1971. Cercetări fitocenologice asupra padurilor din Muntii Plopiș. Stud. Cercet. Biol. Ser. Botan. (Bucharest) 23: 337-345.
- Donița N., Roman N., 1976. Vegetation (map 1:1000000). Atlas of the Socialistic Republic of Romania VI-2. Institute of Geography, Bucharest.
- Em H., 1964. Der Wald der Balkan- und Zerreiche in der SR Mazedonien. *Quercetum farnetto-cerris macedonicum* Oberd., 1948 emd. Ht. God. Zbor. Zemjodelsko-Sumariskiot Fak. Univ. Skopje Sumarstvo 17: 235-253.
- Em H., 1968. Traubeneichenwald und das Vorkommen der Hainbuche in Mazedonien. Feddes, Rept., 78 (1-3): 83-95.

- Em H., 1969. Versuch einer chorologischen Analyse der Dendroflora Macedoniens. God. Zbor. Zemjodelsko-Sumarskiot Fak. Univ. Skipie. Sumarstvo 22: 15-23.
- Gajewski W., 1937. Les éléments de la flora de la Podolie polonaise. Pl. Polon. (Warszawa) 5.
- Glavač V., Ellenberg H., Horvat I., 1972. Vegetationskarte von Südosteuropa. Fischer, Stuttgart.
- Grupče Li., 1983. Programme for complex ecological studies in ass. *Quercetum frainetto-cerris macedonicum* Oberd. 1948. em. Horvat 1959 as part of the UNESCO Program "Man and Biosphere", project No. 8 in the Galičica National Park. God. Biol. Inst. u Saraievu 36: 79-86.
- Grupče Li., Mulev M., Drenkovski R., 1983a. Organized stationary for complex studies of the oak ecosystem in the Galičica National Park. Ann. Fac. Biol. Univ. Skopje 36: 181-187.
- Grupče Li., Mulev M., Drenkovski R., 1983b. Annual litter and its structure in the ecosystem *Quercetum frainetto-cerris macedonicum* Oberd. 1948. em. Horvat 1959 in Galičica National Park. God. Biol. Inst. u Saraievu 36: 87-91.
- Grupče Li., Mulev M., Drenkovski R., 1983c. Intensity of litter breakdown in the oak ecosystem *Quercetum frainetto-cerris macedonicum* in the Galičica Park. Ann. Fac. Biol. Univ. Skopje 36: 155-161.
- Horvat I., 1950. Les associations forestières en Yougoslavie. Inst. za Šumarska Istraž., Zagreb.
- Horvat I., 1954. Pflanzengeographische Gliederung Südosteuropas. Vegetatio 5-6: 434-447.
- Horvat I., 1958. Laubwerfende Eichenzonen Südosteuropas in pflanzensoziologischer, klimatischer und bodenkundlicher Betrachtung. Angew. Pflanzensoziol. (Stolzenau/Weser) 15: 50-62.
- Horvat I., 1959. Wärmeliebende Eichen- und Kiefernwälder Südosteuropas in systematischer Betrachtung. Biol. Glasn. (Zagreb) 12: 1-40.
- Horvat I., Glavač V., Ellenberg H., 1974. Vegetation Südosteuropas. Geobotanica selecta 4. G. Fischer, Stuttgart.
- Jakucs P., 1961. Die phytozönologischen Verhältnisse der Flaumeichen-Buschwälder Südostmitteleuropas. Ung. Akad. Wissenschaft., Budapest.
- Jovanović B., 1954. La phytocenose *Quercetum confertae-cerris* comme indicateur biologique. Glasn. Šumarskog Fak. Beograd B: 207-219.
- Kaźmierczakowa R., 1971. Ecology and production of *Potentillo albae-Quercetum* and *Tilio-Carpinetum* ground flora in two forest reserves on the Malopolska Upland. Stud. Nat. A (Kraków) 5.
- Marković-Marijanović J., 1955. Beitrag zur Kenntnis der Sedimente und der Morphologie des Presepaer Beckens. Misz. Geol. Inst. "J. Zujovic" (Beograd) 8: 53-84.
- Mayer H., 1984. Wälder Europas. G. Fischer, Stuttgart.
- Meusel H., 1943. Vergleichende Arealkunde. Borntraeger, Berlin-Zehlendorf, vol. 1 and 2.
- Meusel H., Jäger E., Weinert E., 1965, 1978. Vergleichende Chorologie der zentral-europäischen Flora. G. Fischer, Jena, vol. 1 and 2.
- Mulev M., Grupče Li., Drenkovski R., 1983. Seasonal dynamics of carbohydrates in several herbaceous plants important to the community of *Quercetum frainetto-cerris macedonicum* Oberd. 1948. em. Ht 1959 in the Galičica National Park. Ann. Fac. Biol. Univ. Skopje 36: 171-180.
- Oberdorfer E., 1948. Gliederung und Umgrenzung der Mittelmeervegetation auf der Balkanhalbinsel. Ber. Geobot. Forschungsinst. Rübel Zürich für das Jahr 1947, pp. 84-111.
- Pop J., 1967. Vergleichende Untersuchungen über die Zerreichenwälder der Hochebene von Miersing und der Crisana-Vorberge. Contr. Bot. (Cluj) 1967: 305-313.
- Rizovski R., msc. (1972). The forests with oak (*Quercus frainetto* Ten.) in southern part of SR Macedonia (dissertation for doctor's degree). Univ. of "Kiril and Metodij", Skopje.

- Rizovski R., 1974. Forests of balcanian oak (*Quercus frainetto* Ten.) as individual vegetative belt in down part of river Vardar. God. Zbor. Zemjodelsko-Šumarskiot Fak. Univ. Skopje. Šumarstvo 26: 89-99.
- Stefanović K., 1982. Characteristics of the soil in some forest communities on Avala mountain. Acta Biol. Yugosl. (Beograd) 31(2): 207-214.
- Szafer W. (ed.), 1966. The vegetation of Poland. Pergamon Press-PWN. Oxford-Warszawa.
- Tomasević D., 1960. Die Waldtypen und ihre Degradationsformen am Vodno Gebirge. God. Zbor. Zemjodelsko-Šumarskiot Fak. Univ. Skopje. Šumarstvo 13: 57-92.
- Turrill W.B., 1929. The plant-life of the Balkan Peninsula. A phytogeographical study. Clarendon Press. Oxford.
- Tutin T.G., Heywood V.H. and others (eds.), 1964—1980. Flora Europaea. vol. 1-5. Cambridge Univ. Press. Cambridge.
- Walter H., Lieth H., 1960, 1964. Klimadiagram Weltatlas 1. 2. G. Fischer. Jena.
- Walter H., Straka H., 1970. Arealkunde. Floristisch-historische Geobotanik. 2nd ed., E. Ulmer Stuttgart.
- Woiterski T., 1971. National parks of Yugoslavia. Ochr. Prizr. 36: 11-129.

Zespół Quercetum frainetto-cerris w dolnym piętrze leśnym pasma Galičica w Macedonii

Streszczenie

Lasy dębowe z *Quercus frainetto* i *Q. cerris*, występujące u wschodnich podnóży Galičicy, są od kilku lat obiektem badań ekologicznych związanych z programem „Człowiek i Biosfera” — MAB. (Grupče 1983, Grupče i in. 1983 a, b, c, Mulev i in. 1983). Celem obecnej publikacji jest przedstawienie fitosocjologicznej i fitogeograficznej charakterystyki tych lasów. Badania były przeprowadzone wspólnie, dzięki umowie o współpracy Instytutów Botaniki Uniwersytetu Jagiellońskiego w Krakowie i Uniwersytetu im. Cyryla i Metodego w Skopje.

Pasma górskie Galičica rozciąga się między Jeziorem Ochrydzkim i Jeziorem Prespańskim, na granicy Jugosławii z Albanią (rys. 1). Występują tu zarówno utwory bezwapienne (piaskowce, zlepienie i łupki paleozoiczne) jak i triasowe wapienie i dolomity. Lasy z *Quercus frainetto* i *Q. cerris* rozwijają się na podłożu bezwapiennym, na glebach słabo kwaśnych, które można określić wstępnie jako gleby brunatne wylugowane (tab. 1). Klimat omawianego regionu ma cechy subkontynentalne (typ IV(VI) wg Waltera i Lietha 1960); zimy są chłodne, lecz tylko skrajne temperatury spadają poniżej 0°C (niekiedy nawet do -20°), lata gorące i suche (rys. 2, tab. 2). Roślinność Galičicy — do granicy z piętrem alpejskim — tworzą głównie lasy. W niższych położeniach są one bardziej zróżnicowane, z udziałem licznych gatunków drzew, wyżej głównie bukowe. Kserotermiczna dąbrowa z *Quercus frainetto* i *Q. cerris* rozwija się w niskich położeniach, od 860 po 1000 (1100) m n.p.m. W jej płatach nie zdegradowanych do postaci zarośli — śikara — (jaką reprezentują w tab. 3 zdjęcia 1-4) drzewa są do 25 m wysokie, o mało rozłożystych koronach, przepuszczających sporo światła. Podszycie wykazuje rozmaity stopień zwarcia, w runie panują byliny, choć nie brak też drobnych krzewinek i niskich krzewów. Skład florystyczny jest

stosunkowo bogaty (tab. 3). Wpływa na to jednak głównie udział gatunków sporadycznych. W spektrum geograficznym znaczną rolę (ok. 50% całości) odgrywają rośliny bałkańskie i submediterrańskie (tab. 4). Analiza fytosociologiczna wskazuje na przynależność badanych płatów do zespołu *Quercetum frainetto-cerris macedonicum* i bałkańskiego związku *Quercion frainetto-cerris*.

Porównanie opisywanych lasów z danymi o pokrewnych zbiorowiskach (tab. 5) wskazało m.in. na duże podobieństwo między *Quercetum frainetto-cerris macedonicum* i *Q. frainetto-cerris thracicum (serbicum)*. Równocześnie zaznaczyła się pewna odrębność zespołu u podnóży Galičicy, pozwalająca na wyróżnienie osobnego wariantu geograficznego: *Quercetum frainetto-cerris macedonicum*, wariant z *Helleborus cyclophyllus*.

Badany las, położony na południowych krańcach Jugosławii, ma 88 gatunków rosnących także w Polsce, choć po części rzadko, i 38 gatunków wspólnych z ciepłą dąbrową *Potentillo albae-Quercetum*, opisaną z Wyżyny Małopolskiej przez Kaźmierczakową (1971).