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Forests of the Protected Landscape Area Annówka
in the Lublin province

Lasy Obszaru Chronionego Krajobrazu „Annówka” w województwie lubelskim

INTRODUCTION

The Protected Landscape Area Annówka was established in 1990. It is situated in the Kock and Borki gminas (communes), Lubartów district, Lublin province in the area of 20.7 km². Protection covers a phytosociologically diversified, vast and dense forest complex, within which there are meadows, ponds, streams and farmland. This is a valuable natural object where comparatively well-preserved forest biocenoses are characterized by high dynamics and harmony with the soil and water environment. The Protected Landscape Area (PLA) Annówka was created not only for landscape but also economic reasons because the forests play an essential role in the water cycle and in preserving ecological balance in nature.

The PLA derives its name from a small village of Annówka (with twenty-two farms) situated almost in its central part (Fig. 1). So far, a detailed geobotanical study of this area has not been conducted. As few as three phytosociological records in the forests near the village of Borki were taken by Fijałkowski (5). The same author found the stations of three rare plant species near the settlements of Pasmugi and Talczyn (2). A fairly comprehensive description of the natural environment and socio-economic relations in this area has been presented in a separate study (14).

The purpose of the present study is to give a floristic-geological description of forest communities in the PLA Annówka and to list the stations of more rare plant species occurring in this area. Attention also focused on the condition of the oldest trees of monument-type size. A description of non-forest communities will be presented in a separate study.



Fig. 1. Situation map of PLA Annówka

METHODS OF INVESTIGATION

The phytosociological profile of forest communities in the PLA Annówka was made using the Braun-Blanquet method (16). Field investigations were carried out during two vegetation periods (1996-1997), using a 1:25 000 topographic map and a 1:20 000 forest stand map of the Radzyń Podlaski forest division. Phytosociological records were taken in all the encountered forms of plant cover diversity. This was intended to collect materials representing the whole scale of possible variability of individual units. A total of 120 records were taken, of which 116 were included in the present study. A 10-degree scale was adopted for estimating the ratios for individual species. The records were listed in Tables 1-4. In Table headings the number of a forest section was appended to individual records. With forest belonging to farmers, the following abbreviations were used: Las Szlachecki – Sz, Annówka – Ann, Pasmugi – Pas, Las Włociejński – Wł. The detailed field location of the records was shown in Figure 2.

Species membership in syntaxonomic groups specified in the Tables was determined after Matuškiewicz (9) and partly after Fijałkowski (4). Basing on the analysis of the materials collected, eleven forest associations were distinguished.

The nomenclature of vascular plants was adopted after Mirek et al. (11). The bryophyte nomenclature was given in accordance with the list compiled by Ochyra and Szmajda (13) while that of lichens after Nowak and Tobolewski (12).

The description of habitat conditions of the associations distinguished was given according to the observations recorded during field investigations and on the basis of physical and chemical properties of soil samples collected from 16 genetic levels of four soil profiles. Chemical analyses were performed by the Regional Chemical-Agricultural Centre in Lublin, using the methods commonly applied in soil-science (1). The results obtained were specified in Table 5.

GENERAL DESCRIPTION OF THE FORESTS

Geobotanically, the PLA Annówka is situated in the Mazovian region, the Małe Mazowsze (Small Mazovia) district, the Łuków-Siedlce High Plain sub-district (3). It lies at the intersection of the ATPOL lattice squares FD 76, 77, 86, 87. Forests cover 1698.4 ha, which is 82.07% of the area. Most forests are in

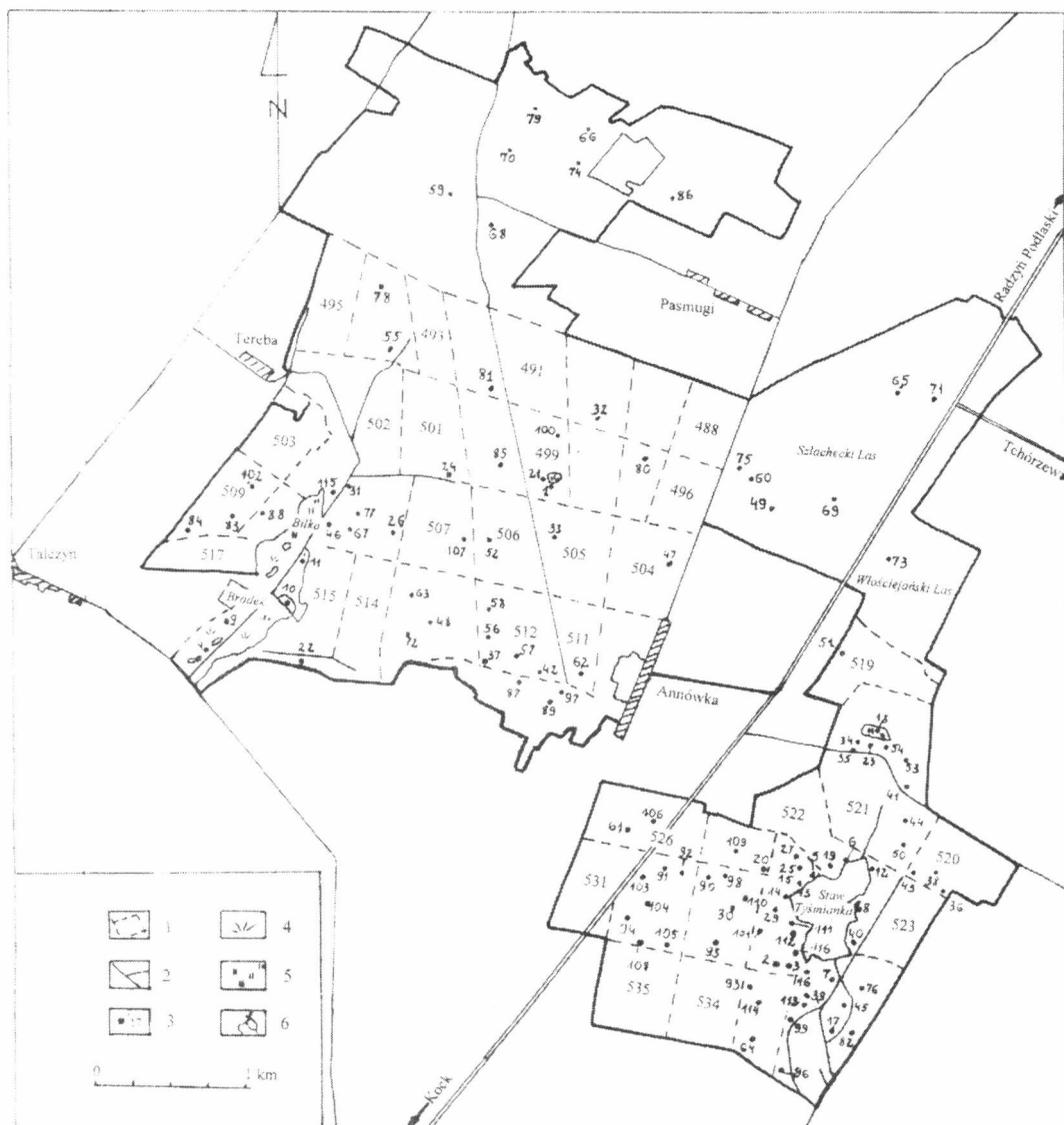


Fig. 2. Stations of phytosociological records in the PLA Annówka forests: 1 – intersectional lines, 2 – forest and field roads, 3 – sites of taking phytosociological records, 4 – marshes, 5 – meadows, 6 – streams and drain ditches

the Kock gmina, partly in the gmina of Borki. These are state-owned forests (1157 ha) administered by the Radzyń Podlaski forest inspectorate comprising two subdivisions of Kock and Borki and the adjoining farmers' forests that belong to the villagers of the neighbouring villages (Talczyn, Annówka, Tchorzew and Pasmugi).

The state-owned forests include the following ranges: in the west part of PLA – the Tereba forest, in the southeast – Tyśmianka and in the north – Pasmugi. The farmers' forests situated in the north-east part of the complex (north-east of Annówka) are called Las (Forest) Szlachecki and Las Włociejjański while in the north (near the settlements of Nowiny and Pasmugi) they have no names of their own; that is why in this study they will be conventionally called Pasmugi forest. It is the forests that account for the natural attraction of the Protected Landscape Area (PLA).

The Tereba forest (Kock forest district (FD) occupies the largest area (over 700 ha). Fresh mixed forest habitats dominate here. A smaller area is occupied by the habitats of the fresh mixed coniferous forest and alder carr, and a negligible area by the fresh forest and fresh coniferous forest. The dominant tree stand is the pine timber forest, locally with a substantial admixture or even vast numerical superiority of *Quercus robur*, or somewhat less of *Betula pendula*. Phytosociologically, these are associations of: the central-Polish, mixed pine-oak coniferous forest *Quercus roboris-Pinetum*, the sub-oceanic fresh coniferous forest *Leucobryo-Pinetum*, the bright oak forest *Potentillo albae-Quercetum* as well as the black currant alder carr *Ribo nigri-Alnetum* and the sub-continental dry-ground forest *Tilio-Carpinetum*.

The somewhat smaller complex Tyśmianka (Borki forest district (FD) covers ca. 400 ha. This is the most interesting part of the PLA Annówka on account of the ponds Tyśmianka. It is marked by the highest diversity of forest habitat types, species composition and the age of tree stands. There is a mosaic of alternating habitats of alder carr (one quarter of the area), fresh forests and fresh mixed forests, and of the fresh mixed coniferous forests and fresh coniferous forests. The tree stands are in the lower age class than in Kock FD. Also this complex is dominated by *Pinus sylvestris*, but with a high percentage of *Alnus glutinosa*, and with smaller percentages of *Picea abies*, *Betula pendula* and *B. pubescens*. Phytosociologically, the following associations were distinguished: grey willow shrubs *Salicetum pentandro-cinereae*, the black currant alder carr *Ribo nigri-Alnetum*, the ash-alder riverside carr *Circaeo-Alnetum*, the low dry-ground forest *Tilio-Carpinetum stachyetosum silvaticae*, the sub-oceanic fresh coniferous forest *Leucobryo-Pinetum* and the inland humid coniferous forest *Molinio-Pinetum*.

The peripheral complex Pasmugi, consisting mainly of the farmers' forests, is the least interesting both in respect of its spatial diversity and the forest stand composition. The habitats of fresh mixed forests and fresh mixed coniferous forests are mainly found here. Pine trees of different age (40-80 years) dominate but the timber forest was almost entirely cleared. Phytosociologically these are: the sub-oceanic fresh coniferous forest *Leucobryo-Pinetum*, less often the pine-oak mixed coniferous forest *Quercus roboris-Pinetum* and deformed expanses of the bright oak forest *Potentillo albae-Quercetum*.

Far more interesting are the farmers' forests, which comprise the ranges of Las (Forest) Szlachecki and Las Włóściejański. They have preserved parts of tree stand similar to the timber forest. *Pinus silvestris* dominates, but old specimens of *Quercus robur* are found fairly often. From the phytosociological standpoint, the ranges are mostly pine-oak mixed coniferous forests *Quercus roboris-Pinetum* and a sub-continental fresh coniferous forest *Peucedano-Pinetum* as well as expanses of the bright oak forest *Potentillo albae-Quercetum*. Pine and pine-birch greenwoods constitute a large percentage of the outer area of these forests.

THE SURVEY OF FOREST COMMUNITIES

On the basis of the analysis of 116 phytosociological records eleven forest plant associations were distinguished. In the list below, the numbers of associations correspond to those used throughout the text and in Tables 1-4.

1. *Salicetum pentandro-cinereae* (Almq. 1929) Pass. 1961
2. *Ribo nigri-Alnetum* Sol.-Górn. 1975
3. *Circaeo-Alnetum* Oberd. 1953
4. *Tilio-Carpinetum* Tracz. 1962
T.-C. stachyetosum silvaticae
T.-C. typicum typical variant
T.-C. typicum impoverished variant
5. *Potentillo albae-Quercetum* Libb. 1933
6. *Quercus roboris-Pinetum* J. Mat. 1981, W. Mat. 1981
7. *Festuco ovinae-Pinetum* Kobendza 1930
8. *Dicano (scopariae)-Pinetum* s.l. (Sokołowski 1963)
9. *Peucedano-Pinetum* Mat. (1962) 1973
10. *Leucobryo-Pinetum* Mat. (1962) 1973
L.-P. dry variant
L.-P. typical variant
L.-P. humid variant
11. *Molinio-Pinetum* prov. (= Community *Pinus - Molinia* J. Mat. 1973)

THE FLORISTIC AND ECOLOGICAL DESCRIPTION OF ASSOCIATIONS

1. *Salicetum pentandro-cinereae* (Table 1, rec. 1-4)

The grey willow dwarf shrubs in a typical form developed in Borki FD in the vicinity of Tyśmianka ponds and in Kock FD, along the stream near Talczyn (mainly in the Brodek range). Small expanses were also recorded in the vicinity of inner-forest marshes and meadows (e.g. in sect. 499 and 508 in Kock FD), in the

zone of the transition of marsh communities into terrestrial ones. They are characterized by intermittent flooding.

The association is composed mainly of *Salix cinerea* with a cover of up to 70%. There is a small admixture of: *Frangula alnus*, *Salix aurita*, *Betula pendula* and *B. pubescens*. In the green layer the most numerous is *Calamagrostis canescens* (cover up to 50%). There are less numerous occurrences of: *Lysimachia vulgaris*, *Juncus effusus* and *Deschampsia caespitosa* in individual expanses. Only in one record taken in the fringe of an outer forest marsh (near the humid coniferous forest) a considerable admixture of wintergreens: *Orthilia secunda* (30%-cover) and *Pyrola media* was reported.

2. *Ribo nigri-Alnetum* (Table 1, rec. 5-16)

The largest and best-preserved expanses of the black currant alder carr are situated in Borki FD along the western bank of Tyśmianka ponds (sect. 524, 528), the smaller ones in the valley of the effluent stream (sect. 532). Phytocenoses of this association also occur in Kock FD, in the stream valley east of Talczyn (sect. 516).

The tree stand in most expanses is comparatively young (50-60 years old) and one-layered. It is composed of *Alnus glutinosa*. Crown density reaches 60% on average. The shrubs layer is mainly formed by *Salix cinerea* and *Frangula alnus*. In some expanses they are followed by *Ribes nigrum* and *Padus avium*.

The differentiation of the association, characteristic of alder carr, into little valleys and tree clumps in the studied area is marked only in some expanses (rec. 5-10). In most expanses clumps are small, limited to a slight mound around tree trunk bases. In the undergrowth some species attain considerable cover (over 30%), which gives grounds to distinguish appropriate facies: with *Solanum dulcamara* (rec. 5-6), *Calla palustris* (record 7), *Cardamine amara* (record 8), *Thelypteris palustris* (rec. 9-10), *Carex acutiformis* (rec. 11-15) and *Scirpus sylvaticus* (record 16).

Records grouped in the first part of Table I represent typical expanses *Ribo nigri-Alnetum* while records with the sedges dominant in the undergrowth were treated after Olaczek (15) as a young form of the association arisen through natural succession out of rush-plant communities or anthropogenically. The floristic composition and the young age of tree stand are regarded by Olaczek as an indicator of association degeneration called juvenalization.

Phytosociologically, the studied expanses of *Ribo nigri-Alnetum* can be assigned to the Central European geographic variety. They represent a fertile sub-association of black currant alder carr *R.n.-A. typicum* (18). They were formed on silty-marshy and half-bog soils. These are habitats with high humidity where water stagnates for the best part of the year.

3. *Circaeo-Alnetum* (Table 1, rec. 17-30)

The ash-alder riverside carr finds best conditions for growth in the surroundings of Tyśmianka ponds in the valleys of small, slow-flowing streams (sect. 518, 524-525, 528, 532, Borki FD and sect. 499-500 and 515, Kock FD). It develops there in the immediate vicinity of the alder carr and the low dry-ground forest.

The tree stand in most expanses is one-layered. It is usually formed by *Alnus glutinosa*. In some better-preserved phytocenoses there is an admixture of *Fraxinus excelsior* but it tends to form the lower tree layer. *Betula pendula* seldom occurs in the admixture, while only in one expanse *Alnus glutinosa* is dominated by *Alnus incana* (70% density in sect. 524). In most expanses *Padus avium* dominates. It is most often accompanied by *Frangula alnus* and *Fraxinus excelsior*. In the abundant undergrowth, attaining 100% cover, some species dominate, which gave grounds to distinguish facies with: *Urtica dioica* (rec. 17-18), *Impatiens noli-tangere* (rec. 19-24), *Thalictrum flavum* (record 25), *Humulus lupulus* (record 26), *Galium aparine* (record 27) and *Rubus idaeus* (rec. 28-30).

The basic characteristic that differentiates the studied expanses of the ash-alder riverside carr from the neighbouring alder carr is the occurrence of a wide species group of fertile leafy forests of the class *Quercio-Fagetea* (25 species against 6 species in the association *Ribo nigri-Alnetum*). They are also distinguished by a negligible percentage of rush-plant species of the class *Phragmitetea* (4 species against 16 in the alder carr association).

Circaeo-Alnetum occupies the alder carr habitats intermittently flooded with surface water. In the summer the level ground water level goes down to the depth of 70 cm below the surface. The soil, with which the expanse in record 25 is linked, is a river alluvial soil formed from loose sand.

Profile 1 (see Table 5)

0-12 cm, dusty, slightly loamy, firm-rooted sand,
13-26 cm, loose, brown sand with rusty crumbs,
27-40 cm, light loamy, grey-brown sand,
41-75 cm, loose grey-yellow sand, highly hydrated,
75 cm ground water level.

The pH of the upper soil layers is close to neutral (pH in 1 n KCl = 6.2). Soil abundance in phosphorus and potassium has average values.

4. *Tilio-Carpinetum* (Table 2, rec. 31-52)

The association of the sub-continental dry-ground forest occupies the largest area in Borki FD, in the northern and eastern side of Tyśmianka ponds (sect. 518, 520-523). Smaller expanses were formed along streams and drain ditches and in the local ground depressions (sect. 532, 513-512, 508 and 504).

Table 2. Floristic composition of association *Tilio-Carpinetum*

Nr zespołu No of association	4																	
Nr zdjęcia No of record	31	32	33	34	35	36	37	38	39	40	41	43	45	47	49	50	51	52
Oddział leśny Forest section	508	480	505	518	518	520	512	520	532	528	518	512	520	504	52	521	519	506
Zwarcie warstwy drzew a w % Density of tree layer a in %	40	50	50	70	70	60	60	70	80	60	90	50	60	10	30	90	50	30
Zwarcie warstwy drzew a ₁ w % Density of tree layer a ₁ in %	20	10	-	40	40	60	60	20	-	-	-	30	40	10	80	-	50	50
Zwarcie warstwy krzewów b w % Density of shrub layer b in %	70	70	70	40	60	50	60	60	20	30	30	20	60	30	40	40	60	30
Pokrycie warstwy runa c w % Cover of herb layer c in %	60	80	30	100	100	60	90	70	80	100	100	70	50	80	10	20	100	40
Pokrycie warstwy mchów d w % Cover of moss layer d in %	-	-	10	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+
4. <i>Tilio - Carpinetum</i> :																		
<i>Carpinus betulus</i> a							6				3	4	3	1	+	1		
<i>Carpinus betulus</i> a ₁															8			5
<i>Carpinus betulus</i> b		+	7				+	2					+	1	7		+	2
<i>Carpinus betulus</i> c							+				+	+					+	
<i>Galium schultesii</i>						!	!					+			!			+
<i>Carpinion betuli</i> :																		
<i>Tilia cordata</i> a						+	2			3	+				+	2		
<i>Tilia cordata</i> b					!	+	1			1	1				+	2		+
<i>Tilia cordata</i> c										+								
<i>Corylus avellana</i> b	7	7		+	5		3	+		1	2	5		5	3	1		2
<i>Corylus avellana</i> c		+				+		+										+
<i>Stellaria holostea</i>						+	+	1		+	6	7	5	3			1	+
<i>Dactylis polygama</i>											4				+			
<i>Acer platanoides</i> c											+							
<i>Cerasus avium</i> c															+			
<i>Fagetalia silvaticae</i> :																		
<i>Acer pseudoplatanus</i> a										3								
<i>Acer pseudoplatanus</i> b										3								2
<i>Acer pseudoplatanus</i> c										6								2
<i>Padus avium</i> b				!			+											+
<i>Padus avium</i> c							+											+
<i>Dryopteris filix - mas</i>	3	2	2			+							+					+
<i>Viola reichenbachiana</i>				+		+				+	+		+					
<i>Milium effusum</i>		!	!					3										
<i>Asarum europaeum</i>				!	!	!	4				!							
<i>Galeobdolon luteum</i>						!	+	!	!	+	+							+
<i>Polygonatum multiflorum</i>							+					!	!					+
<i>Atrichum undulatum</i> d				!							+				1	!		
<i>Impatiens noli - tangere</i>				!	+						+							
<i>Stellaria nemorum</i>						+				!								
<i>Pulmonaria obscura</i>											+							!
<i>Circaea lutetiana</i>						+												
<i>Festuca gigantea</i>						+												
<i>Stachys sylvatica</i>						+												
<i>Astrantia maior</i>																		
<i>Sanicula europaea</i>																		+
<i>Fagus sylvatica</i> c																		
<i>Neottia nidus - avis</i>																		
<i>Quercus - Fagetea</i> :																		
<i>Fraxinus excelsior</i> a											!							
<i>Fraxinus excelsior</i> a ₁						4												
<i>Fraxinus excelsior</i> b				4	5													1
<i>Euonymus verrucosus</i> b						!	!				!							!
<i>Euonymus verrucosus</i> c							!											
<i>Euonymus europaeus</i> b				!	1													
<i>Euonymus europaeus</i> c						+					+							
<i>Anemone nemorosa</i>	+					1	1	+		1			+	1	1			
<i>Aegopodium podagraria</i>				6	8	4	+			2	+							
<i>Melica nutans</i>						+	1			+	!			+	5	4	+	
<i>Melittis melisophyllum</i>							+							+	+			
<i>Poa nemoralis</i>							+											+
<i>Brachypodium sylvaticum</i>														+				
<i>Hepatica nobilis</i>											+							
<i>Vaccinio - Piceetea</i> :																		
<i>Pinus sylvestris</i> a	4	5	5	x	+	2	+			+							3	3
<i>Pinus sylvestris</i> c		+																
<i>Picea abies</i> a											+							

admixture there are also less frequent occurrences of *Acer pseudoplatanus*, *Alnus glutinosa* and *Fraxinus excelsior*. In some expanses *Pinus silvestris* (coming from plantings) dominates. In the shrub layer, *Corylus avellana* has the greatest share, apart from the shrubs of arborescent species. *Frangula alnus*, *Padus avium*, *Euonymus verrucosus* and *E. europaeus* occur less frequently.

Differences in the tree stand structure cause that humidity and light conditions in individual expanses develop unevenly, whereby producing different vegetation conditions for the undergrowth plants.

The analysis of 22 phytosociological records permits to distinguish in the studied area the following types of dry-ground forest phytocenoses: *Tilio-Carpinetum stachyetosum silvaticae* and *T.-C. typicum*. Additional variety within the association, in a way overlapping its natural variability, was introduced by human economy. In the sub-association *T.-C. typicum* a typical and an impoverished variants were distinguished. In both sub-associations degenerative forms with *Pinus sylvestris* can be distinguished.

Tilio-Carpinetum stachyetosum silvaticae

This humid dry-ground forest sub-association overgrows the local, basin-shaped ground hollows in sect. 490, 505, 512/513 of Kock FD. Small expanses have also developed in Borki FD in the vicinity of Tyśmianka ponds, near marshy meadows.

The most natural form is represented in Table 2 by records 35-38. On the basis of domination in the undergrowth of *Aegopodium podagraria* (rec. 35-37), *Asarum europaeum* (record 38) and *Milium effusum* (record 39), facies with these species were distinguished.

Records 31-33 illustrate a degenerative form of this community resulting from the tree stand deformation through introduction of the pine-tree (pinetization). In the undergrowth of these expanses, *Athyrium filix-femina* and *Dryopteris filix-mas* ferns dominate, attaining a total of 50-60% cover. Record 34 relates by its character to a marshy meadow community through a considerable percentage of *Fraxinus excelsior* and *Ribes nigrum* in the undergrowth. This expanse covers brown soils formed from loamy sands.

Profile 2 (Table 5)

0-1 cm leaf litter, fairly well decomposed,

2-4 cm grey humus, gradually passing into:

5-40 cm dusty, light loamy sand, firm-rooted, of grey colour, somewhat humid,

41-70 cm light loamy sand, yellow-beige with rusty stains,

71-85 cm loamy sand, of rusty colour, gradually passing into:

86-115 cm slightly loamy sand, steel-yellow, compressed, sticky, humid.

The upper soil layers have the acid pH (in deeper layers – close to neutral). Soil richness in phosphorus and potassium is low.

Tilio-Carpinetum typicum

Phytocenoses of the typical form of high dry-ground forest were reported in sect. 504, 508, 512-513 of Kock FD and in 518-521 and 528 of Borki FD, in the vicinity of mixed coniferous forests, less often near marshy meadows, in the flat terrain.

In the floristic composition the dominant group is made up of species of the alliance *Carpinion betuli* (8), order *Fagetalia silvaticae* (16) and the *Quercus-Fagetea* class (10). In comparison with the expanses of low dry-ground forest, *Carpinus betulus*, *Betula pendula* and *Tilia cordata* exhibit a far higher share of the tree stand. Moreover, planted *Pinus sylvestris* has a large share of two expanses of the community, and *Acer pseudoplatanus* in one. The latter species self-seeds very well (record 40). In the undergrowth, *Dactylis polygama* (record 41), *Stellaria holostea* (record 42-45), *Astrantia maior* (record 46), *Melica nutans* (record 47-48) and *Carex brizoides* (record 51) have the highest cover. Domination of those species permitted to distinguish in the sub-association *T.-C. typicum* two variants: typical and impoverished, with appropriate facies.

The last four records in Table 2 represent highly deformed expanses of high dry-ground forest. As a result of the thinning of the oak tree stand the role of canopy is played by very dense hornbeam saplings (80% in record 49). The shading that they produce eliminates most shrub and undergrowth species. Also in another expanse (record 50), due to high shading, a clear instance of floristic impoverishment can be observed. The trees of dry-ground forest were replaced by the self-seeding, photophilous common birch (*Betula pendula*, 60% cover). A form of degeneration of the association is monotypization in these expanses (15).

The last two records represent a degenerative form of the association resulting from the artificial introduction of the pine (pinetization). Following the disturbance of the structure of the whole phytocenosis, *Carex brizoides* has spread excessively. The high cover of this species (90% in record 51) is accompanied by very low species diversity. In the highly deformed expanse of dry-ground forest represented by record 52, *Rubus idaeus* and *Impatiens parviflora* attain the highest cover in the undergrowth layer. A form of the association's degeneration is here neophytization (15).

5. Potentillo albae-Quercetum (Table 3, rec. 53-63)

The best-preserved fragments of the bright oak forest were reported in sect. 518 in Borki FD and in the farmers' forest Pasmugi, while more deformed fragments – in sect. 512 and 513 in Kock FD and in the Szlachecki Las forest. This community occurs most often on small mounds, seldom in flat areas. It lies

in the neighbourhood of the dry-ground forest or mixed coniferous forest. This is a mixed forest with a medium tree stand density of 50%. *Quercus robur* dominates, with planted *Pinus sylvestris* sometimes gaining domination. In admixture in individual expanses there are scarce occurrences of *Betula pendula*, *Tilia cordata*, *Acer pseudoplatanus* and *Fraxinus excelsior*. The latter species was planted in sect. 518, Borki FD where it occurs both in the underbush and in the lower tree layer, whereby the expanses represented by rec. 53 and 54 are related with dry-ground forests.

The shrub layer is abundant and rich in species, where *Corylus avellana* dominates. It is accompanied by *Frangula alnus*, *Juniperus communis*, *Euonymus verrucosus*, *Sorbus aucuparia* and tree saplings. The herbaceous layer attains the 60-100% cover. It is dominated by the class *Querco-Fagetea* species. There are also fairly numerous representatives of meadow plants of class *Molinio-Arrhenatheretea*. The percentage of characteristic plants of the association and order *Quercetalia pubescentis* is nominal. The most representative species – *Potentilla alba* attains the 20% cover only in one record. The impoverishment of the floristic composition in these species can be accounted for in individual expanses by the impoverishment of habitat, following the planting of pine (record 55), or deterioration of light conditions as a result of the overthickening of the shrub layer, mainly the hazel (6).

The greatest cover (50-90%) in several expanses is attained by *Convallaria majalis*. The expanses represented by record 53-59 correspond approximately to the association *Potentilla albae-Quercetum typicum* in the Mazovian – Little Poland variety (8). In the remaining expanses (record 60-63) grasses dominate: *Agrostis capillaris* and *Festuca rubra* attaining the 30-40% cover. These expanses were recognized as a degenerate form of the bright oak forest (caespitization). The bryophyte layer in all the studied expanses is weakly developed (it does not exceed the 10% cover) or it is entirely absent.

6. *Quercus roboris-Pinetum* (Table 3, record 64-86)

It is very difficult to separate the mixed coniferous forest in the area investigated from other forest communities with the participation of pine and oak. Some records included in Table 3 may represent a degenerate bright oak forest or a highly transformed dry-ground forest. The distinction of the association was based on the characteristic species combination, in which species of the order *Vaccinio-Piceetalia* dominate with a constant participation of some plants of the *Querco-Fagetea* class.

In the tree stands of most expanses investigated *Quercus robur* dominates. It is usually accompanied by *Pinus sylvestris*, less often *Populus tremula*, *Betula pendula* and *Carpinus betulus*. Unlike the other species, *Pinus sylvestris* occurs in

the highest layer only and does not exhibit a tendency to regenerate. The shrub layer, where *Corylus avellana* dominates, exhibits a high density (53% on average). *Frangula alnus* and the brushwood *Carpinus betulus* constitute a substantial admixture. The main component of the undergrowth layer (with 30-90% cover) is *Vaccinium myrtillus*. In places *Convallaria majalis* (record 64-67), *Pteridium aquilinum* (record 79), *Maianthemum bifolium* (record 81-82) also grow in large numbers, and in thinned places – *Rubus hirtus* (record 83-85) and *Rubus idaeus* (record 86). Other numerous species like *Trientalis europaea*, *Calamagrostis arundinacea*, *Luzula pilosa* occur often but in small numbers. The bryophyte layer is weakly developed. *Pleurozium schreberi* and *Polytrichum attenuatum* were reported in it.

The mixed coniferous forests under description represent the association *Quercus roboris-Pinetum typicum* in the Mazovian variety (7). They cover the flat area and slight mounds. The largest expanses were reported in the farmers' forests: Włościejański, Szlachecki and Pasmugi. They grow on grey brown podzolic soils formed from loamy soils.

Profile 3 (Table 5)

0-2 cm leafy litter, weakly decomposed,

3-6 cm slightly loamy dusty grey sand, dry, rooted, it passes through stains into:

7-23 cm light, dusty loamy sand, yellow-beige, firm-rooted,

24-90 cm strong, dusty loamy sand, beige-grey, dry, firm-rooted,

91-110 cm strong, dusty loamy sand, beige-orange, moist, highly beaten,

111-125 cm yellow clayey dust, highly beaten with pebbles.

The pH in surface layers is acid (pH in 1 n KCl = 4.6). Richness in phosphorus is low, in potassium – medium.

7. *Festuco ovinae-Pinetum* (Table 4, record 87)

The coniferous forest with *Festuca ovina* represents only one phytosociological record taken on a small mound in the farmers' forest, near the south part of sect. 512, Kock FD. The studied expanse covers several dozen square km in the vicinity of *Quercus roboris-Pinetum*.

Pinus sylvestris dominates in the tree stand. There are also single occurrences of *Quercus robur* and *Betula pendula*. In the shrub layer the highest percentage is of *Juniperus communis*. It is accompanied by small numbers of *Frangula alnus* and oak saplings. *Festuca ovina* dominates in the undergrowth (50% cover). A frequent admixture is also made up of: *Agrostis capillaris*, *Melampyrum pratense*, *Sedum maximum* and *Peucedanum oreoselinum*. The bryophyte layer is formed mainly by *Pleurozium schreberi* (70% cover).

The association covers podzolic soils formed from slightly loamy sands. In respect of its floristic composition and habitat requirements it does not differ from the expanses described from the lowland areas of the Lublin region (4, 5).

8. *Dicrano (scopariae)-Pinetum* (Table 4, record 88)

The association of the dry pine coniferous forest with a high percentage of *Dicranum scoparium* (90% cover) is represented only by one phytosociological record taken in sect. 509, Kock FD. This is a light pine forest (ca 60 years old) with a poor oak-pine underbush, covering a small ground elevation. The undergrowth is scanty, made up chiefly of *Rumex acetosella*, attaining a 50% cover in places. It is mostly accompanied by grasses: *Festuca ovina*, *F. psammophila* and *Agrostis capillaris*.

The old name of the association was preserved to define the coniferous forests situated on the floristic-ecological and trophic borderland between *Cladonio-Pinetum* and *Leucobryo-Pinetum* (4). Sokołowski (17) described similar expanses as *Dicrano-Pinetum cladonietosum*, a facies with *Dicranum scoparium*. In his opinion they have resulted from the destruction of communities of the typical sub-association.

9. *Peucedano-Pinetum* (Table 4, record 89)

The association of the sub-continental, fresh coniferous forest is represented also by one record taken in the south part of sect. 512, Kock FD, on the ridge of a local height. This community, in respect of its floristic composition and habitat requirements, is related to the degenerate expanses of *Potentillo albae-Quercetum*. It differs, however, by a significant percentage of coniferous forest species: *Pinus sylvestris* in the tree stand, and *Frangula alnus* and *Juniperus communis* in the shrub layer. In the undergrowth, *Festuca rubra* and *Peucedanum oreoselinum* dominate (cover of 30 and 20% respectively.). They are accompanied by mesotrophic species: *Solidago virgaurea*, *Polygonatum odoratum*, *Melica nutans*, and on the surface complementing the records, also by *Convallaria majalis*, whereby the studied expanse is also related to *Quercus roboris-Pinetum*. On the basis of the comprehensive study of pine coniferous forests in Poland (10), this expanse can be recognized as *Peucedano-Pinetum typicum*, a typical form. The association grows on comparatively dry podzolic soils formed from slightly loamy sands.

10. *Leucobryo-Pinetum* (Table 4, record 90-110)

The largest expanses of the sub-oceanic fresh coniferous forest have developed in the west part of the Borki forest district, smaller ones – in the southwest part of the Kock forest district and in the Pasmugi forest range. The association is formed by uneven-aged pine-trees with an admixture of common

Table 4. Floristic composition of associations: *Festuco ovinae-Pinetum*, *Dicrano-Pinetum*, *Peucedano-Pinetum*, *Leucobryo-Pinetum* and *Molinio-Pinetum*

Nr zespołu	7	8	9	10	11
No. of association	40	512	87	7	
Nr zdjęcia	30	509	88	8	
No. of record	40	512	89	9	
Oddział leśny					
Forest section					
Zwarcie warstwy drzew a w %	40	512	87	7	
Density of tree layer a in %	40	512	89	9	
Zwarcie warstwy drzew a ₁ w %					
Density of tree layer a ₁ in %					
Zwarcie warstwy krzewów b w %	50	80	10		
Density of shrub layer b in %	50	80	10		
Pokrycie warstwy runa c w %	90	100	30		
Cover of herb layer c in %	90	100	30		
Pokrycie warstwy mchów d w %	70	70	50		
Cover of moss layer d in %	70	70	50		
7. <i>Festuco ovinae</i> - <i>Pinetum</i> :					
<i>Festuca ovina</i>	5	+			
8. <i>Dicrano (scopariae)</i> - <i>Pinetum</i> :					
<i>Dicranum scoparium</i>	9	+			
9. <i>Peucedano</i> - <i>Pinetum</i> :					
<i>Solidago virgaurea</i> (D)	x	1			
<i>Polygonatum odoratum</i> (D)	x	+			
<i>Convallaria majalis</i> (D)		x			
<i>Scorzonera humilis</i> (D)			1		
10. <i>Leucobryo</i> - <i>Pinetum</i> :					
<i>Deschampsia flexuosa</i> (D)		+	9	9	8
11. <i>Molinio</i> - <i>Pinetum</i> :					
<i>Molinia caerulea</i>				1	
<i>Polytrichum commune</i> d					2
Dicrano - <i>Pinetum</i> :					
<i>Pinus sylvestris</i> a	4	3	1	3	4
<i>Pinus sylvestris</i> b	1				
<i>Pinus sylvestris</i> c					
<i>Dicranum polysetum</i> d	+	1			
<i>Vaccinio - Piceetalia</i> and <i>Vaccinio - Piceetea</i> :					
<i>Picea abies</i> a		r		+	3
<i>Picea abies</i> a ₁					3
<i>Picea abies</i> b			1	+	+
<i>Picea abies</i> c				r	
<i>Vaccinium myrtillus</i>	+	+	1	1	+
<i>Trientalis europaea</i>			+	1	+
<i>Orthilia secunda</i>		x			x
<i>Vaccinium vitis-idaea</i>			+		
<i>Dryopteris dilatata</i>					+
<i>Lycopodium annotinum</i>					+
<i>Quercus - Fagetea</i> :					
<i>Tilia cordata</i> a					
<i>Tilia cordata</i> b					
<i>Carpinus betulus</i> b		+			
<i>Corylus avellana</i> b			1	1	+
<i>Padus avium</i> b					+
<i>Padus avium</i> c					+
<i>Viola reichenbachiana</i>	+	+			
<i>Rubus saxatilis</i>				r	
<i>Dryopteris filix-mas</i>					x
Towarzyszące - Accompanying sp.:					
<i>Quercus robur</i> a	+	3	3		2
<i>Quercus robur</i> b	+	2	1	+	+
<i>Quercus robur</i> c				r	+
<i>Betula pendula</i> a				+	
<i>Betula pendula</i> b					1
<i>Betula pendula</i> c				r	
<i>Betula pubescens</i> a ₁					
<i>Betula pubescens</i> b					
<i>Quercus petraea</i> b	+				
<i>Quercus petraea</i> c					
<i>Quercus rubra</i> b					
<i>Quercus rubra</i> c					
<i>Populus tremula</i> b					

form, the following variants can be distinguished: a dry variant with *Festuca psammophila* (record 90) related to *Festuco ovinae-Pinetum* and a moist variant with *Molinia coerulea*, *Lysimachia vulgaris* and *Carex nigra* (record 99-101).

The analysis of individual records indicates far-reaching anthropogenic transformations of this association, manifested in the disorders of the undergrowth structure, which can be seen in the facies participation of such species as *Calamagrostis epigeios*, *Rubus hirtus* and *R. plicatus*.

The fresh coniferous forest has developed on podzolic and grey-brown podzolic soils formed from slightly loamy sands.

Profile 4 (Table 5)

0-3 cm slightly loamy sand of grey colour,

4-24 cm grey, dusty, slightly loamy sand,

25-50 cm sandy loam, dry, yellow-beige,

51-132 cm moist, beaten loam, of rusty colour, with fairly large pebbles at 60 cm deep,

133-175 dusty, slightly loamy sand, bright yellow.

The pH of the upper soil layers is acid (pH in 1 n KCl = 4.1). Medium soil abundance in phosphorus, high in potassium.

11. *Molinio-Pinetum* (Table 4, record 111-116)

The expanses of the inland humid coniferous forest cover an altogether small area. They have developed mainly in the southwest part of Borki FD in the vicinity of a small pond Tyśmianka (sect. 528, 532-533). Far smaller expanses are found in Kock FD near meadows Bilka (sect. 508). They occupy ground depressions on sandy yet well moistened soils, intermittently even with stagnant water on the surface.

The tree stand is composed of *Pinus sylvestris* with a substantial admixture of *Betula pendula*, which attain 50% density. The shrub layer is definitely dominated by *Frangula alnus*. Only in one expanse (record 111) *Picea abies* dominates, attaining 60% density. In the undergrowth *Vaccinium myrtillus* and *Molinia coerulea* dominate, and in one of the expanses – *Lycopodium annotinum* (60% cover). Facies with these species can thus be distinguished. *Molinia coerulea* finds its growth optimum in the most humid parts of the community, where it attains 80% cover (record 114-116), while *Vaccinium myrtillus* reaches its optimum in drier places. The studied expanses represent the central-eastern-Poland variety (10).

FLORISTIC AND DENDROLOGICAL PECULIARITIES

Some more rare plants occurring in the vicinity of the studied PLA (Protected Landscape Area) Annówka have been reported earlier (2) but without closer location of their stations. These are *Hierochloë australis* and *Vicia cassubica*

Table 5. Some physical and chemical properties of soils in the PLA Annówka forests

Nr profilu No. of profile	Nr oddziału lesnego No. of forest section	Głębokość poziomu w cm Depth of horizon in cm	Typ gleby	Cześć szkieletowa w % > 1 mm Stones and gravel in %	Cześć ziemi w mm - Earth parts in mm										pH		Zawartość w mg/100 g. gleby			
					1-0,5	0,5-0,25	0,25-0,10	0,10-0,05	0,05-0,02	0,02-0,006	0,006-0,002	> 0,002	1,0-0,1	0,1-0,02	> 0,02	H ₂ O	1 n KCl	% próchnicy of humus	CaCO ₃	P ₂ O ₅
1	524	5-12	psp	0,0	1	6	48	15	20	9	0	1	55	35	10	6,3	6,2	0,41	7,8	12,0
		20-25	pl	0,0	2	6	75	8	4	5	0	0	83	12		6,6	6,3	0,08	4,8	4,0
		27-40	pgl	0,0	7	31	41	2	4	8	2	5	79	6	15	7,3	6,6	0,04	3,0	1,0
2	518	60-70	pl	0,0	9	39	47	0	0	5	0	95	0	5	8,0	6,8	0,04	3,2	1,3	
		2-40	pgp	0,0	5	17	30	10	23	13	2	0	52	33	15	4,6	3,9	0,04	4,0	5,0
		40-70	pgl	0,0	8	22	31	9	16	7	6	1	61	25	14	6,1	6,0	0,04	2,4	2,0
		115	ps	0,0	7	29	41	8	5	4	0	6	77	13	10	7,5	6,4	0,0	3,0	3,3
		3-6	psp	0,0	5	22	28	19	16	7	2	1	55	35	10	5,1	4,6	0,08	4,6	10,0
3	512	7-23	pglp	0,0	4	25	27	13	16	11	0	4	56	29	15	4,4	3,8	1,05	3,8	4,7
		40-56	pgimp	0,0	3	17	28	14	22	12	3	1	48	36	16	4,5	4,1	1,18	4,2	3,3
		115	pl	0,0	2	5	14	6	36	21	0	16	21	42	37	5,1	3,9	0,25	5,2	10,0
4	522	0-3	ps	0,0	7	19	43	13	10	5	0	3	69	23	8	4,5	4,1	9,93	7,0	25,3
		10-20	psp	0,0	7	19	38	13	14	9	0	0	64	27	9	4,5	4	1,47	3,8	9,0
		25-50	gp	0,0	7	16	32	10	15	16	3	1	55	25	20	4,5	4,4	0,35	3,4	4,3
		100-130	gip	0,0	6	7	24	12	8	14	7	22	37	20	43	8,5	7,0	0,17	19	17,1
		175	psp	0,0	1	2	62	27	1	7	0	65	28	7	7,6	6,8	0,04	3,4	3,0	

reported from the mixed and pine coniferous forests in Talczyn and *Chimaphila umbellata* reported from the pine coniferous forest in the village of Pasmugi.

During the author's own investigations, stations of *Hierochloë australis* and *Vicia cassubica* were not found in the PLA Annówka forests. It was found, however, that the rich flora of this area includes many interesting species. Worth noting is the presence of protected and rare plants and nature-monument tree specimens.

Out of the oldest trees only one specimen of *Quercus robur*, with a breast-high girth of 434 cm and 25 m high, is a registered nature monument. It grows in sect. 510, Kock FD, near the forester's lodge in Annówka. It is protected against lightning strike and fenced off.

Moreover, other abundant trees also merit the rank of nature monuments. Some of those named below were included in the notification to the Provincial Nature Conservation Officer during the nature survey in the Kock gmina, for example:

Quercus robur with a girth of 314 cm, 25 m high, boughs at the height of 15 m, healthy – it grows near the above-named nature monument, fenced off.

In the Kock forest district there are also: one specimen of *Quercus robur* with a girth of over 300 cm, 20 m high, in the south fridge of the forest in sect. 512/513 in the *Tilio-Carpinetum* association.

Three specimens of *Fagus sylvatica* with girths of 235, 238 and 240 cm in sect. 504 (near an inner forest road, north of the seat of the Annówka forest district), in the *Tilio-Carpinetum* association.

The alley of approx. 30 specimens of *Tilia cordata*, each with a girth of over 300 cm, along sect. 526 on the northern side. It reaches the road passing through Annówka, along which over 20 similar specimens of *Tilia cordata* grow. Many of those trees have cancerously deformed trunks and characteristic outgrowths of lateral shoots forming a wreath at the trunk base.

In Borki FD four specimens of *Quercus robur* merit protection: one with a girth of 375 cm in sect. 533, association *Quercus roboris-Pinetum*; two specimens in the forest fringe, with girths of 440 and 446 cm, near the road to the village of Lipniak (near a wayside shrine) and one specimen with a girth of 330 cm, far into the forest (on the eastern side). All the oaks are healthy.

Among the shrubs and herbaceous plants a dozen odd specimens rank in the regional and national scale as rare elements of the flora. The plants under total legal protection merit special attention. They are:

Chimaphila umbellata – several specimens at the roadside in the Las Włociscjański forest, in the association *Quercus roboris-Pinetum*.

Epipactis helleborine – a dozen odd specimens in sect. 500 and 501, Kock FD (on the north side of a meadow) in the association *Tilio-Carpinetum*; one specimen in sect. 503 (near the village of Tereba), over a ditch.

Lilium martagon – numerous occurrences in sect. 518, Borki FD, in the association *Tilio-Carpinetum*, several specimens in the Pasmugi forest, in an

expanse of *Potentillo albae-Quercetum*, single occurrences in sect. 492 and 502 (near the intersection of lines of sect. 501/494/493, in the association *Quercus roboris-Pinetum*).

Lycopodium annotinum – several stations rich in specimens in sect. 528, Borki FD, in the association *Molinio-Pinetum*.

Neottia nidus-avis – two specimens near the road in sect. 513, Kock FD, in the association *Quercus roboris-Pinetum*.

Plants under partial protection include:

Asarum europaeum – fairly numerous specimens in the north part of Borki FD (sect. 518-522) and in the south part of sect. 512/513, Kock FD; less numerous in sect. 515 and 516 near a ditch, in the association *Tilio-Carpinetum*.

Convallaria majalis – in canopies in sect. 508, 512-513 and 494, Kock FD and 518 and 533, Borki FD; numerous specimens in sect. 492 and in the farmers' forests, especially in the Szlachecki Las forest and near the village of Pasmugi, mainly in expanses of *Quercus roboris-Pinetum* and *Potentillo albae-Quercetum*.

Frangula alnus – a common species in the studied forests. The most numerous species occur in sect. 516, 508 and 499, Kock FD, and in sect. 528, Borki FD.

Primula veris – a dozen odd specimens in sect. 500 and 501, Kock FD (on the north side of an inner forest meadow), in the association *Tilio-Carpinetum*.

Ribes nigrum – numerous specimens occur in sect. 516 (Brodek forest range), east of Talczyn and in the vicinity of Tyśmianka ponds, mainly in sect. 522, Borki FD.

Viburnum opulus – single specimens in sect. 508 and 516, Kock FD and 518, 521 and 524, Borki FD, in the association *Tilio-Carpinetum* and *Ribes nigrum-Alnetum*.

Apart from the protected species, other rare elements of the flora and those interesting for their distribution also merit attention. These include:

Acer pseudoplatanus – the most abundant station in sect. 528, Borki FD, less abundant in sect. 506, Kock FD, in the expanses of *Tilio-Carpinetum* association. It has excellent self-seeding.

Ajuga genevensis – most numerous specimens grow in Kock FD, in the inner forest meadows Bilka, north-east of Talczyn; single specimens also at the roadside in sect. 512-513.

Alnus incana – three specimens (each with a diameter of ca. 40 cm) in sect. 524, Borki FD; nice saplings, single seedlings, in *Circaeo-Alnetum* association.

Anthericum ramosum – several specimens in sect. 518, Borki FD, at the road to the village of Lipniak.

Astrantia maior – one expanse of several m² in sect. 508, Kock FD, in *Tilio-Carpinetum* association (near a cutting with planted *Alnus glutinosa*).

Bidens frondosa – several specimens on the roadside in sect. 525, Borki FD, in the *Circaeo-Alnetum* association.

Calla palustris – several small expanses in Borki FD, in sect. 521 and 524 (in the vicinity of Tyśmianka pond) and in section 532 in a ditch, in the association *Ribo nigri-Alnetum*.

Campanula persicifolia – several specimens in sect. 518, Borki FD and in the forest west of Pasmugi village, in the expanses of the bright oak forest.

Carex paniculata – numerous specimens in the Brodek forest range, east of Talczyn village, in the association *Ribo nigri-Alnetum*.

Dactylis polygama – fairly numerous in sect. 518, Borki FD and 508, Kock FD, in the association *Tilio-Carpinetum*.

Dryopteris dilatata – single tufts in sect. 497, 508, Kock FD, 525-526 and 530, Borki FD and one specimen in Pasmugi forest, in the association *Leucobryo-Pinetum*.

Fagus sylvatica – three beautiful specimens in sect. 504 (described above as prospective nature monuments), moreover, a planted specimen in sect. 526, Kock FD, on a height in the oak forest.

Festuca psammophila – the highest concentration in sect. 525, Borki FD, single specimens in sect. 509, Borki FD, in the light, pine coniferous forest.

Galium boreale – a dozen odd specimens on the roadside in the farmers' forest, west of Pasmugi village, in the expanse of *Potentillo albae-Quercetum*.

Gymnocarpium dryopteris – several specimens in sect. 490, Kock FD, in the expanse of *Tilio-Carpinetum*.

Hepatica nobilis – sparse specimens in sect. 518, Borki FD, in the association *Tilio-Carpinetum*.

Melandrium rubrum – several specimens on the forest fringe (sect. 526, Kock FD, on the north side), in the association *Quercu roboris-Pinetum*.

Melittis melisophyllum – a dozen odd specimens in sect. 513, Kock FD, less numerous stations in sect. 508 and 520 in the farmers' forests: Szlachecki and Pasmugi forests, in the expanses of *Tilio-Carpinetum* and *Potentillo albae-Quercetum*.

Potentilla alba – most numerous in sect. 518, Borki FD and 512, Kock FD. Single specimens in the farmers' forests, west of Pasmugi village.

Sambucus racemosa – fairly numerous specimens in sect. 507, rarely in sect. 508 and 503, Kock FD, in the *Leucobryo-Pinetum*.

Scorzonera humilis – single specimens in sect. 512, 513, Kock FD, 520, 523, Borki FD and in the farmers' forests, in the association *Quercu roboris-Pinetum*.

Thalictrum aquilegiifolium – several specimens in section 518, Borki FD, in the expanse *Potentillo albae-Quercetum*.

Thalictrum flavum – sparse specimens in sect. 525, Kock FD, in the association *Circaeo-Alnetum*.

Vincetoxicum hirundinaria – fairly numerous specimens near the road to Lipniak village (sect. 518, Borki FD), in the expanse of *Potentillo albae-Quercetum*.

Viscaria vulgaris – several specimens in Las Szlachecki forest, on the roadside, in the association *Potentillo albae-Quercetum*.

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STRESZCZENIE

Przedstawiony na ryc. 1 i 2 Obszar Chronionego Krajobrazu „Annówka” w SE Polsce obejmuje zróżnicowany fitosocjologicznie, rozległy kompleks leśny, w obrębie którego znajdują się łąki, stawy, cieki oraz pola uprawne.

W pracy przedstawiono wyniki badań florystycznych i geobotanicznych przeprowadzonych w lasach o powierzchni 1698,4 ha. Na podstawie 116 zdjęć fitosocjologicznych (tab. 1-4) wyróżniono 11 zespołów roślinnych. W obrębie zespołów wydzielono 2 podzespoły, 5 wariantów i 43 facje.

Najwyższym stopniem naturalności wśród ekosystemów leśnych wyróżniają się zbiorowiska lasów liściastych, uzależnione w znacznym stopniu od specyficznych warunków siedliskowych.

Największą wartością są zbiorowiska olsowe (*Ribo nigri-Alnetum*) i łągowe (*Circaeo-Alnetum*) wykształczone w sąsiedztwie stawów Tyśmianka. Zbiorowiska łąkowe reprezentują różne formy degeneracyjne zespołu *Tilio-Carpinetum* powstałe w wyniku antropresji (pinetyzacja, monotypizacja, neofityzacja).

Spośród 6 wyróżnionych zespołów borowych, powierzchniowo największy udział ma suboceaniczny bór świeży *Leucobryo-Pinetum*. Znaczną powierzchnię zajmują zbiorowiska zbliżone do środkowopolskiego sosnowo-dębowego boru mieszanego *Quercus roboris-Pinetum*.

Badania fitosocjologiczne ważniejszych zespołów roślinnych uzupełniono analizami właściwości fizycznych i chemicznych gleb, pochodzących z 4 odkrywek (tab. 5).

W wyniku przeprowadzonych badań florystycznych scharakteryzowano stanowiska 11 gatunków objętych całkowitą i częściową ochroną prawną oraz 24 innych gatunków rzadkich na Lubelszczyźnie lub interesujących ze względu na ich rozmieszczenie. Do najciekawszych należą: *Chimaphila umbellata*, *Epipactis helleborine*, *Lilium martagon*, *Lycopodium annotinum*, *Neottia nidus-avis*, *Asarum europaeum*, *Primula veris*, *Alnus incana*, *Anthericum ramosum*, *Calla palustris*, *Dryopteris dilatata*, *Gymnocarpium dryopteris*, *Thalictrum flavum* i *Melandrium rubrum*. Wskazano również stanowiska ok. 40 najstarszych drzew, które kwalifikują się do objęcia ochroną jako pomniki przyrody.