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THE FUNGI OF MOUNT BABIA GORA
III. THE INDICATING VALUE OF MACROMYCETES IN THE FOREST ASSOCIATIONS

by

Anna Bujakiewicz

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16. Abstract
The result of mycosological investigation of the forests of the upper mountain forest zone of Mt. Babia Gora and the synthetic characteristics of participation of macromycetes in all the forests studied is presented. Regularities and distinct connections have been found in the occurrence of macromycetes on the background of various forest associations, differences in exposure, orography, climate and changes induced by man.

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THE FUNGI OF MOUNT BABIA GORA

III. THE INDICATING VALUE OF MACROMYCETES IN THE FOREST ASSOCIATIONS /3*

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Introduction

Elaboration presented below deals with the characteristics of upper subalpine forests and a synthesis of the mycosociological research performed in all 8 forest associations of Mt. Babia Gora (Bujakeiwicz 1981). The paper endeavors to answer the question concerning the relation between the slopes' exposure, the terrain's orography, climatic conditions, the complex system of flora and the mycoflora component of the forest associations studied on the northern and southern slopes of Mt. Babia Gora. Tests which represent the dynamic of the changes occuring within the framework of the forest mycoflora as a result of the forest economy have also been conducted.

The Subalpine Forest

The upper subalpine forest on Mt. Babia Gora averages from 1150 meters above sea level to 1390 meters. These are natural spruce forests, and many areas are even primeval. They lie on both sides of the massif within the borders of the Babiogorski National Park. /4

Piceetum excelsae carpaticum (Szaf., Pawl., Kulcz. 1923) Br.Bl., Vlieg. et Siss. 1939--Carpathian spruce forests (table 1, 2).

The spruce forest occupies different species of habitats in the

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*Numbers in the margin indicate pagination in the foreign text.

subalpine region and show a great floristic differentiation. Observation plots have been established in patches of two subassociations, namely: Piceetum excelsae carpaticum athyrietosum alpestris and Piceetum excelsae carpaticum myrtilletosum.

The Piceetum excelsae carpaticum athyrietosum alpestris is the the richest unit in within the confines of the spurce forest. Patches of this subassociation occur in slightly podzolized soils, on rocky slopes, in which the humus from decaying plants fills the cracks of rocks to a certain depth (up to 60 cm) (Celinski, Wojterski 1978). The reaction of the topsoil layers is acidic. A very important characteristic of the patches of this subassociation is the large amount of ferns. A rather rough layer of humus arises from the decaying remains of these plants.

Patches of the subassociation of upper subalpine forests with ferns, more abundantly settled, are differentiated by: Collybia dryophila, Cortinarius bataillei and by a group of species of fungi met in sycamore and beech forests (table 3). The reason for these connections is the substrata, made up of the remains of ferns and ash twigs. The mass appearance of Pistillaria todei, a rather rare fungus (Pilat 1972), and a relatively small number of Psilocybe crobula are connected to fern remains. Hymenoscyphus calyculus and Calycella citrina sprout on fallen ash branches. A certain indicator of a fertile settlement can also be the appearance of the Rhodophyllus staurosporus, a fungus noted in areas rich in nutritious substances (Frejlak 1973).

Patches of this subassociation are richer in fungi (101 species) than patches of subassociations with ferns (89 species) both with regard to the number of species of terrestrial fungi and the number of those growing on trees. Patches of the subassociation with the

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Tabela 1 - Table 1

Piceetum excelsae carpaticum /Szaf., Pawl., Kulcz., 1923/ Br.Bl., Vlieg et Siss. 1939

														Relevé Nr.
Nr kolejny/Serial number/	1	2	3	4	5	6	7	8	9	10	11	12	13	
Nr zdjęcia w terenie/Number of record/	40	44	18	17	59	43	41	42	20	21	19	57	58	
Data/Date/	18 6 74	27 8 74	26 6 69	26 6 69	8 9 76	27 8 74	27 8 74	27 8 74	26 6 69	26 6 69	26 6 69	8 9 76	8 9 76	
Miejsce zdjęcia/Locality/	BPN	BPN	BPN	BPN	Cz	BPN	BPN	BPN	BPN	BPN	BPN	Cz	Cz	
Ekspozycja/Exposition/	SSW	SEE	NE	N	SW	SEE	SEE	SEE	NW	NW	NW	SW	SW	
Nachylenie/Inclination/	15	15	30	5	3	15	30	30	5	25	10	20	5	
Wysokość n.p.m. w m /Altitude in m/	1305	1305	1310	1225	1140	1300	1290	1220	1285	1185	1210	1330	1345	
Zwarcie warstwy drzew w % a_1	80	70	50	50	60	40	70	70	50	20	50	60	80	
" " " a_2 /Density of trees in %/			5							5	5			
Zwarcie warstwy krzewów w % b /Density of shrubs in %/	.	.	.	.	.	.	zn	.	5	.	5	.	.	
Pokrycie warstwy zielnej w % c /Cover of herb layer in %/	60	80	85	100	60	90	70	80	70	90	80	80	90	
Pokrycie warstwy mszystej w % d /Cover of moss layer in %/	10	80	60	20	80	80	60	60	40	30	60	50	80	
Średnia wysokość drzew w m /Mean height of trees in m/	15	30	20	25	18	30	25	35	25	22	25	25	20	
Średnia średnica drzew w cm /Mean diameter of trees in cm/	25	50	57	69	17	50	48	46	57	44	63	66	40	
Klasa wieku /Age class/	VI	VII	VII	V	IV	VII	VII	VII	VII	V	VII	VII	V	
Powierzchnia zdjęcia w m^2 /Area of record in sq.m/	200	400	200	200	100	400	200	400	200	200	200	400	100	
Liczba gatunków w 1 zdjęciu /Number of species in one record/	14	16	18	17	14	19	26	28	24	22	18	14	10	
Podzespół /Subassociation/	a t h y r i e t o s u m					m y r t i l l e t o s u m								Stałość - Constancy
Gat. Char. Vaccinio-Piceion:														
Picea excelsa a_1			3.3	3.3				3.3	2.2	3.3	3.3			II
	4.4	4.4			4.4	3.3	4.4					4.4	4.4	IV
" " a_2			+	.				.	.	.	.			I
" " b	.	.	.	.	.	.	+	.	+	.	.	.	.	I
" " c	.	+	.	+	.	1.1	.	.	.	.	.	.	.	II
Homogyne alpina	1.1	2.1	+	3.3	1.1	2.3	1.2	2.2	2.2	2.2	2.2	1.2	2.3	V
Lycopodium annotinum	.	.	.	+	.	.	.	.	2.2	.	+	.	.	I
Luzula flavescens	1.2	.	.	.	.	.	1.2	.	.	.	.	+.2	.	II
Plagiothecium curvifolium	+.2	.	2.2	+.2	.	2.2	2.2	2.2	+.2	+.2	1.2	+.2	+	V
Plagiothecium undulatum	.	+.2	3.3	1.1	3.3	2.3	.	.	+.2	2.2	+	.	.	IV
Rhytidiadelphus loreus	.	.	.	.	.	1.2	.	+.2	.	.	.	.	.	I
Sphagnum girgensohnii	.	.	1.2	.	.	.	.	.	+.2	.	.	.	.	I
Gat.Ch.Vaccinio-Piceetalia i Vaccinio-Piceetea:														
Sorbus aucuparia b	.	.	.	.	r	.	+	.	.	.	.	+	.	I
" " c	+	+	.	.	.	1.1	1.1	1.1	.	.	.	.	.	II
Vaccinium myrtillus	2.2	3.3	2.3	1.2	1.2	4.4	4.4	5.4	3.3	3.3	2.3	4.4	5.5	V
Dryopteris austriaca	3.3	4.4	2.2	1.2	3.3	2.2	2.1	2.2	2.2	2.2	1.2	3.3	1.2	V
Lycopodium selago	.	.	r	+	.	.	.	.	+	.	r	.	.	II
Polytrichum attenuatum d	+.2	4.4	3.3	2.2	3.3	3.3	3.3	3.3	1.2	2.3	3.3	3.3	4.4	V
Dicranum scoparium "	1.2	.	3.3	1.2	2.2	1.2	1.2	1.2	2.2	1.2	+	+.2	1.2	V
Towarzyszące/Accompanying/:														
Oxalis acetosella	3.3	2.2	2.2	2.2	+	2.3	1.2	1.2	1.1	2.2	2.2	2.2	+	V
Athyrium alpestre	+.2	1.2	3.3	2.2	+.2	1.2	+.2	.	+	2.2	1.1	2.2	.	V
Luzula silvatica	.	+	2.2	2.2	.	.	+	+	2.2	1.2	+	.	.	IV
Rubus idaeus	+	+	r	+	.	+	1.1	+	.	+	+	+	m	V
Calamagrostis villosa	+.2	+.2	.	1.2	.	.	1.2	1.2	1.2	+.2	1.2	.	.	IV
Deschampsia flexuosa	.	+.2	+	1.2	.	2.2	1.2	1.2	+.2	+.2	1.2	+.2	+.2	V
Prenanthes purpurea	+	.	.	.	.	.	+	+	.	.	.	.	.	II
Mnium affine	.	.	1.2	.	.	.	.	+.2	1.2	1.2	2.2	.	.	II

Sporadyczne/Sporadic/:

Abies alba c 17, Anemone nemorosa 19, Athyrium filix-femina 59/2.3/, Barbilophozia florkei d 22, Brachythecium starkei 18,22,[illegible] 20, Calamagrostis arundinacea 22, [illegible] C. canescens 57, Doronicum austriacum 20,21, Gentiana asclepiadea 19,21, Lophocolea heterophylla 23,20, Luzula silvatica 20,21,23,10, Luzula nemorosa 20, Lonicera nigra b 19, Majanthemum bifolium 18,19,58, Petasites albus 21, Phyteuma spicatum 19, Polygonatum verticillatum 21, Rhytidiadelphus triquetrus d 21, Ribes petraeum 19, Rubus hirtus 21, Salix caprea c 20, Soldanella carpatica 20, Stellaria nemorum 19,22,42, Streptopus amplexifolius 23,42.

Objaśnienia/Explanations/:

BPN - Babiogórski Park Narodowy /Babia Góra National Park/

Cz - Czechosłowacja /Czechoslovakia/

Numery zdjęć w terenie odpowiadają numerom stanowisk na mapie /Bujakiewicz 1979/
/Numbers of records correspond with numbers of localities on map /Bujakiewicz 1979/

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Tabela 2 - Table 2

Macromycetes w płatach zespołu Piceetum excelsae carpaticum
Macromycetes in patches of Piceetum excelsae carpaticum association

Nr kolejny /Serial number/	1	2	3	4	5	6	7	8	9	10	11	12	13	Stałość - Constancy
Nr powierzchni obserwacyjnej /No of observation plot/	40	44	18	17	59	43	41	42	20	21	19	57	58	
Wielkość powierzchni /Area of plot/ m^2	200	400	200	200	100	400	200	400	200	200	200	400	100	
Wysokość n.p.m. w m /Altitude in m/	1305	1305	1310	1225	1140	1300	1290	1220	1285	1185	1210	1330	1345	
Ekspozycja /Exposition/	SW	SSE	NE	N	NW	SSE	SSE	SSE	NW	NW	NW	SW	SW	
Nachylenie /Inclination/	15	15	30	5	3	15	30	30	5	25	10	20	5	
Typ gleby /Soil type/	•	•	a	•	•	•	b	•	•	•	•	•	•	
pH /Soil reaction/	4.8	4.8	4.5	4.0	•	4.5	4.0	4.0	4.0	4.0	3.5	•	•	
Stosunki wodne /Water conditions/	•	•	uw	•	•	•	uw	•	•	•	•	•	•	
Stopień zmian /Degree of changes/	0	0	0	0	0	0	0	0	0	0	0	0	0	
Liczba obserwacji /Number of observations/	11	10	14	12	2	10	10	10	14	13	12	1	1	
Liczba gatunków /Number of species/	44	41	48	28	14	44	42	33	29	36	29	5	3	
Podzespół /Subassociation/	athyrietosum alpestris					myrtilletosum								
Ziemia /ground/:														
Stropharia aeruginosa	2^{n}													I
Cortinarius subtortus	1^{r}													I
Collybia dryophila	4^{a}				1^{a}									I
Rhodophyllus staurosporus	2^{a}										2^{r}			I
Clitocybe ditopa	2^{a}		1^{n}								2^{n}			II
Laccaria laccata	1^{a}					1^{r}	1^{r}							II
Hygrophorus pustulatus	3^{a}		1^{n}	1^{n}					1^{a}	1^{r}				II
Cystoderma sublongisporum	4^{a}	3^{a}	3^{r}			2^{r}	1^{r}	1^{r}	2^{r}					III
Hygrophorus olivaceoalbus	1^{r}	3^{a}	3^{n}	1^{r}	1^{r}	4^{n}	2^{n}	3^{a}	3^{n}	3^{n}	1^{r}			V
Russula ochroleuca		1^{a}	3^{n}	4^{a}		2^{a}	1^{n}	3^{a}	3^{n}	3^{r}	3^{a}			IV
Cortinarius bataillei		2^{n}		1^{r}										I
Clitocybe vibecina		1^{a}				1^{n}								I
Lyophyllum inolens			1^{n}											I
Lyophyllum tesquorum			1^{n}											I
Xerocomus subtomentosus			1^{r}											I
Clitocybe langei			1^{n}						1^{r}					I
Cortinarius malicorius				1^{n}										I
Rhodophyllus cetratus				1^{r}										I
Xerocomus badius				1^{n}										I
Cystoderma amianthinum				3^{r}						1^{r}				I
Cantharellus lutescens				2^{r}				1^{n}						I
Clavulina cinerea				2^{n}			2^{n}							I
Lactarius lignyotus				1^{r}		1^{r}				1^{r}				II
Lactarius rufus					1^{n}									I
Laccaria amethystina						1^{r}								I
Russula integra						1^{r}								I
Russula obscura						1^{r}								I
Xerocomus chrysenteron						1^{r}	1^{r}							I
Clavulina cristata							1^{n}							I
Clitocybe incilis							1^{r}							I
Elaphomyces granulatus							1^{r}							I
Inocybe grammata							1^{r}							I
Lactarius subdulcis							1^{r}							I
Tubaria pellucida							1^{r}							I
Cortinarius hemitrichus							1^{r}	1^{r}						I
Cortinarius fistularis								1^{r}						I
Lactarius turpis								1^{r}						I
Russula emetica								1^{n}	1^{n}		1^{r}			I
Amanita inaurata									1^{r}					I
Paxillus involutus									1^{r}					I
Lyophyllum gibbosum									1^{n}	1^{n}				I
Cystoderma carcharias										1^{r}				I
Inocybe boltonii										1^{r}				I
Russula queletii										1^{r}				I
Szczątki roślinne /plant remains/:														
Mycena epipterygia	2^{n}													I
Mycena phyllogena	2^{n}			1^{r}										I
Micromphale perforans	1^{r}	1^{r}			1^{r}	1^{r}	2^{n}							II
Mycena chlorinella	1^{n}	1^{n}	2^{r}	1^{r}		1^{a}	1^{r}	1^{r}						III
Strobilurus esculentus	$1^{r}1$	1^{r}				2^{r}	2^{n}	2^{n}	1^{n}		1^{r}			III
Piceomphale bulgarioides	3^{a}	3^{a}		1^{a}		4^{n}	2^{a}	3^{a}	1^{a}	1^{a}	1^{a}			IV
Mycena rorida	1^{n}	1^{r}	8^{a}	1^{n}		4^{a}		3^{n}	6^{a}	6^{a}	4^{a}			IV
Mycena galopoda	4^{a}	5^{a}	10^{a}	6^{a}	1^{n}	7^{a}	5^{a}	3^{a}	11^{a}	10^{a}	7^{a}	1^{a}	1^{a}	V
Marasmius androsaceus	3^{a}	5^{a}	8^{a}	9^{a}	1^{n}	4^{a}	6^{a}	6^{a}	2^{n}	5^{a}	4^{a}	1^{a}	1^{a}	V
Pistillaria todei		1^{a}	2^{a}			1^{n}	1^{n}							II
Mycena cinerella		1^{r}	2^{n}					1^{r}						II
Melastiza scotica		1^{r}							2^{r}	1^{r}	1^{r}			II
Psilocybe crobula			2^{n}											I
Pezizella chionea			1^{a}											I

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Colpona degenerans			1^a				1^a							I
Hymenoscyphus caudatum			1^a						1^n					I
Galerina vittaeformis			1^r								1^r			I
Typhula sclerotioides							1^r							I
Opadłe gałązki itp. /fallen twigs etc./:														
Galerina uncialis	1^n	1^r					1^r							II
Mycena rubromarginata	4^a	1^r	1^r	1^n					1^r	3^n				III
Lachnellula subtilissima	4^a		2^a			1^a				1^a	1^a			II
Dacrymyces stillatus	2^a	2^a	2^a	2^a		1^a		2^a		3^a				III
Galerina budipes	2^n	3^n	1^r			1^r	2^n		2^n	1^n		1^r		IV
Collybia inodora		3^n												I
Mycena amicta		1^r												I
Pholiota spumosa		1^r												I
Collybia confluens		1^n	2^a			1^a								I
Sphaerobolus stellatus		2^a	2^a			2^n	2^a		2^a	2^a	1^n			III
Hymenoscyphus calyculus			2^n											I
Calycella citrina			1^n											I
Dasyscyphus bicolor v. rubi			1^a					1^a						I
Hirschioporus fusco-violaceus						1^a								I
Aleurodiscus amorphus								1^a			1^a			I
Galerina triscopa										2^n	1^r			I
Galerina sideroides											1^a			I
Gymnopilus stabilis											1^r			I
Pniaki, kłody /stumps, logs/:														
Tricholomopsis rutilans	2^r													I
Gymnopilus liquiritiae	1^r													I
Gymnopilus subsphaerosporus	1^r													I
Hyphodontia aspera	1^r													I
Pholiota flammans	1^r													I
Haematoloma radicosum	2^r				1^r									I
Mycena alcalina	1^r				1^r				1^n	1^r				II
Stereum sanguinolentum	5^a		1^n		1^a		1^r						1^a	II
Tyromyces caesius	5^a	2^n	1^a			1^n	1^a	1^r						III
Phellinus viticola	11^a	3^a	1^a			4^a	5^a	1^a	1^a					III
Haematoloma capnoides	3^n	3^n	1^n	2^a			1^n		1^n	1^a				III
Xeromphalina campanella	5^a	1^r				1^r	2^n	1^r	2^a	4^a	1^n			IV
Haematoloma dispersum	1^n	3^a	3^a	1^r	1^a	3^a	1^r			1^n				IV
Calocera viscosa	4^a	4^a	3^n	3^r	1^a		5^a	4^n	4^n	6^n	1^n			IV
Mycena luteoalcalina	2^n	3^n	6^a	1^n		2^n	1^r	1^r	5^n	4^n	2^n			IV
Fomitopsis pinicola	8^a	9^a	1^a		1^a	9^a	8^a			4^a		1^a		IV
Crepidotus cesatii	1^r					1^n	1^n				1^n			II
Ischnoderma benzoinum	1^r						3^a							I
Columnocystis abietina		1^a				1^a								I
Coriolellus serialis f. serialis		1^a						1^n						I
Climacocystis borealis		1^n										1^a		I
Pholiota scamba		1^r	1^n	1^r	1^n					1^r				II
Mycena maculata		2^n	5^a	1^n	1^n	1^n	1^r	2^n		1^a				IV
Mycena viscosa			3^n	1^r						1^n	1^n			II
Notopanus porrigens			1^n											I
Gymnopilus bellulus			1^r											I
Gloeophyllum sepiarium			2^a				1^n							I
Phellinus nigrolimitatus			1^n			4^a		1^a						II
Armillariella mellea						1^n								I
Gerronema chrysophyllum						1^n								I
Gloeophyllum odoratum						1^n								I
Rigidoporus sanguinolentus						1^n								I
Dacrymyces palmatus						1^r								I
Coriolellus serialis f. callosus						1^n		1^n						I
Gymnopilus picreus						1^r			1^r					I
Omphalina ericetorum						2^r				1^r				I
Tricholomopsis decora							1^n							I
Phellinus ferreus							1^n							I
Mycena laevigata								1^a						I
Heterobasidion annosum								1^n			1^r			I
Amylostereum chailletii											2^a			I
Trametes versicolor											1^a			I
Panellus violaceofulvus											1^r			I
Mchy /mosses/:														
Laccaria proxima	1^n													I
Galerina hypnorum	2^n	3^n				2^n	2^n	2^a						II
Galerina sahleri	1^r	2^a	9^a	7^a		2^a	2^r	2^n	2^a	7^a	8^a			IV
Galerina mniophila			3^n	4^n					1^r	1^r				II
Mycena longiseta			1^r											I
Szczątki grzybów /rotten fungi/:														
Collybia tuberosa		1^n	3^a					2^n	4^a	3^n	1^r			III
Poczwarki owadów /pupae of insects/:														
Isaria farinosa			1^r					1^r						I
Nawóz /dung/:														
Stropharia stercoraria										1^n				I

Objaśnienia /Explanations/:
a – gleba skrytobielicowa /slightly podzolized soil/; b – gleba bielicowa /podzolic soil/;
uw – umiarkowanie wilgotna /moderate moist/

Vaccinium have, however, few species which are distinguished. Only the Lyophyllum gibberosum, Gymnopilus picreus and Omphalina ericetorum have value distinguishing this in relation to the subassociation with ferns. Also Mycena laevigata, a calciphobic montane type, deserves mention (Kubichka 1963a; Kotlaba, Pouzar 1962). The most numerous in the patches of the subassociation with Vaccinium are: Russula ochroleuca, Collybia tuberosa, Hygrophorus olivaceoalbus and Sphaerobolus stellatus. /8

A total of 130 species were collected in the upper subalpine forests of Mt. Babia Gora. In comparison to the mycoflora of the upper subalpine forests in Karkonosze, numbering 88 species (Nespiak 1971), this is a rather significant value. Terrestrial fungi make up 33 percent of the flora in the Babiogora forests and fungi growing on decayed trees 31 percent. The number of the species of terrestrial fungi even in floristically poor upper subalpine forests does not exceed the number of vascular plants (illustration 1).

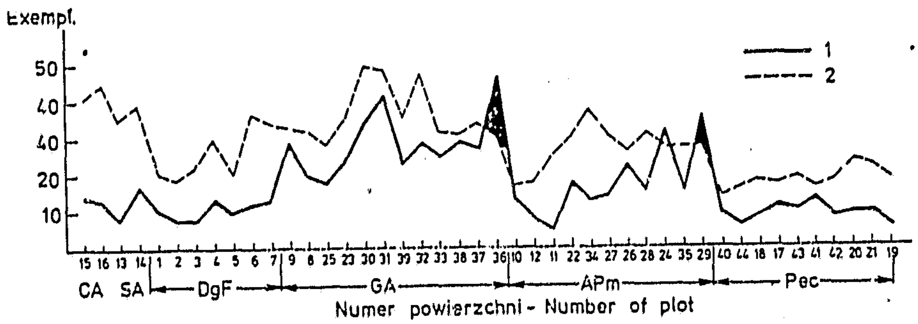

Fig. 1. Number of species of terrestrial macromycetes and number of species of vascular plants (and mosses) in the studied forest associations on Mt. Babia Góra
1 — terrestrial fungi; 2 — vascular plant and mosses
(Explanation of forest associations see Table 4)

Research has demonstrated that patches of upper subalpine forests on Mt. Babia Gora show the highest percentage of fungus species in connection with the association of Abieti Piceetum montanum. The number of species of fungi excluded here is relatively small, only those in groups of fungi which settle on stumps and grow on fallen twigs make up a rather significant percentage.

For example, *Pholiota scamba*, *Cortinarius bataillei*, *C. subtortus*, *Clitocybe ditopa* and *Gymnopilus picreus* are connected with patches of *Piceetum excelsae carpaticum* on Mt. Babia Gora. Jahn (1969) took two other species from the association of *Piceetum subalpinum* in the Harz mountains, stressing their roel in distinguishing these forests. The appearance of *Cortinarius bataillei* and *C. subtortus*, fungi which grow on a decalcified base (Favre 1960, Nespiak 1975) is in accord with the character of the soils in which the Carpathian spruce forest on Mt. Babia Gora develops. *Chroogomphus helveticus*, a montane fungus (Doerfelt 1973) which grows in the coniferous forests of the Tatras and Alps (Stern 1969; Nespiak 1962b; Horak 1963 and others), also is deserving of consideration. It is noted on Mt. Babia Goria in the upper subalpine forests beyond the permanent research areas. The upper subalpine forests, moreover, differentiate several species of fungi (for example *Hygrophorus olivaceoalbus*, *Cystoderma sublongisporum*, *Marasmius* /9
androsaceus, *Naematoloma dispersum* and *Galerina sahleri*), which as a rule have a broader scale of occurance than this association, but which show the highest levels of constancy of occurance and richer fructification in patches of the forest under discussion. Since these levels are the expression of the range, dimensions and hardiness of the fungi, it should be concluded that these fungi find the optimum conditions for their development in this association on Mt. Babia Gora (tables 2 and 4).

Patches of the upper subalpine forests on the southern slopes of Mt. Babia Gora are richer (92 species) than the patches on the northern slopes (83 species), and this discrepency mainly concerns fungi which have settled on rotting trees. Only on the northern slopes of Mt. Babia Gora were collected *Galerina mniophila*, *Lyophyllum gibberosum* and *Cortinarius malicorius* in in the upper subalpine forests, however

on this side of the massif the following have been noted more frequently: Melastiza scotica, Galerina sahleri and Mycena rorida. The appearance of Galerina uncialis and Climacocystis borealis is connected to the forests on the southern sides. Montane fungi, such as Phellinus nigrolimitatus, P. viticola and Hygrophorus olivaceoalbus, as well as Galerina badipes, Crepidotus cesatii, Cystodrma sublongisporum and Gerronema chrysophyllum, appear in greater abundance here than on the northern sides. The primeval, forest character of the studied spruce stands is stressed by the appearance of of the boreal-montane species of Phellinus nigrolimitatus (Kotlaba 1972) and the fructification of GErronema chrysophyllum (Kotlaba, Pouzar 1962). Crepidotus cesatti, growing most frequently in mountainous regions, was also collected in the Babiogora upper subalpine forests by Wojevod (1965). The mass appearance of the spring Piceomphale bulgarioides and Strobilurus esculentus turned attention to the southern slopes. Lactarius subdulcis and Laccaria amethystina, fungi which grow on Mt. Babia Gora in the lower forests, were noted in the patches of the subassociation with Vaccinium. Their fructification at such considerable heights (1300 meters above sea level) is connected probably with the presence of beeches near the studied patches. The observations performed on the northern slopes of Mt. Babia Gora above the timber line of for example beeches, detected (Modrzynski, Ostrowicz 1976) that these species usually in the form of small trees or dwarf specimens sometimes appeared very high up. It is quite possible that this phenomenon also occurs on the southern slopes of Mt. Babia Gora. /10
Meyer (1963) has turned his attention to the mycorrhizic relationship of Laccaria amethystina with beech, counting it in the facultative mycorrhizic species, which create an ectotrophic mycorrhiza with beech. The mycorrhizic connection of Lactarius subdulcis with beech has been stressed by Shmarda (1969). This relationship is presumed not to be a constant phenomenon (Jahn, Nespiak, Tuexen 1967).

The layer of the upper subalpine forests is a geobotanical region, in which especially rigorous climatic conditions predominate. This is even shown by the course of curves which illustrate the mean values of minimum and maximum temperatures for the Markowyy Szczawina station, situated on the North Slope on the edge of the subalpine forest (illustration 2, Bujakiewicz 1981). The snow cover, retained for a long period of time (illustration 1, Bujakiewicz 1981), retards the development of the fungi and intensive decline in relation to the incline of the slopes do not favor their fructification.

The decrease in the number of fungus species in relation to an increase in the altitude above sea level is a generally accepted phenomenon. Earlier research performed on the northern slopes of Mt. Babia Gora (Bujakiewicz 1974) has verified this. It is also known that fungi appearing in the high mountains show certain changes in the morphology of the fructification (Weir 1918; Friedrich 1940; Favre 1955; Pilat 1969; Frejlak 1973 and others). In the upper subalpine forests on Mt. Babia Gora it has been observed that the majority of these fungi have small and delicate fructifications (Mycena, Galerina, Clitocybe, Cortinarius, Collybia), concealed among clumps and clods of moss. Of the terrestrial fungi, Russula ochroleuca has the largest fructifications. The larger number of species which create fructifications resupinate or spread out on the ground also deserve attention. These fungi occur more frequently on the under side of spruce logs (Phellinus nigrolimitatus, P. ferreus, Coriolellus serialis, Rigidoporus sanguinolentus, Columnocystis abietina) or in the cracks of stumps. Larger dimensioned spores have been verified for Gerronema chrysophyllum (Bujakiewicz 1979).

The natural upper subalpine forests are not very dense in connection with which the amount of light, air and water here is rather significant. These facts are probably decisive for the appearance of the fructifications of Gloeophyllum sepiarium, a fungus which commonly grows in a line in open areas, in upper subalpine forests. Weir (1918) counted this species among those typical for exposed locations.

The upper subalpine forests in Karkonosze (Nespiak 1971), where *Hygrophorus olivaceoalbus*, *H. pustulatus*, *Lactarius lignyotus* and *Galerina sahleri*, have many traits in common with the Babia Gora upper subalpine forests with regard to the mycoflora. The upper subalpine forests of Karkonosze are, however, distinguished by a group of turbary fungi, which in the upper subalpine forests on Mt. Babia Gora /11
do not appear. The spruce forests of the Tatras appear to be very similar to those of Mt. Babia Gora (Nespiak 1960, 1962a; Frejlak 1973).

The spruce forests in Bieszczade, with regard to the lack of upper subalpine forests, have a variable character, since fragments of them occur in lower forests among beeches. Many common fungi also grow in the lower spruce forests.

The Share and Role of Ecological Groups of Fungi in the Studies of Forest Associations

The forest, as a biocenosis structurally and location-wise quite differentiated, is the both the best and most difficult object for mycosociological research.

The view in the present paper on the problem of the fundamentals of distinguishing fungi from groupings of larger plants basically coincides with the standpoint of Kornasie (1957) and Tomilin (1962). The ecological groups of tracked fungi were differentiated in size as a type of sinusial groupings (terrestrial and mulch fungi), rigidly based on the totality of the ecological conditions, which the forest association creates for the fungi. Fungi settling on rotting stumps create a connected community, and fireplace and coprophilic fungi make up independent associations (Ebert, for Wojewod 1975). Fungi, which grow among moss and are connected with special substratas, composed of for example by dead insects or the decomposing remains of the fructifications of other fungi, are tracked separately.

The share of special ecological groups of fungi in patches of a given forest association results from the function met by the fungi in the biocenosis (the decomposition of the organic remains, symbiosis, parasitism, etc.).

Defining the level of the relationship of fungi with a given forest association is an exceptionally difficult task, since the relationship between fungi and an association of the above plants covers much territory. The already differentiated ecological groups of fungi are an expression of such a relationship with a defined elecological factor, in this case the substrata, which is a component element of the forest association. It should be recognized that subdivisions in the ecological groups have a manifestly artificial character, since many species of fungi demonstrate the ability to settle simultaneously several different types of substrata. Each of the ecological groups of mycromycetes, moreover, are characterized by a variation in the rhythm of the appearance of fructification.

The ecological conditions of the development of these same sinusial groupings are quite varied not only in different forest associations, but also within the confines of the same patch of forest association. This results from the heterogeneity of microsettlement conditions, quite markedly differentiated in the montane forests.

Tabela 3 - Table 3
Gatunki macromycetes lokalnie wyróżniające
niższe jednostki zespołu Piceetum excelsae carpaticum
Macromycetes locally differential
for lower units of Piceetum excelsae carpaticum association

Podzespół /Subassociation/	Pec ath.	Pec myrt.
Liczba stałych powierzchni /Number of permanent plots/	5	8
Liczba obserwacji /Number of observations/	47	71
Collybia dryophila	5^{a}	
Cortinarius bataillei	3^{r-n}	
Haematoloma radicosum	3^{r}	
Psilocybe crobula	2^{n}	
Hymenoscyphus calyculus	2^{a}	
Calycella citrina	1^{n}	
Hygrophorus pustulatus	5^{n-a}	2^{r-a}
Mycena rubromarginata	7^{r-n}	4^{r-n}
Tyromyces caesius	8^{n-a}	3^{r-n}
Rhodophyllus staurosporus	7^{a}	2^{r}
Galerina mniophila	7^{n}	2^{r}
Haematoloma dispersum	9^{r-a}	5^{r-a}
Cystoderma sublongisporum	10^{r-a}	6^{r}
Phellinus viticola	15^{a}	11^{a}
Pholiota scamba	4^{r-n}	1^{r}
Mycena cinerella	3^{r-n}	1^{r}
Pistillaria todei	3^{a}	2^{n}
Clitocybe ditopa	2^{n-a}	2^{n}
Galerina badipes	6^{r-n}	7^{r-n}
Sphaerobolus stellatus	4^{a}	9^{n-a}
Lactarius lignyotus	1^{r}	2^{r}
Crepidotus cesatii	1^{r}	3^{n}
Ischnoderma benzoinum	1^{r}	3^{a}
Melastiza scotica	1^{r}	4^{r}
Phellinus nigrolimitatus	1^{n}	5^{a}
Galerina sahleri	19^{r-a}	23^{r-a}
Hygrophorus olivaceoalbus	9^{r-a}	16^{r-a}
Collybia tuberosa	4^{n-a}	10^{r-a}
Russula ochroleuca	8^{n-a}	15^{r-a}
Mycena rorida	11^{r-a}	23^{n-a}
Omphalina ericetorum		3^{r}
Lyophyllum gibberosum		2^{n}
Gymnopilus picreus		2^{r}

Objaśnienia /Explanations/:

Pec ath. - Piceetum excelsae carpaticum athyrietosum alpestris
Pec myrt. - Piceetum excelsae carpaticum myrtilletosum

Tabela 4 - Table 4

Wartość wskaźnikowa wybranych gatunków macromycetes w zespołach leśnych Babiej Góry

Indicating value of selected species of macromycetes in the forest associations of Mt. Babia G.

Jednostka fitosocjologiczna /Phytosociological unit/	CA	SA	DgF	GA	APu	Poc	DP	Sph
Zakres wysokości n.p.m. w m /Range of elevation in m.alt./	710 935	1040 1100	820 1060	730 1030	810 1035	1185 1345	780	765 790
Liczba powierzchni /Number of plots/	5	2	13	14	13	13	2	3
Liczba obserwacji /Number of observations/	30	22	88	160	142	120	11	21
Na ziemi /on the ground/:								
Naucoria scolecina	5							
Naucoria escharoides	5							
Cortinarius helvelloides	3							
Cortinarius alnetorum	3							
Lactarius obscuratus	2							
Cortinarius bibulus	2							
Naucoria langei	2							
Russula pumila	2							
Naucoria subconspersa	2							
Paxillus filamentosus	1							
Cortinarius pulchripes	1							
Pholiotina blattaria	1	1						
Tubaria conspersa	1	2						
Conocybe ambigua		1						
Conocybe rickeniana		1						
Rhodophyllus juncinus		2	I					
Rhodophyllus griseorubellus			I					
Rhodophyllus clandestinus			I					
Coprinus silvaticus			I					
Lycoperdon echinatum			I					
Inocybe calamistrata			I					
Rhodophyllus radiatus			I					
Agaricus abruptibulbus			I	I				
Lactarius blennius			I	I				
Rhodophyllus nidorosus			I	I				
Hygrophorus eburneus			I	I				
Inocybe brunneo-atra			I	I				
Lactarius fuliginosus			I	I				
Rhodophyllus rhodopolius			I	I				
Clitocybe gibba			I	II				
Lactarius subdulcis			III	II	II	I		
Collybia butyracea			I	III	I			
Mycena pura	1	2	II	IV	I			
Russula cyanoxantha			II	III	II			
Cystoderma carcharias			II	IV	I	I		
Mycena zephirus			I	IV	I			
Laccaria amethystina			I	III	II	I		
Russula alutacea			I	IV	III			
Cystoderma fallax				II				
Thelephora palmata				II				
Russula mustelina				II				
Inocybe friesii				II				
Clavulina rugosa v. rugosa				II				
Clitocybe radicollata				II				
Inocybe grammata				II		I		
Amanita inaurata				II		I		
Russula delica				III	I			
Russula nigricans				III	II			
Russula integra				IV	II	I		
Lactarius aurantiacus				IV	III			
Collybia asema				II	I			
Lactarius piperatus				II	I			
Russula densifolia				II	I			
Amanita rubescens				II	II			
Hydnum repandum				II	II			
Lactarius picinus				II	II			
Lycoperdon umbrinum				II	II			
Albatrellus ovinus				I	I			
Amanita porphyria				I	I			
Cortinarius sanguineus				I	I			
Inocybe umbrina				I	II			
Xerocomus badius				II	II	I		
Cantharellus lutescens				II	II	I		
Lycoperdon foetidum				II	III			
Lactarius lignyotus				II	II	II	1	
Rhodophyllus staurosporus		1		I	I	I		
Hygrophorus pustulatus		2	I	III	I	II		
Elaphomyces granulatus				I	II	I		
Lactarius rufus				I	II	I		
Lactarius camphoratus					II			
Cantharellus cibarius					I			
Morchella elata					I			
Cortinarius camphoratus					I			
Phellodon tomentosus					I			

ORIGINAL PAGE IS OF POOR QUALITY

Cortinarius bataillei						I		
Cortinarius malicorius						I		
Lyophyllum gibberosum						I		
Cortinarius collinitus				I	II		1	1
Rhodophyllus cetratus			I	II	III	I	1	
Russula ochroleuca		1	II	III	IV	IV	1	
Hygrophorus olivaceoalbus		1	I	II	II	V	1	1
Russula emetica				III	III	II	2	1
Cystoderma sublongisporum				II	II	III	1	2
Na szczątkach roślinnych /on plant remains/:								
Pezizella alniella	4							
Calyptella flos-alba	1							
Cyathicula coronata	1							
Hymenoscyphus rhodoleucus	1							
Phialea cyathoidea	2	2		I	I			
Mycena pterigena	1	1						
Rutstroemia luteovirescens		1						
Psilocybe crobula		2				I		
Typhula erythropus		2	I					
Marasmius recubans		1	I					
Mycena capillaris	1	1	III		I			
Anthina flammea			I					
Xylosphaera carpophila			I					
Marasmius alliaceus v. subtilis			III		I			
Marasmius bulliardii			II	I	I			
Mycena vulgaris				II				
Galerina pseudocamerina				II				
Cudonia circinans				I				
Mycena strobilicola				II				
Mitrula abietis				I				
Hemimycena pseudogracilis				I				
Mycena rosella				III	I		1	
Mycena aurantiomarginata				II	II			
Mycena flavoalba				II	II			
Ciboria rufofusca				I	I			
Mycena lineata				II	I			
Mycena stylobates		1	I	III	II			
Mycena phyllogena		1		IV	III	I		
Strobilurus esculentus			I	IV	II	III		
Mycena cinerella			I	II	I	II		
Piceomphale bulgarioides				IV	IV	IV	1	
Marasmius androsaceus				IV	IV	V	2	
Pistillaria todei		1	I			II		
Melastiza scotica						II		
Mitrula vitellina							1	
Monilinia oxycocci								1
Na opadłych gałązkach itp. /on fallen twigs etc./:								
Mycena speirea	3							
Mycena vitilis	2							
Clavariadelphus fistulosus	1							
Tubaria furfuracea	2	1	I	I				
Scutellinia carneo-sanguinea	2	2		I				
Mycena amygdalina	1	2	I		I			
Mycena vitrea	2	2	I		I			
Hymenoscyphus calyculus	3	2	II			I		
Psathyrella fusca		2	I					
Mycena crocata		2	II		I			
Polyporus varius v. elegans			I	I				
Tubercularia vulgaris		1	II					
Hymenoscyphus serotinus		1	III	I	I			
Diatrype disciformis		1	IV	II	II			
Marasmius alliaceus v.alliaceus	1	2	IV	II	II			
Calycella citrina	2		III	I	II	I		
Dasyscyphus crystallinus			II	I				
Pholiota lenta			II	I				
Mycena amicta	1	1	I	III		I		
Galerina triscopa	1		I	III	I	I		
Aleurodiscus amorphus				II	III	I		
Mycena rubromarginata	1	1	II	V	V	III	1	
Sphaerobolus stellatus			I	I	I	III		
Galerina badipes				I		IV		
Galerina unicalis						II		
Na pniakach i kłodach /on stumps and logs/:								
Phaeomarasmius erinaceus	2							
Pholiota alnicola	1							
Mycena acicula	1	1						
Calocera cornea		1						
Coprinus micaceus		1	I					
Mycena erubescens		2	I	I				

Hericium coralloides		1	II					
Polyporus squamosus			II					
Polyporus varius v. varius			I					
Dentipellis fragilis			I					
Inonotus nodulosus			I					
Ustulina deusta			I					
Oudemansiella mucida			I					
Ceriporia rhodella			I					
Datronia mollis			I					
Psathyrella sarcocephala			I					
Tremella foliacea f. succinea			I					
Stereum rugosum			II		I			
Trametes hoehnelii			II		I			
Pholiota aurivella		1	II		I			
Haematoloma sublateritium			I	I				
Notopanus porrigens			II	I	I	I	1	
Galerina unicolor		2	II	III	II			
Omphalina epichysium	1		II	I	I			
Hypoxylon fragiforme			III	II	I			
Oudemansiella radicata			I	I	I			
Lentinellus cochleatus			I	I	II			
Gloeophyllum odoratum				II	II	I	1	
Hymenochaete cruenta				I	I		1	
Columnocystis abietina				I		I		
Haematoloma radicosum				I	II	I		
Haematoloma dispersum			II	II	II	IV	1	
Mycena viscosa		1	I	IV	III	II		
Xeromphalina campanella	1	1	I	III	IV	IV	1	
Skeletocutis amorpha					I			
Tricholomopsis decora					I	I		
Phellinus viticola				I	I	III		
Phellinus nigrolimitatus					I	II		
Climacocystis borealis						I		
Pholiota scamba			I			II	1	
Wśród mchów /among mosses/:								
Gerronema setipes	2	2	I					
Galerina hypnorum		1	III	III	IV	II		
Galerina sahleri			I	I	I	IV		
Galerina mniophila		1			II	II		
Lactarius theiogalus							1	
Galerina mycenoides							1	
Laccaria proxima							2	1
Hebeloma helodes							2	1
Cantharellus tubaeformis							1	1
Cortinarius uliginosus							2	2
Cortinarius fulvescens							2	2
Galerina tibiicystis							1	2
Galerina paludosa							1	2
Haematoloma elongatum								3
Lyophyllum palustre								2
Omphalina sphagnicola								2
Haematoloma udum								1
Na wypaleniskach /on fireplaces/:								
Geopyxis carbonaria				III	II			
Lyophyllum anthracophilum				II	II			
Trichophaea gregaria				II	I			
Peziza violacea				II	II			
Pholiota carbonaria				II	I			
Na nawozie /on dung/:								
Psilocybe coprophila				I	I			
Stropharia stercoraria				I	I	I		
Na grzybach /on fungi/:								
Cordyceps ophioglossoides					I			
Cordyceps capitata					I			
Collybia tuberosa			I		I	III		
Na owadach /on insects/:								
Isaria sphecophila				II	III			

Objaśnienia /Explanations/:

OA - Caltho-Alnetum
SA - Sorbo-Aceretum
DgF - Dentario glandulosae-Fagetum
GA - Galio-Abietetum
APm - Abieti-Piceetum montanum
Pec - Piceetum excelsae carpaticum
BP - Bazzanio-Piceetum
Sph - Sphagnetum magellanici

Hyspometric differences and differences in the slopes' exposure and illumination affect here the ecological conditions of the microsettlements. The complex structure of forests which is decisive for the differences in the shadowing of its floor plays an important role. The angle of the slope's incidence, upon which depends the run-off of rain water, and the slipping of soil, rocks and stumps, is not without significance. Edaphicial variations are connected here, as well as variations, for example in the amount of rotting trees, which in worked forests are systematically removed. Leischner-Siska (1939) also turned his consideration to the affect of the exposure and incline of slopes on the development of fungi. 12

On the bases of these developments the definition of the share and role of ecological groups of fungi in forest associations requires substructures in the form of special ecological investigations, which is very difficult to perform under mountainous conditions, and above all requires studies over a significantly smaller territory.

The aim of the mycosociological investigations in the forests of Mt. Babia Gora is the determination of the level of the attachment of fungi representing various ecological groups to settlements occuring in a given forest association. The expression of this attachment is the loyalty of a species of fungus to a given forest associations, the constancy of its appearance, which reflects the frequency of the occurance of the species in patches of this association and the abundance of the creation of fructifications, which is the expression of the dynamism of this species.

On the basis of the analysis of the loyalty, constancy and abundance of the occurance of fungi, locally characteristic and locally distinguishing species were distinquished within the confines of all ecological groups of fungi (tables 3, 4). 212 (44 percent) species of fungi, which have the greatest indication value for the studied forest associations, were taken from among the 479 species gathered at the permanent observation areas.

Really, in each of the distinguished ecological groups the tendency toward the grouping of certain fungus species into defined types of settlements was observed. According to Kalamees (1968), the decisive factors for the conformities in the appearance of fungi are the differences in the moisture of the settlements, the characteristics of the soils and the plant collections within the studied forests.

The group of terrestrial fungi, which relatively best characterizes a forest association, deserves special attention from among the distinguished ecological groups. It should be emphasized here, however, that under mountainous conditions the edaphicial relations are differentiated somewhat more so in a relatively small area and, therefore, even the patches of the same association do not always create with terrestrial fungi the same conditions for their fructifications. The problem of the symbiosis of trees with fungi /13 also deserves consideration. Although many species of forest fungi form mycorrhizial relationships, the more precise defintion of these relationships under natural conditions is practically impossible. This problem takes on significance in the case of forest associations, in which many species of microtrophic trees occur in the forest. This happens in patches of rich Carpathian beeches, in whose forest grow fir and spruce. Fungi thriving in mycorrhizial relationships with spruces also appear in this association, although their abundance is incomparably less in beech than in fir or upper subalpine forests.

83 species of terrestrial fungi were chosen for analysis from a total of 193. The fungi of this group, most strongly connected to the phytocenotic whole, have provided the most locally characteristic /17
species. This appears above all in associations of Caltho-alnetum and Galio-Abietetum. Fungi in a Carpathian beech forest are characterized by a low level of constancy. The species characteristic for three zonal associations of lower subalpine forests, namely for Dentario glandulosae-Fagetum, Galio-Abietetum and Abieti-Piceetum montanum, form the most numerous and most pronounced group. Galio-Abietetum fir forests demonstrate a kinship both with beech and with mixed forests neighboring them in the area. The mixed forests--Abieti-Piceetum montanum and upper subalpine forests--Piceetum excelsae carpaticum on Mt. Babia Gora do not have many characteristic species. A series of terrestrial fungi occur in a Bazzanio-Piceetum association, which grows on a turbary base among peat clumps and moss.

In the group of fungi which fruit on plant remains (36 of 69 species were chosen) it is possible to distinguish species which appear in deciduous forests and sylvan species. Some of these, despite the fact that substrata, in which they could fruit, occur in related associations, do not move to them and therefore can be considered as characteristic spcies. The majority of the fungi of this group has, however, a rather broad ecological scale. They can distinguish at the most the relationships of Alno-Padion (Caltho-Alnetum) and Fagion (Sorbo-Aceretum and Dentario glandulosae-Fagetum). The Galio-Abietetum association has in this group a series of unconnected fungi and decidedly more sylvan species, which grow most commonly in forests in which the spruce finds the optimum conditions for development.

25 species of fungi which fruit on fallen twigs were selected from a group of 57 for comparison purposes. The fungi of this group

were distinguished by a rather broad ecological scale and were more related to a type of substrata than to a defined association. In the investigated area, *Fagetalia* forests have the most characteristic species in this group.

Fungi growing on rotting stumps and logs (of 117 species, 39 were selected for analysis), like locally characateristic species, play a special role in Carpathian beech forests. Moreover, they form groups of species characteristic for several forest associations, of both lower and montane subalpine forests. In the group of stump fungi are found several which also develop on the roots and stumps of living trees, for example on *Fagus*: *Ustulina deusta*, *Polyporus varius v. varius*, *Oudemansiella mucida*, *Pholiota aurivella* and *Fomes fomentarius*, on *Abies*: *Pholiota aurivella* and *Lentinus adhaerens*, and on *Picea*: *Climacocystis borealis*, *Megacollybia plathyphylla* and *Fomitopsis pinicola*. Since these fungi are for the most part both saprophytes and parasites, they are not treated differently in the tabuluar comparisons.

Fungi growing among mosses and peat (17 species were selected for 18
analysis from among a total of 22) are good indicating species in patches of *Sphagnetum magellanici* and *Bazzanio-Piceetum*, which often neighbor each other in the territory. These fungi also differentiate patches of the following associations: *Abieti-Piceetum montanum* and *Piceetum excelsae carpaticum*.

Fireplace and coprophilic fungi, fungi which grow on insects and on the fructifications of other fungi, have the value of locally characteristic species only for the lower subalpine *Galio-Abietetum* and *Abieti-Piceetum montanum* forests on the southern slopes of Mt. Babia Gora, which in the case of the first two groups is narrowly connected to the influence of forestry management in this territory.

As is seen from the above analysis, the subalpine forests on Mt. Babia Gora are distinguished by the characteristic share of the groupings of fungi, at various levels depending on the configuration of ecological conditions in a given forest association.

In the forests of Mt. Babia Gora, certain conformities are also observed in the appearance of fungi concerning the characteristic of ubiquitousness, which is, of course, representative of various ecological groups. The Laccaria laccata, which is common in all forests, appears on Mt. Babia Gora most frequently in patches of _Galio-Abietetum_ and _Dentario glandulosae-Fagetum_; _Mycena galopoda_ and _M. rorida_ grow, above all, in patches of _Piceetum excelsae carpaticum_; _Lachnellula subtilissima_ and _Naematoloma capnoides_ fruit mainly in patches of _Galio-Abietetum_ and _Abieti-Piceetum montanum_, while _Calocera viscosa_, _Xeromaphalina campanella_ and _Mycena maculata_, in patches of _Abieti-Piceetum montanum_ and _Piceetum excelsae carpaticum_.

Considerations Concerning the Dynamics of the Changes of the Mycoflora in the Studied Forests

The activity of man in the forests of Mt. Babia Gora dates back for centuries. Settlement begun in the region of Mt. Babia Gora in the seventeenth century was the cause for the clearing of forests in order to obtain pastures for cattle and sheep (Jostowa 1974). Forest exploitation began in this area at the start of the nineteenth century (Dzieciolowski 1963). In 1924, after the transference of the property to the Polish Academy of Arts, a certain limitation in the exploitation of the forests was introduced and at the time was born the project to protect Mt. Babia Gora, realized in full only in 1954 with the creation of the Mt. Babia Gora National Park. This protects the most beautiful and most natural parts of the Carpathian Wilderness, mainly on the northern slopes of Mt. Babia Gora, while on the southern slopes it encompasses only the upper subalpine forests.

Mycosociological research on Mt. Babia Gora, performed both in natural forests within the Park and in worked forests, has provided the opportunity to observe the differences and similarities in the mycoflora of these forests.

The subjects of the observations were, above all, the fir and mixed forests on the southern slopes of Mt. Baba Gora, in which forestry operations have been performed right in all the studied patches. The most pronounced changes in the composition of the mycoflora were observed in plots 34, 26 and 27 in patches of *Abieti-Piceetum montanum* and in plots 25, 33, and 39 in patches of *Galio-Abietetum*. The degeneration factors are these (Falinski 1966): felling, burning connected with forestry operations, the introduction of alien trees into forest associations and the grazing of sheep and cattle in the forest. /19

The following example will illustrate the rapid and far-reaching changes in plot 34 (*Abieti-Piceetum montanum*). Two years after phytosociological records (Bujakiewicz 1981) were made of this plot, the degradation of the settlement was really total. Changes ensued in the structure of the forest, in the distribution of the forest undergrowth and the moss layer. The dragging of felled trees through the plot resulted in the tearing away of the moss mulch and layer. The mulch's burning changed the plots soil surface into ash. In the clearings, as the remains in the patch of mixed forest should be called, ensued an invasion of ruderal and stenothermal plants. The amounts of *Chamaenerion angustifolium*, *Rubus idaeus*, *Denecio* fuchsii, Veronica officinalis and Petasites albus increased:

	28 V 76	17 VII 76	10 IX 77
Picea excelsa a_1	2.2	+	+
Petasites albus	1.1	1.1	2.3
Chamaenerion angustifolium	1.1	2.2	2.3
Rubus idaeus	1.1	1.2	2.3
Senecio Fuchsii	1.1	2.3	3.3
Veronica officinalis	r	+.2	1.3
Epilobium collinum	r	1.2	1.2
Rumex acetosella	r	+.2	+.2
Salix silesiaca	1.1	1.2	1.2

These changes were markedly reflected in the composition of the mycoflora. Some fungi found in the first year of research (1973), for example Russula alutacea and Amanita pantherina v. abietinum, were not noted in the patch under discussion for the next four years of research, although they actually fructified (Russula alutacea) in neighboring forests every year. Other fungi expanded the area of their occurance within the confines of the studied patch (for example Lycoperdon foetidum). The consecutive appearances of fungi on ground which had been scorched could also be followed. The development of pyrophilic fungi depend on the when the ground had been scorched and on its intensity (Moser 1949; Svrchek 1949; Skirgiello 1950). Anthracobionic fungi, which were Geopyxis carbonaria and Peziza violacea /20

	No. of fructifications				
	1973	1974	1975	1976	1977
Geopyxis carbonaria	–	100	52	8	
Peziza violacea			4		
Lyophyllum anthracophilum			50	8	
Pholiota carbonaria			11	7	9
Lycoperdon foetidum			32	50	9
Naucoria pseudoamarescens				7	
Coprinus angulatus				1	

After a certain period of time, lasting 1-2 years, depending on the intensity of the base's scorching, Hepaticae (Marchantia polymorpha) and mosses (Funaria hygrometrica) as well as ruderal plants typical for forest clearings predominate the scorched earth. In this stage, Geopyxis and Peziza disappear or fruit less often, since species with an anthracophilic character, for example Pholiota carbonaria and Lyophyllum anthracophilum, occur.

The above observations were very difficult to make, since intensive forestry work has destroyed the areas of scorched ground. A similar succesion of fungi on patches of scorched ground was obsered in plots: 25, 26 and 28.

Coprophilic fungi occur most frequently in the same patches, in which the fireplace fungi grow. Their fructification is connected with the dung left mainly by horses used in forestry operations.

A significant share of parasitical fungi were also observed in the studied worked forests. A large number of them, for example Heterobasidion annosus, appeared in a fir forest--Galio-Abietetum (plots 37, 38, 25, 33). In the studied area this grew mainly on spruce stumps. This fungus demonstrates a greater biological activity and can affect changes in the course of an ecological succession (Orlosh 1966). Armillariella mellea attacks the trees on the southern slopes of Mt. Babia Gora considerably more frequently than on the northern slopes. It was especially abundant in patches of Abieti-Piceetum montanum (plots: 34, 26 and 27) and of Galio-Abietetum (plot 33). Both mentioned fungi pathogens for the weak (Domanski, S. Kowalski, T.

Kowalski 1977), chiefly attacking weakened trees. Moreover, in many patches of Galio-Abietetum and Abieteti-Piceetum montanum Lachnellula subtilissima attacked seedlings and young firs.

A series of species of vascular plants from the Betulo-Adenostyletea class, which grow as a rule in fecund areas or those distinguished by ample light, appear in fir forests. A similar /21 relationship among the fungi has been observed in forests of this type. Here, Cystoderma carcharis appears in mass, Rhodophyllus sericeus less so, fungi which require greater amounts of light (Skirgiello 1950). Chiefly appearing here are Amanita spissa, Hydnum repandum, Russula foetens and R. delica, fungi which frequently appear outside the boundries of the forest (Guminska 1976b). On the northern slopes of Mt. Babia Gora Russula delica was also noted only in worked forests (plots 8 and 9). Lycoperdon foetidum and L. umbrinum, fungi which--in proportion to the light conditions--markedly expanded the area of their appearance (plots 34, 26, 39), belong to the species of the areas with the most light in the patches of mixed forests.

Plots (31 and 32) in the Galio-Abietetum fir forest, which is the private property of the Mala Lipica Lumber Commune and are found near the forest's clearings, are characterized by a very unique composition of microflora. A series of terrestrial fungi, which require a more fecund base than that which characterizes the typical fir forest, occurs here. For example, Conocybe subovalis, C. tenera, Lepiota eriophora, Inocybe brunneo-atra and I. geophylla v. geophylla, as well as Blitocybe inorata (Gulden 1965) and Lactarius salmonicolor (Rauschert, in Guminska 1976b), two species which demonstrate a tendency to appear in soils containing calcium, fruit here. The role of the soils in the studied plots is almost passive, which can be interpreted as the influence of the many year grazing of sheep and cattle here. The share of Poa annua, Veronica chamaedrys and *Juniperus communis* is evidence of the settlement's alteration.

Changes in the forest structure and in the floristic composition of the undergrowth of some studied patches--despite the worked forest regions--are relatively insignificant. In these patches were noted the largest number of fungus species gathered from the patch's plots: these are plot: 36--93 species, 30-82, 31 and 33--72 species each and 29-70 species.

In some of these patches, the number of fungus species exceeded that of the vascular plants (ill. 1). From among the observed plots found in the protected forests, the patch of rich Carpathian beeches (plot 1--73 species) and that of sycamores (plot 14--64 species) are roughly equal in regard to the wealth of mycoflora. This is in accord with the observations which caused Salata (1972) to claim in the Roztocz forests that patches of the associations, which are floristically somewhat more meagre, are very rich in fungi.

The rather abundant appearance, moreover, of groupings of various saprophitic fungi, which following after each other with an annual and seasonal rhythm, has been observed in some patches of the *Galio-Abietetum* fir forest on the southern slopes of Mt. Babia Gora. /22
In plot 30 during the first year of observation (1974) fungi of the *Mycena* family, for example *M. pura*, *M. vulgaris*, *M. rosella*, *M. rubromarginata*, *M. aurantiomarginata* and *M. phyllogena*, created a group which was differentiated by its abundant appearance. In later years (1975, 1976), these fungi fructified less abundantly, and such fungi as *Cystoderma carcharias*, *Lactarius aurantiacus* and *Hygrophorus pustulatus* began to dominate. Seasonal changes in the occurance of fungi in the discussed plot gradually came about. Fungi of the *Mycena* family (*M. pura*, *M. amicta*, *M. flavoalba*, *M. rubromarginata*) usually dominated at the end of spring and beginning of summer (June). In

July (mid-summer), the number of fructifications of these fungi gradually decreased, and the fructifications of Cystoderma carcharias, which occured abundantly in August (the end of summer) and most abundantly in September and October (fall), then began to occur. Mycena vulgaris and Lactarius aurantiacus dominated in September, while Mycena rosella, M. phyllogena, M. aurantiomarginata and Hygrophorus putulatus in October.

Hoefler (1955) observed a similar phenomenon in the old worked spruce forests in the Alps, noting in the consecutive appearances of groupings of fungi successive stages related to the development of a plant association. The role of fungi in the succession of plant agglomerations was also stressed by Haas (1953), while Peter (1948) turned his attention to the need for the detailed study of the groupings of fungi in agglomerations. The discussed fir forest occurs in a settlement close to that of beech. This points to the share of some species of the Fagetalia familie. Presently, spruce predominates in spruce-fir stands. Fir grows back well. The observed phenomenon resulting from the groupings of saprophitic fungi attests to certain changes which took place in the settlement of this forest, although a more accurate definition of the type and direction of these changes requires further study.

The occurance of a relatively small number of fungi typical for the natural settlements of wilderness forests is a marked indication of the negative changes in the lower subalpine forests on the southern slopes of Mt. Babia Gora. These fungi occur in the discussed territory only in the upper subalpine forests, and hence, within the boundries of the Park. For example, Phellinus nigrolimitatus and Climacocystis borealis fruit here. The appearance of Phellodon tomentosus, Ditiola radicata and Columnocystis abietina in worked, but not too radically changed patches of mixed and fir forests also deserve consideration. These fungi are rather rare and occur mainly

in the mountains (Zablocka 1932; Domanski 1965; Frejlak 1973; Heinrich, Wojewoda 1974). *Lentinellus cochleatus*, *Amylostereum chailletii* and *Hymenochaete cruenta*, which have a character of montane fungi (Bujakiewicz 1979) also fruit here in relatively large /23
numbers. There are many more fungi which indicate a natural settlement in the Mt. Babia Gora National Park. A large number of fungi connected to beech appear here. These include: *Plicatura crispa*, *Mycena crocata*, *Oudemansiella mucida*, *Tremella foliacea f. foliacea*, *Datronia mollis* and *Hericium ramosum*. Those which occur in connection with fir include *Hericium coralloides* and those with spruce, *Tricholomopsis decora*.

The threat to the natural environment of Mt. Babia Gora concerns not only the area of the subalpine forests on the southern slopes of the massif, but also the natural settlements within the Park, about which attests a complex sociological map of the Mt. Babia Gora Park made in 1968 (Wadsmundzki 1974). It provides a survey of the destruction and damage caused to the geographical environment of Mt. Babia Gora by the pollution of the area as the result of tourism. The most endangered areas are those around Przeleczy Krowiarki, the zones along the main tourist trails and the Markowy Szczawini and Sokolica regions. The pollution's direct affect on the composition of the mycoflora in the studied patches of the forest associations within Mt. Babia Gora National Park has not been observed. Only along the main trails on Mt. Babia Gora, for example along the Upper and Lower Plaj, on the trails' loamy escarpment have fungi appeared, which in the discussed territory were not noted in the subalpine forests (*Chalciporus piperatus*, *Inocybe lacera*, *I. hystrix*, *I. geophylla v. lateritia*) or found only in worked forests (*Peziza badia*, *Hydnum rufescens*). Nespiak (1968) turned his attention to the problem of the appearance of certain fungi along forest paths, treating this grouping as "a component part and good indication of the ranges of regional associations."

Such fungi as _Bovista nigrescens_, _Camarophyllus pratensis_, _Panaeolus sphinctrinus_ and _Marasmius oreades_ typical of these settlements have been collected in the numerous clearings and pastures which occur, above all, on the southern slopes of Mt. Babia Gora and are caused by logging. Fungi connected with larch, such as _Suillus grevillei_, _S. aeruginascens_, _Hygrophorus lucorum_ or _Tricholoma psammopus_, are also often numerous in clearings. _Aleuria aurantia_ occur in mass on forest paths and in clearings used for forestry-logging operations, beaten down ground. _Macrocystidia cucumis_ and _Pholiota abstrusa_ are less numerous here.

The Similarities and Differences in the Mycoflora of the Subalpine Forests on the Northern and Southern Slopes of Mt. Babia Gora

A comparison of the mycoflora of the studied forests on the basis of the differences in orography, in climate, in the layer system and in /24 the wealth of plant life, as well as impact of human activity, has demonstrated fundamentally important dependences and conformities (table 5).

The northern slope of the massif, on which the forests have for the most part a natural character, has been shown to be an area which is mycofloristically more meagre than the southern slope. This concerns both the the number of collected species and the abundance of the fungi's fructifications. Relatively rigorous climatic conditions and the slope's steepness probably are decisive for this. A total of 369 species of fungi were collected on the nothern slope, 302 of which were noted in the permanent observation plots. The fungi, as a rule, appear in this area sporadically, and mass appearances are observed rarely, and then only on the lower parts of the massif. A series of fungus species, which attest to the natural character of the forest settlements, however, have been collected there. Above all, the fungi connected with the conventionally arranged patches of Caltho-Alnetum, Sorbo-Aceretum and Dentario glandulosae-Fagetum associations have an indicating value for the northern slopes of Mt. Babia Gora. A series of montane fungi occur in the Piceetum excelsae carpaticum patches.

The southern slope of Mt. Babia Gora is much richer in fungi, which is in accord with the observations of other authors (Friedrich 1940; Guminska 1962b). A total of 462 fungus species were collected in this area, 356 of which were in the permanent reseach plots. The fungi fruited here in relative abundance. In some patches the number of spcies of terrestrial fungi exceeded that of the species of vascular plants (illustration 1). Consideration is also turned to species locally characteristic for a fir forest, Galio-Abietetum, among which are found terrestrial fungi, fungi connected with a rich coniferous mulch, which often appear in areas distinguished by significant amounts of light and higher temperatures (Cystoderma, Inocybe, Lepiota, Lycoperdon). The mass appearances of early-spring fungi (Piceomphale bulgarioides, Strobilurus esculentus and others) were observed here earlier and considerably more often than on the northern slopes, on which these fungi appear sporadically. The group which distinguishes well the lower subalpine worked forests on the southern slopes are fireplace and coprophilic fungi, as well as fungi connected to trees foreign to the studied montane forests. The occurance of the fungus which attacks Vespa wasps also deserves attention. Protected on both slopes in Mt. Babia Gora National Park, Piceetum excelsae carpaticum forests are richer in fungi on the southern slopes than on the northern. The group of fungi connected with forests which occur in high peat areas has a great indicating value for the southern slopes.

Tabela 5 - Table 5

Porównanie mikoflory lasów występujących na stokach północnych i południowych Babiej Góry

Mycofloristic comparison of forests occurring on north- and south-facing slopes of Mt. Babia Góra

Ekspozycja /Exposition/	North						South						
Nazwa zespołu /Name of association/	CA	SA	DgF	GA	APm	Pec	CA	DgF	GA	APm	Pec	BP	Sph
Zakres wysokości n.p.m. w m /Range of elevation in m. alt./	710 935	1040 1100	820 1030	730 743	860 1070	1105 1310	810 1015	925 1060	[illegible] 1030	830 1085	1220 1345	760	775 790
Liczba powierzchni /Number of plots/	3	3	7	2	3	5	3	6	12	10	8	2	3
Liczba obserwacji /Number of observations/	23	22	82	23	34	65	7	6	137	108	35	11	21
Lactarius obscuratus	14^{a}												
Cortinarius tibulus	9^{n}												
Paxillus filamentosus	7^{n}												
Naucoria langei	5^{a}												
Calyptella flos-alba	2^{r-n}												
Mycena vitilis	4^{r-a}												
Naucoria subconspersa	2^{a}												
Cortinarius helvelloides	12^{a}						1^{a}						
Naucoria scolecina	11^{a}						4^{a}						
Mycena speirea	5^{r-n}						1^{n}						
Naucoria escharoides	6^{n}						3^{n-a}						
Pezizella alniella	5^{r-a}						5^{a}						
Russula pumila	3^{n}						1^{r}						
Cortinarius alnetorum	5^{a}						2^{a}						
Phaeomarasmius erinaceus	1^{r}						1^{n}						
Mycena pterigena	1^{n}	4^{a}											
Calocera cornea		5^{a}											
Rutstroemia luteovirescens		3^{a}											
Tubaria conspersa		3^{a}											
Psilocybe crobula		3^{r}				2^{n}							
Conocybe ambigua		2^{r}											
Conocybe rickeniana		2^{a}											
Rhodophyllus juncinus		9^{a}	[illegible]										
Hymenoscyphus serotinus		2^{a}	1^{a}		7^{a}								
Mycena capillaris	1^{a}	3^{a}	7^{a}					1^{n}					
Polyporus varius v. varius			9^{a}										
Polyporus squamosus			5^{a}										
Hericium coralloides			4^{r}										
Corticellis fragilis			3^{a}										
Xylosphaera carpophila			3^{a}										
Antrodia flammea			2^{a}										
Polyporus varius v. elegans			2^{r}										
Rhodophyllus clandestinus			2^{r}					1^{r}					
Rhodophyllus griseorubellus			2^{r}					1^{r}					
Marasmius alliaceus v. subtilis			6^{r-r}		5^{a}			2^{r-n}					
Stereum rugosum			3^{r-n}					1^{n}		1^{n}			
Lactarius blennius			2^{r}	1^{r}									
Lactarius fuliginosus			1^{r}	1^{r}									
Hygrophorus eburneus			2^{n}	2^{a}									
Hypoxylon fragiforme			10^{n-a}	2^{a}	5^{a}			1^{a}					
Diatrype disciformis		2^{a}	24^{a}	4^{a}	7^{a}			1^{n}					
Hymenoscyphus calyculus	8^{a}	8^{a}	7^{n-a}			2^{a}	1^{a}	2^{n-a}					
Marasmius alliaceus v. alliaceus	1^{r}	2^{r}	45^{r-n}	3^{r}	8^{r-n}			3^{r-n}					
Lactarius pterosporus				1^{r}				1^{r}					
Rhodophyllus rhodopolius				4^{n}									
Mycena vulgaris				2^{a}					3^{r-a}				
Cystoderma fallax				3^{n}					4^{n}				
Lactarius aurantiacus				2^{r}					25^{r-a}	8^{r-a}			
Thelephora palmata									7^{r-n}				
Russula mustelina									6^{r-n}				
Inocybe friesii									2^{r-n}				
Inocybe incoccinna									5^{r-n}				
Galerina pseudocamerina									5^{r}				
Cudonia circinans									3^{r-a}				
Mycena strobilicola									4^{r-n}				
Clavulina rugosa v. rugosa									4^{r}				
Clitocybe radicellata									4^{r}				
Inocybe tarda									2^{r}				
Inocybe grammata									6^{r-n}		1^{r}		
Lepiota ericophora									1^{r}				
Lepiota ventriosospora									1^{r}				
Lachnellula willkommii									7^{a}				
Strobilurus tenacellus									1^{r}				
Suillus grevillei									1^{r}				
Lycoperdon umbrinum									7^{r-n}	5^{r-n}			
Lycoperdon foetidum				1^{r}					9^{r-a}	15^{r-a}			
Isaria sphecophila									7^{r-a}	5^{r}			
Ciboria rufofusca									1^{r}	1^{r}			
Geopyxis carbonaria				1^{r}					18^{r-a}	14^{n-a}			
Trichophaea gregaria				1^{a}					2^{r-a}	2^{r}			
Lyophyllum anthracophilum									11^{r-a}	10^{r-a}			
Peziza violacea									7^{r-n}	5^{r}			
Pholiota carbonaria									6^{r-n}	6^{r-n}			
Stropharia stercoraria						1^{n}			2^{r}	2^{r}			
Psilocybe coprophila									2^{n}	1^{r}			
Panaeolus sphinctrinus									1^{r}				
Lasiobolus ciliatus										1^{a}			
Strobilurus esculentus			1^{r}			$[illegible]^{r-n}$			25^{r-a}	6^{r}	8^{r-n}		
Picecomphale bulgarioides				1^{a}	2^{n}	4^{a}			21^{a}	27^{a}	1^{a}	1^{a}	
Cordyceps ophioglossoides										3^{r-a}			
Lactarius camphoratus										2^{r-n}			
Morchella elata										3^{r-n}			
Lyophyllum gibbosum						2^{a}							
Melastiza scotica						4^{r}					1^{r}		
Cortinarius cataillei						1^{r}					2^{n}		
Phellinus nigrolimitatus						1^{n}				1^{n}	5^{a}		
Galerina badipes						4^{r-n}			1^{r}		9^{r-n}		
Phellinus viticola						2^{a}			1^{n}	1^{r}	24^{a}		
Galerina uncialis											3^{r-n}		
Climacocystis borealis											2^{n-a}		
Lactarius theiogalus												5^{a}	
Galerina mycenoides												4^{a}	
Mitrula vitellina												2^{n}	3^{n}
Hebeloma helodes												4^{n}	3^{n}
Cantharellus tubaeformis												2^{a}	3^{a}
Cortinarius fulvescens												2^{r-a}	3^{a}
Cortinarius uliginosus												4^{r-n}	7^{n-a}
Galerina tibiicystis												1^{r}	5^{r-a}
Galerina paludosa												1^{n}	6^{n-a}
Lyophyllum palustre													5^{n-n}
Haematoloma elongatipes													4^{r-n}
Monilinia oxycocci													2^{r}
Haematoloma udum													2^{n}
Omphalina sphagnicola													2

Objaśnienia /Explanations/:

- CA - Caltho-Alnetum
- SA - Sorbo-Aceretum
- DgF - Dentario glandulosae-Fagetum
- GA - Galio-Abietetum
- APm - Abieti-Piceetum montanum
- Pec - Piceetum excelsae carpaticum
- BP - Sphagno-Piceetum
- Sph - Sphagnetum magellanici

Tabela 6 - Table 6

Liczba gatunków macromycetes zebranych na Babiej Górze w poszczególnych zakresach wysokości n.p.m. w m

Number of species of macromycetes collected on Mt.Babia Góra in particular ranges of elevation in m.

Zakres wysokości /Range of elevation/	Zespoły leśne /Forest associations/								Inne /Others/	Łącznie /Totally/
	CA	Sph	BP	GA	DgF	APm	SA	Pec		
700	11	.	.	1	.	.	.	.	.	12
701 - 800	55	84	34	108	15	27	.	.	27	247
801 - 900	26	.	2	244	80	145	.	.	80	390
901 - 1000	57	.	.	84	176	129	.	.	13	290
1001 - 1100	9	.	.	16	138	103	93	4	8	223
1101 - 1200	.	.	.	.	18	16	5	68	14	101
1201 - 1300	.	.	.	.	.	5	.	128	3	133
1301 - 1400	.	.	.	.	.	.	.	85	3	86
1401 - 1500	.	.	.	.	.	.	.	.	11	11
1501 - 1600	.	.	.	.	.	.	.	.	8	8
1601 - 1725	.	.	.	.	.	.	.	.	5	5

Objaśnienia /Explanations/:
CA - Caltho-Alnetum
Sph - Sphagnetum magellanici
BP - Bazzanio-Piceetum
GA - Galio-Abietetum
DgF - Dentario glandulosae-Fagetum
APm - Abieti-Piceetum montanum
SA - Sorbo-Aceretum
Pec - Piceetum excelsae carpaticum

The Seasonality of the Appearance of Fungi in the Subalpine Forests of Mt. Babia Gora 27

Multiyear mycosociological studies performed in the forests of Mt. Babia Gora have yielded matieral which also concerns the phenology of fungi. These studies could not, however, aim at tracking the whole year development of fungi due to lack of frequent visits to the research area.

The climatic conditions of Mt. Babia Gora are quite distinct, and the levels of plant life are quite differentiated by the duration of climatic phenomena. Maps, which concern some climatic factors of Mt. Babia Gora in the period encompassing the research years of 1968-1977 (Bujakiewicz 1981), attest to this.

As a result of observations begun in the forests of Mt. Babia Gora, species of fungi which dominate in three seasons in the stuided forest associations, and which can taken as indicative for them, have been distinguished (table 7). Only those patches, in which at least several dozen observations had been made in the course of the entire study, were included in the comparison. The distinguishing of indicative fungi was sometimes rather more difficult than earlier, since the fungi did not occur in great numbers, and mass occurances were a rarity.

The divisional concepts in the comparison of the forests of the northern and the southern slopes of Mt. Babia Gora allowed the observation of the differences in the occurance of fungi in the patches of the same associations on slopes with different exposures. These differences were pronounced, for example in Galio-Abietetum and Piceetum excelsae carpacticum patches.

The seasons on Mt. Babia Gora, diffentiated on the basis of the average daily temperatures (Obrebska-Starklow 1963; Dylewska 1966), took shape in the following manner: winter--the average temperature was below 0°C, early spring--from 0° to 5°, spring--from 5° to 15°, summer--above 15°, fall--from 15° to 5°, late fall-from 5° to 0°. The beginning of the seasons did not occur simultaneously in the climato-plant levels of Mt. Babia Gora. The nnnnnn vegetation period begins later and ends earlier in the upper subalpine forests than in the lower.

Spring in the lower subalpine forests occurs in the first half of April and lasts on the average until the middle of June, summer ends in the middle of August, fall in the middle of October, and late fall at the end of November. In the upper subalpine forests spring begins at the beginning of May (or only in the middle of this month) and lasts up until the middle of July, summer is short and lasts until the beginning of August, fall until the beginning of October, and late fall until the end of November.

Tabela 7 — * /28

Grzyby przewodnie dla fenologicznych

Fungi characteristic of phenological

Nz	Stok północny (North slope)		
	wiosna (spring)	lato (summer)	jesień (autumn)
CA		*Lactarius obscuratus* *Cortinarius helvelloides*	*Naucoria subconspersa* *Cortinarius alnetorum* *Naucoria escharoides* *Naucoria scolecina*
SA		*Calocera cornea* *Hymenoscyphus calyculus*	*Mycena pterigena* *Typhula erythropus*
DgF	*Dasyscyphus virgineus*	*Russula cyanoxantha* *Calycella citrina* *Polyporus varius* v. *varius* *Marasmius alliaceus* s.l.	*Lactarius subdulcis* *Hymenoscyphus serotinus* *Mycena capillaris* *Pholiota aurivella*
GA		*Russula cyanoxantha*	*Mycena phyllogena* *Mycena vulgaris* *Mycena pura* *Cystoderma carcharias*
APm		*Calocera viscosa*	*Panellus serotinus*

* Continued on page 34

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Table 7
pór roku w zespołach leśnych na Babiej Górze
seasons in the forest associations of Mt. Babia Góra

Nz	Stok południowy (South slope)		
	wiosna (spring)	lato (summer)	jesień (autumn)
CA[1]			
SA[1]			
DgF[1]			
GA	*Piceomphale bulgarioides* *Strobilurus esculentus* *Xeromphalina campanella* *Lachnellula subtilissima*	*Mycena pura*	*Lactarius aurantiacus* *Cystoderma carcharias* *Clavulina cinerea* *Mycena viscosa* *Mycena phyllogena* *Mycena rosella* *Mycena aurantiomarginata* *Hygrophorus pustulatus*
APm	*Piceomphale bulgarioides* *Xeromphalina campanella* *Lachnellula subtilissima*	*Mycena rorida* *Lactarius camphoratus*	*Cortinarius collinitus* *Lycoperdon foetidum* *Naematoloma capnoides* *Cordyceps ophioglossoides*

/30

Table 7 (conclusion)

Pec		*Marasmius androsaceus* *Mycena luteoalcalina* *Mycena rorida* *Mycena galopoda* *Galerina sahleri* *Galerina mniophila* *Russula ochroleuca* *Naematoloma dispersum*

Objaśnienia (Explanations):
Nz — nazwa zespolu (name of association); CA — *Caltho-Alnetum*, SA — *Sorbo-Aceretum*, *tanum*, Pec — *Piceetum excelsae carpaticum*, BP — *Bazzanio-Piceetum*, Sph — *Sphagnetum*
[1] brak odpowiednich danych (lack of adequate data).

Spring

Spring fungi begin fructification with the receding of the snow cover, which in the lower subalpine forests occurs a little earlier than the middle of April. In the upper subalpine forests the first fructifications of the *Piceomphale bulgarioides* and *Strobilurus esculentus* fungi are gathered on the southern slopes under conditions, where in the forest patches still around 20 centimeters of snow lie, and only the areas around the trees were free of it. Gulden (1966) turned his attention to the relationship of the fructifications of *Strobilurus esculentus* on the areas of its appearance. This fungus generally appears during spring both in the lower and upper subalpine forests, although it occurs in relative fewer numbers in fall, and then only in the lower forests.

Strobilurus esculentus and *Piceomphale bulgarioides* occur on Mt. Babia Gora only on the southern slopes, where they occur very early, already in April. On the northern side of the massif both fungi fruit in very small numbers (especially in those areas in which a lot of sunlight reaches the forest floor). The explanation for this phenomenon lies in the multiyear phenological observation of the 31
species of trees, for example of spruces, performed on Mt. Babia Gora by workers of the Mt. Babia Gora National Park Directorate. This has shown, namely, that the spruces on the northern slopes of Mt. Babia Gora often do not produce strobila for many years, although they do so every year on the southern slopes, often in amounts large enough to cover the substratum allowing the development of fungi connected with this type of base. The cause for such a pronounced difference in the vitality of the trees on both sides of Mt. Babia Gora lies for sure in climatic factors. This also concerns the appearance of *Mycena strobilicola* in the fir forests only on the southern slopes. A similar dependence has been observed in the appearance of *Ciboria rufofusca*, an ascomycetous fungus, which fruits in spring on fallen

Pec	*Piceomphale bulgarioides* *Strobilurus esculentus* *Xeromphalina campanella*	*Hygrophorus olivaceoalbus* *Rhodophyllus staurosporus*	*Russula ochroleuca* *Marasmius androsaceus* *Cystoderma sublongisporum* *Pistillaria todei* *Naematoloma dispersum* *Mycena galopeda*
BP		*Inocybe lanuginosa*	*Lactarius theiogalus* *Cortinarius paleaceus* *Laccaria proxima* *Galerina mycenoides*
Pph	*Monilinia oxycocci*	*Galerina paludosa* *Galerina tibiicystis*	*Cortinarius uliginosus* *Lactarius helvus* *Naematoloma elongatipes*

DgF — *Dentario glandulosae-Fagetum*, GA — *Gallo-Abietetum*, APm — *Abieti-Piceetum montana magellanici.*

husks of pine cones. On the northern slopes firs leaf and make cones a little more than every four years (between 1968 and 1974 the firs leafed on these slopes only in 1971), while on the southern slopes they /32 formed cones every year. The appearance of the Ciboria rufofusca is very interesting, since it is a fungus requiring a great air humidity for fructification (Svrchek 1951), which is significantly lower on the southern slopes than on the northern.

Xeromphalina campanella, which grows on the rotted stumps of spruces, is known as the species known in spring in the forests of Mt. Babia Gora. This fungus also occurs in forests in summer and early fall, although it does not fruit so abundantly then as it does in spring. Lentinus adhaerens, Melanoleuca cognata and Lachnellula subtilissima were also collected in many areas during this period. Gyromitra gigas was noted less frequently.

Dasyscyphus virgineus fruits in rather large numbers on the northern slopes of Mt. Babia Gora in beech forests on fallen beeches covered amply with leafy mulch.

Summer

In summertime the undergrowth develops in great profusion in all of the forest associations of forest associations on Mt. Babia Gora. Of the fungi only representatives of the Mycena and Marasmius families are seen relatively frequently during this period. Only in the beech and fir forests does the Russula cyanoxantha occur in number, while Lactarius obscuratus is seen in alder forests, and representatives of the Galerina family on peat bases.

Fall

Fall arrives on Mt. Babia Gora with the end of August and the rather abundant appearance of fungi is noted in really almost all of the subalpine forests. The undergrowth begins to dwindle in fall, the leaves of the trees began to change color. The leaves usually begin to fall in the forests on Mt. Babia Gora at the start of October.

The maximum development of the mycoflora in the subalpine forests on Mt. Babia Gora occurs in September, usually later in the fir forests and woods than in the deciduous forests. The fructification of a large number of fungi which form symbiotic relations with alders is a chacteristic aspect in boggy alder woods, in sycamore forests--fungi connected with the remains of ferns and sycamore leaves, and in beech forests--those connected with beech trees. Fir forests and woods are also very rich in fungi during this period. In the upper subalpine forests on the massif begins to appear the Hygrophorus olivaceoalbus, a montane fungus, which occurs on Mt. Babia Gora in number only on the southern slopes. Fungi with small fructifications among the mosses predominate in this period in the upper forests on the massif's nothern slopes. Russula ochroleuca also appears then in 133
large numbers. The flora of fungi in peat based forests are very differentiated and rich in fructifications during this period.

The first snow fall occurs on Mt. Babia Gora at the beginning of October (sometimes even in the middle of September). Often during this time the hoar frost (illustration 2, Bujakiewicz 1981) and the massive fall of leaves cause the majority of fungi to finish vegetation. Only a small number reach full growth in this period. Mycena capillaris, for example, creates a pronounced aspect in beech forests. More fungi grow then in fir forests (table 7). Hygrophorus pustulatus is often found in the upper subalpine forests. This montane fungus fruits in the studied territory later than the Hygrophorus olivaceoalbus. Its fructifications often grow among Plagiothecium unduatum covered by a layer of snow.

During investigations on the southern slopes of Mt. Babia Gora, between October 17 and 21, 1974, 69 species of fungi, including 31 (44 percent) terrestrial species, were gathered in 21 observation plots under a snow cover around 18 centimeters thick (in some places 40 cm) in the lower subalpine forests. Fructifications of Hygrophorus pustulatus, H. olivaceoalbus, Tricholoma saponaceum and Hydnum repandum were found then. Fungi which fruited abundantly on the needles of spruces and firs included Mycena rosella, M. phyllogena and Mitrula abietis.

Gyromitra infula, Hygrophorus lucorum and Macrocystidia cucumis were noted in fall in many areas outside of the permanent plots.

Observations were not performed in winter because of the considerable depth of the snow cover in the forests of Mt. Babia Gora.

The abundance of the fructifications of fungi has varied over the years depending on the configuration of many ecological factors. According to Danilow (1949) the fertility cycle of fungi is once every four years. Although the performance of three observations per year does not warrent the drawing of too far-reaching conclusions, it can be estimated on the basis of these observtions that the fructification of fungi in the subalpine forests on the northern slopes of Mt. Babia Gora was abundant in 1969, 1973 and 1975. The summers of 1974 and 1975 were unique on the southern slopes. 1975 can be considered as a fecund year for fungi for the entire Mt. Babia Gora region. It was warm and reasonably humid. The yearly precipitation on the northern slopes amounted to 1293.3 millimeters at Zawoja and 1147.5 millimeters for the southern slopes at Stancowa. The most abundant precipitation occured in June (Zawoja 228.3 mm) and in July (Stancowa 219,5 mm). The abundance of the fructification in the mentioned year was pronounced depending on the forest association. The most numerous appearance of fungi was observed in the lower subalpine forests, especially in patches of Dentaria glandulosae-Fagetum, Galio-Abietetum and Abieti-Piceetum montanum.

A Discussion of the Results and Conclusions /34

Mycosociological research on Mt. Babia Gora was performed in the only high montane massif region in Poland which possesses slopes with both nothern and southern exposures, marking it as a classic configuration of climatic-plant layers and a substantial area of well preserved Carpathian wilderness.

The observations were performed in 1968-1969 and 1972-1977 in 65 permanent observation plots, located in representational patches of 8 forest associations, which were differentiated in regard to form, structure and level of the settlement's naturalness.

The research was aimed at defining the indicating value of fungi in subalpine forests on the entire montane massif. The level of attachment to the studied phytisociological units was analyzed for 465 species, 11 sub-species and 3 forms (for a total of 479 taxonomic species) of fungi collected in the permanent observation plots, separated into each of the 9 differentiated ecological groups (table 2), which in general indicate the rather tight connection with ecological conditions characterizing each forest association. Within the confines of all the groups, and especially in the group of terrestrial fungi, on the basis of the analysis of the loyalty of a species of fungus to a given forest association, species (or group of species) of fungi locally characteristic for a studied association (or group of associations) (table 4) or species (or group of species) locally distinguishing smaller units within the confines of associations (table 2) were divided according to the constancy of their appearance in an association and their fructifications.

On the basis of the performed observations, it can be asserted that fungi appear relatively infrequently on Mt. Babia Gora in all of the patches representing a studied forest association. Lange (Hoefler 1937) has already considered the phenomenon of the unequal composition of the mycoflora in patches of the same plant association. Research in Poland, for example in the forests of Roztocz Shrodkowy (Salata 1972), has also verified this.

The numbers expressing the abundance and level of constancy, in the case of many fungi known in the forests of Mt. Babia Gora as characteristic or distinguishing, are very small in relation to the number of observations performed. Certain reservations can be raised as to their indicating value in the studied forest associations. It is necessary here to emphasize the more variable nature of fungi than plants. The specifics of the occurence of the fructifications of fungi, especially those of terrestrial fungi, depend on many factors, for example on atmospheric conditions, on the time of year and on the hardiness and activity of the fungi over a series of years. This means that they most frequently occur sporadically and in unequal numbers. In this situation, even with dozens of observations performed in the same association patch, the presence of the fructifications of a given fungus species cannot always be verified, although the fungal spawn of that species is present in the substratum. It should also be stressed, moreover, that the same level of constancy and abundance of fructification still does not necessarily speak to the relationship of fungi with a forest association. Only the comparison of the characteristics of the occurence of a given pecies on the basis of the the entire scale of the differentiation of forest associations (Hueck 1953) yields a picture of the ecological scale existing in the studied area. Although the role of fungi, which rarely fruit and are not too abundant, is rather limited for the characteristics of the studied settlements, their indicating value, however--after extending the scope of the research--can be significant. Haas (1953) has already considered the important role of fungi as indicating species.

The fact that some fungi known as characteristic or distinguishing on Mt. Babia Gora occur in other (in general covered) forest associations in other areas, does not lessen their role and indicating value shown in the studied areas. Intensification of this type of research, which would enrichen the rather skimpy documentation currently provided by mycosociology, would allow a more precise definition of the ecological scale of fungi species in the future.

Mycological studies in the permanent observation plots performed simultaneously with those throughout the entire subalpine forest have allowed a more complete picture of the mycoflora of the studied area's forests to be obtained. This is a more secure utilization of this method in areas in which phytosociological-cartographical studies have been performed, since the probability of errors in charting the plant configuration in which fungi species are noted is then lessened.

Several conclusions can be drawn from the above considerations.

1. Most characteristic species of fungi appear on Mt. Babia Gora in forest associations which are distinguished in regard to the flora of vascular plants, for example in patches of the *Caltho-Alnetum* and *Sphagnetum magellanici* associations.

The fungi appearing in patches of the *Caltho-Alnetum* association are distinguished by their rather high levels of constancy and abundance. The majority of them are made up of fungi forming a symbiosis with *Alnus* (*A. incana* and *A. glutinosa*) and also those, which are frequently noted in boggy forests in connection with *Alno-Padion* (Bujakiewicz (1973). In patches of *Caltho-Alnetum* the species make up exclusively the highest percentage from among all of the studied forest associations. The *Caltho-Alnethum* association demonstrates a mycofloristic connection with the *Sorbo-Aceretum* association, which is probably caused by the considerable fecundity and humidity of the soils in both association. Fungi with small and /36
delicate fructifications, having the character of hygrophytes, dominate in these forests.

Fungi connected with fertile, humus soils and those growing on the remians of ferns and sycamores have an indicating value for patches of the *Sorbo-Aceretum* association.

The rich Carpathian beech forest, *Dentario glandulosae-Fagetum*, is relatively poor in fungi on Mt. Babia Gora, especially in terrestrial fungi, although the group of fungi growing on rotting beeches and firs well distinguishes it. The share of firs and spruce, natural components in Carpathian beech forests, fundamentally changes the character of this association in relation to lowland beeches forests.

Mycosociological research in patches of fir forests, Galio-Abietetum, has demonstrated the connection of this association both with Fagetalia and Vaccinio-Piceetalia forests. This verifies the systematic position of the Galio-Abietetum association, standing on the edges of the mentioned types (Bujakiewicz 1974). The group of fungi attesting to the relationship of this forest with others appears in especially large numbers in patches of the fir forests on the massifs southern slopes.

Mixed stands, Abieti-Piceetum montanum, although floristically related to those of the upper forests, Piceetum excelsae carpaticum, with regard to mycoflora not only lose the character of a lower subalpine forest, but is expressly connected to Galio-Abietetum fir forests. This is caused by the dominant role of firs in both of these lower subalpine associations, and in addition, beech is mixed into the mixed stands on the northern slopes. This stand is, moreover, considerably richer in fungi than those of the upper subalpine forests.

The Piceetum excelsae carpaticum association on Mt. Babia Gora is among the zonal associations which are the poorest in fungi, and species characteristic for this association are marked by a low lever of constancy. Patches of upper subalpine forests are differentiated by the share of montane fungi.

Moss covered stands, Bazzanio-Piceetum, indicate a mycofloristic connection both with the Sphagnetum magellanici association with regard to the similarity of the settlements, and with the Piceetum excelsae carpaticum with regard to similar structure.

The high peat ground, Sphagnetum magellanici, found on Mt. Babia

Gora in the forest layers, is characterized by the share of fungi connected with montane spruce forests.

On the basis of the research, it can be claimed that forest associations floristically interrelated, for example associations of the Fagion order, as well as the Vaccinio-Piceion order, also indicate the similarity of mycoflora.

The thorough study of the share of fungi in patches of subassociations: rich Carpathian beech forests-Dentario glandulosae-Fagetum, fir forests--Galio-Abietetum and Carpathian spruce forests--Piceetum xcelsae carpaticum (table 3), demonstrates that the existing division is supported by additional verification in the mycoflora of the studied patches. Such conformity, however, has not been observed in patches differentiated within the confines of the Dentario glandulosae-Fagetum association. Haas (1953) and Nespiak (1958) have already turned attention to the important role played by fungi in phytosociological diagnostics. /37

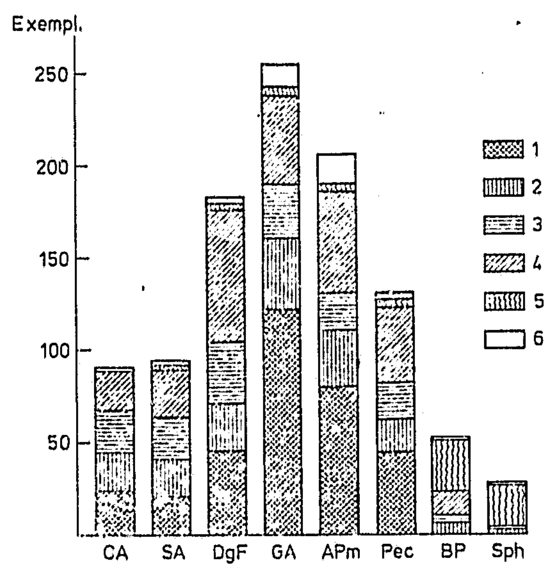

Fig. 2. Number of species of macromycetes collected in the forest associations on Mt. Babia Góra

1 — terrestrial macromycetes; 2 — fungi fruiting on plant remains; 3 — fungi growing on fallen twigs; 4 — fungi inhabiting stumps and logs; 5 — fungi growing among mosses; 6 — other ecological groups

(Explanation of forest associations see Table 4)

Most indicating species are found in the group of terrestrial fungi. The group of fungi growing on rotting wood and those connected with rich mulch, undergoing slow decomposition in the cold montane climate, make up a series of locally characteristic species.

2. The zonally lower subalpine associations have the richest mycoflora on Mt. Babia Gora, namely the Galio-Abietetum fir forests /38
and mixed stands of Abieti-Piceetum montanum (figure 1). Some patches of the mentioned associations, which occur on the southern slopes of Mt. Babia Gora, are distinguished by an exceptional wealth of fungi. They are usually somewhat poorer in regard to vascular plants and are distinguished by the lack of undergrowth density. The negative affect of a very dense undergrowth on the fruiting of fungi is a known phenomenon (Leischner-Siska 1939; Guminska 1962b; Tomilin 1964; Salata 1972 and others) and studies in the subalpine forests of Mt. Babia Gora also verifiy it.

The abundance of fungi species in general exceeds that of vascular plants. Bisby (1933) has already discussed this. In the forests of Roztocz Shrodkowy (Salata 1972) terrestrial fungi greatly dominate vascular plants (and mosses) which occur in the studied patches. These relations are reversed in the forests of Mt. Babia Gora. In the majority of the studied patches the number of species of terrestrial fungi is lower than that of the species of vascular plants (and mosses) (figure 1).

3. The number of fungi species decreases markedly the higher the elevation (table 6).

4. Research has shown fundamentally significant differences between the mycoflora of subalpine forests occuring on the northern

and southern slopes of Mt. Babia Gora. These are connected, above all, with the level of the preservation of the natural forest associations and the affects of human activity, with the different climatic conditions prevailing on both slopes and with the varied orography of the terrain which allows the development of some forest associations only on one side of the massif (table 5).

The mycoflora of the forests on the southern slopes of Mt. Babia Gora is considerably richer (462 species of fungi, including 356 in the permanent plots) than on the northern slopes (369 species, with 302 in the permanent plots). The abundance of the fungi's fructifications on the southern slopes of the massif is also greater. This is tied to the milder climate, the less pronounced sculpture of the slope, the greater heterogeneity of new settlements mainly in connection with human activities (thinning of forests, felling, burning, etc.) and the introduction of alien trees into the natural forests. In the Carpathian patches of Piceetum excelsae carpaticum, occuring on both slopes of Mt. Babia Gora within the boundries of the Park, also possess certain differences in the composition of the mycoflora and the abundance of the fungi's fructifications, connected in this case mainly with the varying climatic conditions on both slopes. They affect the course of the phytophenological phenomena, which are decisive for the sequence of the occurence of some species of fungi.

Qualitative and quantitative differences in the composition of the mycoflora in the forests occuring on both slopes of Mt. Babia Gora /39
stem to a great degree from the differences in the atmospheric conditions prevailing throughout the year and from the cyclicalness in the appearance of fungi over a series of years. The performance of more frequent observations during the vegetation season, if possible on both slopes, would demonstrate this. However, this is very difficult to do under the mountainous conditions.

5. In worked forests changes in the composition of the floristic undergrowth occur in proportion to changes in the forest's and especially the stand's structure. Changes in the composition of the mycoflora also occur simultaneously with this. Some fungi disappear (they do not fruit) as a result of changes in conditions of light, aeration and access to water from atmospherical precipitation. Others expand the range of their occurence and also new fungi begin to appear (see page 18). These changes take place constantly and are usually irreversible. In this case, these fungi play a role in the changes begun by man and these changes can to a great degree become more profound.

6. The observation of the seasonal appearance of fungi in the forest associations of Mt. Babia Gora has allowed the differentiation of species of characteristic fungi for three phenological seasons of the year (table 7). An especially abundant year for the fruiting of fungi in the forests of Mt. Babia Gora was 1975.

Mycosociological research in the subalpine forests on Mt. Babia Gora has allowed the settlements typical of a high massif to be more accurately characterized. The performance of this in an area with relatively well preserved plant life (frequently in protected areas) ensures that the results obtained will yield a picture of the natural configurations existing among the studied forests and the fungi appearing in them. The natural wealth and value of this area was recently recognized in a special manner. In 1977, Mt. Babia Gora was named a biosphere reserve by UNESCO's "Man and the Biosphere" Program, one of 144 in the world and 4 in Poland.

REFERENCES

Bisby, G.R., 1933, The distribution of fungi as compared with that of phanerogams. Amer. Journ. Bot. 20: 246-254.

Danilow, D.N., 1948, The Geographical Distribution and Period of Fungi. Bot. Zhurn. 34: 167-175.

Gulden, G., 1965, Three whitespored agarics new to Norway. Norw. J. Bot. 12: 29-33.

Hoefler, K., 1955, On the fungal vegetation of aforested spruce woods, Sydowia 9: 246-255.

Kalamees, K., 1968, Mycosociological methods based on investigations in the Estonian forests. Acta Mycol. 4: 327-335.

Kornas, J., 1957, The agglomeration of sporipherous plants and their classification. WIad. Bot. 1:3-18.

Meyer, F.H., 1963 Laccaria amethystina (Bolt. ex Fr.) Bk. Br., a hardy fungus for mycorrhizic formation on beeches. Deutsch. Bot. Ges. Ber. 76: 90-96.

Modrzynski, J., Ostrowicz J., 1976, Concerning the upper boundries of the appearance of firs and beeches on the northern slope of Mt. Babia Gora. Chronmy Przyr. Ojcz. 32: 23-34.

Orlosh, H., 1966, Forest fungi on the bas's of the environment. PWRiL, Warsaw.

Peter, J., 1948, Mycosociology. Schweiz. Zeitschr. f. Pilzk. 1: 6-9.

Stern, R., An introduction in the Geology and Vegetation of the

Excursion region of Fritzens. Zeitschr. f. Pilzk. 35: 137-147.

Svrchek, M., 1951, The Jehnedka fir, the fruiting fungus on fir needles--Ciboria rufofusca (Weberb.) Sacc. Cheska Mycol. 5:9-13.

Tomilin, G.A., 1962, The fungi of some typical phytocenoses of the Amur subtaiga. Bot. Zhurn. 47: 1116-1125.

Tomilin, B.A., 1964. Factors of the external environment affecting the distribution of fungi in the plant community. Bot. Zhurn., 49: 230-238.

Weir, J. R., 1918, Notes on the altitudinal range of forest fungi. Mycologia 10: 4-14.

A complete survey of the literature is found in pts. I and II of the paper (Acta Mycol. 15, 2 and 17)

Additional citations:

Bujakiewicz, A., 1981, Acta Mycolo. 17.

Dylewska, M., 1966, Acta Zool. 11.

Dzieciolowski, R., 1963, Z. Ochr. Przyr. 22.

Falinski, J.B., 1966, Ekol. Pol. 12.

Favre, J., 1955, Ergeb. wiss. Unters. Schweiz. Nat. Parks 5.

Friedrich, K., 1940, Flanzenforsch. 22.

Jostowa, W., 1974, Karpaty 2.

Pilat, A., 1974, Ceska Mykol. 26.

Skirgiello, A., 1950, Acta Soc. Bot. Pol. 20.

Svrcek, M., 1949, Ceska Mykol. 3.

Wachsmudzki, L. A., 1974, Karpaty 2.

Wojewoda, W., 1974, Acta Myc. 10.

Zablocka, W., 1932, Acta Soc. Bot. Pol. 9 Suppl.

SUMMARY

Babia Gora is the second highest to the Tatras, mountain range in Poland reaching up to 1725 m above sea level. The isolated massif runs almost parallell to the altitude and has its northern side sloping down more steeply. This slope has also characteristic glacial relief and is rather colder and more humid than the gentle southern slope (Bujakiewicz 1981).

Specific orography of Mt. Babia Gora is brought about by he special structure of geological strata of the Magura sandstone alternating with shales. These strata, declining gently and directed to the south are distinctly eroded on the northern slopes. The bedrock is rather poor in calcium carbonate and results mainly in acidic soils. On the northern slope soils are more differentiated and more fertile.

One of the most characteristic features of Mt. Babia Gora is a classic succession of altitudinal vegetation zones from the lower montane forest zone up to the alpine one. Large areas of the Carpathian virgin forests are preserved in the Babia Gora National Park.

The limits of vegetation zones on the Babia Gora run about 2200 m lower when compared with those of the Tatra Mts. On northern slopes the lower montane forest zone (700-1150 m.s.m.) consists of well developed patches of _Dentario glandulosae-Fagetum_, _Abieti-Piceetum montanum_, _Caltho-Alnetum_ and _Sorbo-Aceretum_ associations. the whole area of the northern slope is protected in the Babia Gora National Park. On southern slopes fir and spruce forests iprevail (_Galio-Abietetum_ and _Abieti-Piceetum montanum_), while beech forests cover only small areas on the Slovakian side of the massif. The upper

montane forest zone, extending from 1150 m to 1390 m.s.m., consists of magnificent spruce forests (Piceetum excelsae carpaticum) and is protected on both slopes of Babia Gora. Above the timber line, from 1390 m up to 1650 m there are dense thickets of dwarf pine (pinetum mughi carpaticum). The alpine zone (1650 m to 1725 m) occupies rather small area and is dominated by grasses, herbs and minute shrubs.

The mycoflora of forests of Mt. Babia Gora has already been elaborated (Bujakiewicz 1979).

The present study in the forests of Mt. Babia Gora was undertaken in order to analize the structure of fungal groups in relation to parrticular forest associations. The primary aim of mycosociological investigation was to define the indicating value of macrofungi in the forests studied. Another problem to solve, was to get an answer for the question whether fungi reflect differences (in orography, climate, vegetational zontation) existing on slopes of north and south exposition. There was also made an attempt to show dynamics of changes in mycoflora of forests affected by lumbering.

Systematic mycosociological research ws performed in the course of 8-year observations on 65 permanent plots laid out by phytosociologist in homogenous patches of 8 strictly definite forest associations distributed on the whole area of Babia Gora (Poland and Czechoslovakia). Permanent plots (400-200 sq. m. each) have been visited 3-4 times a year in the course of 3-4 years, that gave 10-14 excursion lists on each plot and about 600 lists on all sample areas. Number, size and shape of permanent plots correspond with the degree of distribution of forest associations on Mt. Babia Gora and depend on homogenity of stands in chosen forests.

The vascular vegetation of the forests studied was analysed by the Braun-Blanquet survey method and based on elaboration of Celinski, Wojterski (1978). Phytosociological records were made by the author (Bujakiewicz 1981). There has also been made a preliminary description of two associations: Bazzanio-Piceetum Br. Bl. et Siss. 1939 and Sphagnetum magellanici (Malc. 1929) Schwick. 1933, not included in the elaboration mentioned above.

In mycosociological research the synthetic-comparative method has been used in order to establish the connections between fungi and particular forest association. A basis for evaluation of these connections was an analysis of fidelity, constancy and abundance of 479 taxa of fungi collected on permanent plots in all associations (Table 1).

The ecological groups of fungi, distinguished in regard to substratum, are considered separately. they are as follows: 1--terrestrial fungi, 2--fungi growing on decaying plant remains, 3--fungi fruiting on fallen twigs, small branches, bark, 4--fungi inhabiting decaying stumps and logs (including those, growing on living trees), 5--fungi growing among mosses, 6--fireplace fungi, 7--coprophilous fungi, 8--fungi growing on rotten carpophores of fungi, 9--fungi developing on insects.

The opinion of the relation between fungi and vascular plant communities in this paper is generally in accordancd with that of Kornas (1957). Terrestrial fungi, as well as those growing on the plant remains and on fallen twigs form synusiae, being structural and functional elements of particular phytocoenoses. Fungi fruiting on stumps and logs form dependent associations showing reation to the degree of wood decay. Fireplace and coprophilous fungi are considered to be independent of the vascular plant communities (Ebert 1958: after-- (and)--Wojewoda 1975). Each ecological group of fungi has its own annual and seasonal rhythm of fruiting.

Ecological conditions of development of the same synusiae are different not only in different forest associations, but also in patches of the same association. It is the result of great diversity of microhabitats in montane forests.

Mycosociological records like the phytosociological ones, are arranged in tables according to fertility of sites, from the richest to he poorest. The character of relief, soil and humidity regime on plots was described. Four grade scale has been used for description of changes induced by man: 0--no changes observed, 1--slight changes in treestand, 2--great changes in treestand , fireplaces, grazing, etc., 3--destruction (lumbering, changes in structure of forest, devastation of litter, fireplaces, etc.).

In mycosociological tables the first figure in the colum indicates the number of appearances of species in a plot (or in a given forest association) and the letter in potential exponent gives the degree of abundance, according to Jahn, Nespiak, Tuexen (1967): a--abundant, n--numrous, r--rare (combined evaluation of abundance and sociability).

Macromycetes showing the gratest indicating value in the investigated forest associations (locally characteristic) are listed in the Table 4. There have been 212 taxa of 479 chosen for that analysis. The figure in the table marks constancy in phytosociological meaning. The degrees of constancy, for the majority of species, are relatively low in all associations and seems to increase in the moore moist forests and those affected by lumbering.

The distribution of fungi in different forest associations is governed by their substratum preferences, which may be restricted in some associations or very broad in others.

The most outstanding as regards mycoflora among all the forest associations on Babia Gora are patches of Caltho-Alnetum association, not large in area, occurring along streams in local depressions. They are distinguished by the high number of exclusive species (Table 4, 5) having high numbers of constancy. The majority of them are mycorrhiza-formers with Alnus and those growing in the forests of Alno-Padion alliance (Bujakiewicz 1973). Caltho-Alnetum association shows some mycofloristic connections with Sorbo-Aceretum association, that is accounted for in fertility and humidity of soils. in both forests.

Fungi indicating rich, fertile soils and those growing on Acer pseudoplatanus and fern remains are associated with patches of azonal Sorbo-Aceretum association. That forest, developing in the transition zone between the lower and the upper montane forests, is connected with steep slopes strongly eroded by rocks. Although this site does not promote the growth of fungi, the mycoflora of that forest is rather rich. Beech forest fungi are recorded here very often.

Zonal forests have a reat number of species in common for two or more associations, nevertheless there are exclusive species in each type of the forest (Table 4). Forest associations floristically related, e.g. forests of Fagion and forests of Vaccinio-Piceion alliances show also similarities in mycoflora.

Patches of Dentario glandulosae-Fagetum association on Babia Gora are not very rich in terrestrial fungi. A great amount of wood being in all stages of decay is the reason why macrofungi growing on stumps and logs of Fagus and Abies are the best distinguished group in that forest (Table 4). Many species found in that stands are characteristic of forests of Fagetalia order and of Fagion alliance.

Species growing in coniferous forests appear mainly in the patches of Dentario landulosae-Fagetum festucetosum silvaticae subassociation. The occurrence of Abies and Picea, being natural components of mantane beech stands, changes the character of mycoflora of that forest by comparison with Pomeranian beech forests, mainly because of mycorrhizal connections of fungi with conifers and soil acidifying effects caused by spruce.

Galio-Abietetum is the richest in fungi forest association on Babia Gora (Table 4). It has many exclusive species. In some patches terrestrial fungi outnumber vascular plants in species (Fig. 1). Fir forests show connections both with deciduous forests of Fagetalia order (especially in patches of Galio-Abietetum fagetosum subassociation) and with coniferous forests of Vaccinio-Piceetalia order (mainly in Galio-Abietetum homogynetosum subassociation). That coonnfirms its position in phytosociological taxonomy in between the forests of Fagetalia and Vaccinio-Piceetalia orders.

Patches of Abieti-Piceetum montanum association are also very rich in fungi, but do not have many exclusive species. The mycoflora of this forest resembles that of Piceetum excelsae carpaticum to a certain degree, but fi-spruce forest is much richer in fungi and shows strict connections with lower montane stands, especially with Galio-Abietetum association (Table 4).

The mycoflora of the climax spruce forest Piceetum excelsae carpaticum is distinctly impoverished by comparison with that of the lower montane forests (Table 2, 4). Its characteristic (exclusive) species have rather a low degree of constancy. Many of them represent the group of fungi growing usually in long persisting stands of montane virgin forests. Patches of Piceetum excelsae carpaticum myrtilletosum subassociation are richer in fungi when compared with patches of Piceetum excelsae carpaticum athyrietosum alpestris subassociation. The latter are distinguished by the presence of macrofungi growing in more rich sites than those offered by the spruce forests (Table 3).

Azonal associations growing on peat-ground (highmoor) are rather poor in fungi and have many species in common. Bazzanio-Picetum association shows connections both with Sphagnetum magellanici and with Piceetum excelsae carpaticum associations. In patches of Sphagnetum magellanici association besides the presence of typical sphagnicolous mycophytes the occurrence of fungi growing in the montane spruce forests is visible.

Mycosociological research carried out in ptches of the lower phytosociological units of Piceetum excelsae carpaticum (Table 3), Dentario glandulosae-Fagetum, and Galio-Abietetum associations have proved that those divisions are confirmed also by the mycoflora.

Terrestrial fungi, those growing on plant remains and wood decaying fungi give the longest list of indicative species in the forests studied (Table 4).

On Mt. Babia Gora terrestrial fungi of a given patch of forest association generally do not outnumber vascular plants growing in that patch (Fig. 1).

The number of fungal species likewise their abundance decreases with incereasing elevation (Table 6). Some species are associated with particular forest zone, other are cosmopolitan (Table 4).

Comparison between the mycoflora of forests on southern and northern slopes of Babia Gora yields many similarities and differences (Table 5). Northern slopes, covered with primeval forests are poorer in fungi (369) species recorded totally, while 302 on permanent plots) but harbor many species characteristic of montane virgin forests. they are distinguished by the presence of species connected with classically developed patches of the following associations: Caltho-Alnetum, Sorbo-Aceretum and Dentario glandulosae-Fagetum.

Southern slopes, having the lower montane forests modified by lumbering, are richer in fungi (462 species were recorded here totally, in it 356 species on permanent plots). There are additional habitats on southern slopes yielding a number of niches into which fungi can migrate. The most distinct group constitute fungi indicative for widely distributed Galio-Abietetum association. There are among them fungi connected with abundant coniferous litter and those demanding more light. Spring fungi occur here in masses and appear much earlier in the season than those on northern slopes. Fireplace and coprophilous fungi and those attached to trees introduced by man as well as fungi growing on peat ground distinguish the southern slopes very well.

On southern slopes, modifications in structure and in floristic composition of Galio-Abietetum and Abieti-Piceetum montanum associations caused by lumbering (Table 5) result in changes in mycoflora (Bujakiewicz 1981). Some fungi disappear due to variation in lighting, aeration and water supply, others extend their distribution (Lycoperdon foetidum, L. umbrinum) and some new species occur (Corpinus angulatus). Fireplace and coprophilous fungi are very characteristic of such forests. Parasitic fungi (e.g. Heterobasidion annosus, Armillariella mellea) occur here more often, while those, typical of natural forests, are rare. Fungi play here an important part in changes started by man.

Many year observations in the forests of Babia Gora enabled to distinguish fungi characteristic of the main phenological seasons in all types of the forests studied (Table 7). In the course of these studies there was an excellent fungus crop year observed in 1975.

Mycosociological research carried out in the forests of Babia Gora allowed to define more strictly the character of habitats typical of a high mountain massif. Since the vegetation of that massif is rather well preserved, the results obtained feature natural patterns existing between defined forest associations and fungi.