

## VASCULAR FLORA OF DRAINAGE DITCHES IN FOREST AREAS OF THE POLESIE NATIONAL PARK

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### Abstract

This paper presents the results of floristic studies conducted in the years 2003 – 2005 within the area of the Polesie National Park. The aim of the research was to compare the flora of initial succession stages in drainage ditches with the flora of neighbouring forest areas undergoing transformation as a result of drainage. Floristic lists were made in four designated study areas as well as in forest phytocoenoses. The results of field investigations were subjected to analysis with regard to the systematic affinity of the flora and proportions of plant life-forms as well as of historical-geographical groups and range groups.

In the species composition of the studied drainage ditches hemicryptophytes were the dominant group of plant higher life-forms, whereas in the neighbouring communities the flora was represented by both hemicryptophytes and megaphanerophytes.

In historical and geographical terms, the flora of drainage ditches and neighbouring communities represents definitely the group of spontaneophytes. Anthropogenic habitats, which developed within the drainage ditches, were colonised by native flora species characteristic for the Polesie National Park area.

**Key words:** species diversity, vascular flora, drainage ditches, Polesie National Park

### INTRODUCTION

From the environmental point of view, the construction of the Wieprz-Krzna Canal had a very negative effect on the natural environment of the whole area situated within its impact zone. Water relations of this part of the area in question were drastically changed, the water discharge process intensified, which resulted in an absence of water stagnation (Chmielewski and Radwan, 1993), and the allochthonous waters, with different trophic and chemical composition, carried in the canal, contributed to changes in habi-

tat conditions (Wilgat, 1991; Michalczyk and Turczyński 1998; Turczyński et al. 2000). Before the construction of the canal, temporary or permanent swamps accounted for 70% of the area which is currently occupied by the Polesie National Park, including its buffer zone. After carrying out land drainage works, a bare 15% of this valuable area resisted the anthropopressure process. The largest losses in flora abundance were noted in the Łęczna – Włodawa Lakeland, where the loss in natural resources of unique vegetation is estimated, depending on the type of plant community, at 60-95% (Chmielewski and Siewiewicz, 1994).

As early as 1959, Professor Dominik Fijałkowski drew attention to the fact that the Łęczna-Włodawa Lakeland area was still not sufficiently known in floristic and phytosociological terms. In connection with the construction of the canal, carried out at that time, and expected transformations which would take place after its completion, he postulated that it was necessary to undertake biological research in the near future (Fijałkowski, 1959). Since 1975 the topic of adverse changes taking place in the plant cover of the area impacted by the canal has been raised more and more frequently in scientific publications (Chmielewski, 1986). Since that time numerous studies have been undertaken and carried out, designed to get to know better the natural values of this area. Nevertheless, there are still numerous ecosystems and habitats which have not been fully investigated, and the knowledge of their plant cover is only superficial or approximate. Such special habitats include, among others, drainage ditches which are the object of investigation under the present study.

## RESEARCH METHODS

The studies on the flora of drainage ditches were carried out in the years 2003-2006, during which a detailed inventory covered four 100-metre-long sections of the drainage ditches intersecting both forest phytocoenoses and neighbouring communities. The study areas were designated with letters from A to D (Fig. 1). In each study area, representative plant patches were distinguished, within which lists of species were made. Inventories of herbaceous vegetation were conducted on an area of 25 m<sup>2</sup>, whereas of the flora of forest communities on an area of 400 m<sup>2</sup>. The ground cover of the respective plant patch by particular plant species was given in a 10-point scale. The degrees were calculated based on percentage density, where: 1° corresponded to the percent cover of a particular species at a respective study area from 1 to 10%, 2° – 11-20%, 3° – 21-30%, 4° – 31-40%, 5° – 41-50%, 6° – 51-60%, 7° – 61-70%, 8° – 71-80%, 9° – 81-90% and 10° which means that the density of a particular species is from 91 to 100%. Species whose ground cover did not exceed 1 % were designated in the lists by means of pluses (from + to +++), and species represented by a single specimen were designated by the letter “r”.

Species requiring laboratory identification were collected and deposited in a herbarium. The prepared lists included the flora of both the ditch channel and its slopes. A total of 60 floristic lists were made in the drainage ditches and 8 in the neighbouring phytocoenoses. The data collected in field were used for determining the biodiversity of vascular flora of the studied ecosystems. In order to identify taxa, their affinity to historical-geographical groups and range groups was determined in accordance with Chmiel (1993b) as well as the following indicator values were calculated according to Zarzycki et al. (2002):

- continentality index;
- life forms;
- number of stands;
- dynamic tendencies over the last decades.

The affinity of taxa to historical-geographical groups and range groups (Chmiel, 1993 b) as well as the abovementioned indicator values (Zarzycki et al. 2002) were used for further analysis of the flora. Percentage proportions of particular groups and indicator levels were calculated, whereas species being overlapping elements, representing several groups or levels of an indicator in question, were included both in representative groups and levels.



Fig. 1. Location of the study sites in the Polesie National Park area (Kłamućki et al. 2001; changed).

Table 1  
Alphabetic list and ecological characterization of vascular plant species in the studied  
drainage ditches and neighbouring phytocoenoses.

Latin name	Family	Drainage ditch	Neighbouring phytocoenoses	Life form	Continental index	Historical-geographical group	Range group
<i>Achillea millefolium</i> L.	Asteraceae	+	+	H	Ap	ES	3
<i>Aegopodium podagraria</i> L.	Apiaceae	+		G, H	Sp	ES	3
<i>Agrostis capillaris</i> L.	Poaceae	+	+	H	Ap	ES	3
<i>Agrostis gigantea</i> Roth	Poaceae	+	+	H	Ap	ES	3
<i>Agrostis stolonifera</i> L.	Poaceae	+		H	Ap	ES	3
<i>Alisma plantago-aquatica</i> L.	Alismataceae	+		Hy	Ap	KOSM	3
<i>Alnus glutinosa</i> (L.) Gaertn.	Betulaceae	+	+	M	Sp	ES	3
<i>Anemone nemorosa</i> L.	Ranunculaceae	+		G, H	Sp	E	3
<i>Aquilegia vulgaris</i> L.	Ranunculaceae		+	H	Sp	E	3
<i>Betula pendula</i> Roth	Betulaceae	+	+	M	Ap	ES	3/4
<i>Betula pubescens</i> Ehrh.	Betulaceae	+	+	M	Sp	ES	3
<i>Bidens tripartita</i> L.	Asteraceae	+		T	Ap	M-ES	3
<i>Calamagrostis canescens</i> (Weber) Roth	Poaceae	+		H	Sp	ES	3
<i>Calla palustris</i> L.	Araceae	+	+	Hy, G	Sp	CB	3
<i>Calluna vulgaris</i> (L.) Hull	Ericaceae		+	Ch	Sp	sOZ-E	3
<i>Caltha palustris</i> L.	Ranunculaceae	+		H	Sp	CB	3
<i>Calystegia sepium</i> (L.) R.Br.	Convolvulaceae	+	+	G, H, li	Sp	KOSM	3
<i>Carex acutiformis</i> Ehrh.	Cyperaceae	+		G, Hy	Sp	ES	3
<i>Carex canescens</i> L.	Cyperaceae	+		H	.	.	3
<i>Carex elata</i> All.	Cyperaceae	+	+	H, Hy	Sp	sOZ	3
<i>Carex elongata</i> L.	Cyperaceae	+		H	Sp	ES	3
<i>Carex gracilis</i> Curtis	Cyperaceae	+		G, Hy	.	.	3
<i>Carex hirta</i> L.	Cyperaceae	+	+	G	Ap	M-E	3
<i>Carex lasiocarpa</i> Ehrh.	Cyperaceae	+		H, Hy	Sp	CB	4
<i>Carex nigra</i> Reichard	Cyperaceae	+		G	Sp	ES-AM	3
<i>Carex ovalis</i> Gooden.	Cyperaceae		+	H	Ap	ES	3
<i>Carex pairae</i> F. W. Schultz	Cyperaceae	+		H	.	.	3
<i>Carex panicea</i> L.	Cyperaceae	+		G, H	Sp	ES-AM	3
<i>Carex paniculata</i> L.	Cyperaceae	+	+	H	.	.	3
<i>Carex pseudocyperus</i> L.	Cyperaceae	+	+	H, Hy	Sp	KOSM	3
<i>Carex riparia</i> Curtis	Cyperaceae	+		H, Hy	Sp	KOSM	3
<i>Carex rostrata</i> Stokes	Cyperaceae	+		H, Hy	Sp	CB	3
<i>Cicuta virosa</i> L.	Apiaceae	+		H	Sp	ES	3
<i>Cirsium palustre</i> (L.) Scop.	Asteraceae	+		H	Sp	M-ES	3
<i>Comarum palustre</i> L.	Rosaceae	+	+	Ch	.	.	3
<i>Consolida regalis</i> Gray	Ranunculaceae		+	T	Arch	ES-P	3
<i>Crataegus monogyna</i> Jacq.	Rosaceae		+	N	Ap	M-E-IT	3
<i>Deschampsia caespitosa</i> (L.) P.Beauv.	Poaceae	+	+	H	Sp	KOSM	3
<i>Dryopteris filix-mas</i> (L.) Schott	Dryopteridaceae	+		H	Sp	KOSM	3
<i>Elymus repens</i> (L.) Gould	Poaceae	+		G	Ap	M-ES	3
<i>Epilobium palustre</i> L.	Onagraceae	+		H	Sp	CB	3
<i>Equisetum fluviatile</i> L.	Equisetaceae	+	+	Hy, G	Sp	CB	3
<i>Equisetum palustre</i> L.	Equisetaceae	+		G	Sp	M-CB	3
<i>Equisetum sylvaticum</i> L.	Equisetaceae	+	+	G	Ap	CB	3
<i>Eriophorum vaginatum</i> L.	Cyperaceae		+	H	Sp	CB	3
<i>Filipendula ulmaria</i> (L.) Maxim.	Rosaceae	+		H	Sp	ES	3
<i>Fragaria vesca</i> L.	Rosaceae		+	H	Sp	CB	3

cd. Table 1

Latin name	Family	Drainage ditch	Neighbouring phyto-coenoses	Life form	Continental index	Historical-geographical group	Range group
<i>Frangula alnus</i> Mill.	Rhamnaceae	+	+	N	Sp	ES	3
<i>Galeobdolon luteum</i> Huds.	Lamiaceae		+	Ch	.	.	3
<i>Galeopsis speciosa</i> Mill.	Lamiaceae	+		T	Ap	ES	3
<i>Galium aparine</i> L.	Rubiaceae	+	+	T, H	Ap	ES	3
<i>Galium palustre</i> L.	Rubiaceae	+		H	Sp	M-ES-AM	3
<i>Galium uliginosum</i> L.	Rubiaceae	+		H	Sp	ES	3
<i>Genista pilosa</i> L.	Fabaceae	+	+	Ch	.	.	2
<i>Geranium robertianum</i> L.	Geraniaceae	+	+	H, T	Sp	M-CB	3
<i>Geum rivale</i> L.	Rosaceae	+	+	H	Sp	M-E-AM	3
<i>Geum urbanum</i> L.	Rosaceae		+	H	Ap	M-E-IT	3
<i>Glyceria fluitans</i> (L.) R.Br.	Poaceae	+	+	Hy	Ap	M-E-AM	3
<i>Hieracium murorum</i> L.	Asteraceae	+	+	H	Sp	E	3
<i>Hieracium pilosella</i> L.	Asteraceae		+	H	Ap	E	3
<i>Holcus lanatus</i> L.	Poaceae	+	+	H	Ap	M-E	3
<i>Hottonia palustris</i> L.	Primulaceae	+		Hy	Sp	E	3
<i>Hydrocharis morsus-ranae</i> L.	Hydrocharitaceae	+		Hy	Sp	ES	3
<i>Hypericum perforatum</i> L.	Hypericaceae	+	+	H	Ap	ES	3
<i>Iris pseudacorus</i> L.	Iridaceae	+		G, Hy	Sp	M-ES	3
<i>Juncus effusus</i> L.	Juncaceae	+		H	Ap	KOSM	3
<i>Lathyrus pratensis</i> L.	Fabaceae	+		H	Ap	KOSM	3
<i>Lembotropis nigricans</i> (L.) Grisb.	Fabaceae		+	C, N	Sp	E	3
<i>Leontodon autumnalis</i> L.	Asteraceae		+	H	Ap	ES	3
<i>Lemna minor</i> L.	Lemnaceae	+		Hy	Sp	KOSM	3
<i>Lemna trisulca</i> L.	Lemnaceae	+		Hy	Sp	KOSM	3
<i>Lychnis flos-cuculi</i> L.	Caryophyllaceae	+		H	Sp	ES	3
<i>Lycopus europaeus</i> L.	Lamiaceae	+	+	H, Hy	Sp	M-ES	3
<i>Lysimachia nummularia</i> L.	Primulaceae	+		C	Sp	E	3
<i>Lysimachia thyrsoiflora</i> L.	Primulaceae	+	+	H, Hy	Sp	CB	3
<i>Lysimachia vulgaris</i> L.	Primulaceae	+	+	H	Sp	ES	3
<i>Lythrum salicaria</i> L.	Lythraceae	+		H	Sp	KOSM	3
<i>Maianthemum bifolium</i> (L.) F.W.Schmidt	Convallariaceae	+		G	Sp	ES	3
<i>Melandrium album</i> (Mill.) Garcke	Caryophyllaceae	+		T, H	Ap	ES	3
<i>Mentha aquatica</i> L.	Lamiaceae	+		H, Hy	Sp	KOSM	3
<i>Menyanthes trifoliata</i> L.	Menyanthaceae		+	G, Hy	Sp	CB	3
<i>Milium effusum</i> L.	Poaceae		+	H	Sp	CB	3
<i>Molinia caerulea</i> (L.) Moench	Poaceae	+	+	H	Sp	E	3
<i>Mycelis muralis</i> (L.) Dumort.	Asteraceae		+	H	Sp	sOZ	3
<i>Myosotis palustris</i> (L.) L.emend. Rchb.	Boraginaceae	+		H	.	.	3
<i>Myosoton aquaticum</i> (L.) Moench	Caryophyllaceae	+		G, H	Ap	ES	3
<i>Oenanthe aquatica</i> (L.) Poir.	Apiaceae	+		H, Hy	Ap	ES	3
<i>Oxalis acetosella</i> L.	Oxalidaceae	+	+	G, H	Sp	ES	3
<i>Oxalis stricta</i> L.	Oxalidaceae	+		G	.	.	3
<i>Peucedanum palustre</i> (L.) Moench	Apiaceae	+		H	.	.	3
<i>Phragmites australis</i> (Cav.) Trin. ex Steud.	Poaceae	+	+	G, Hy	Sp	KOSM	3
<i>Pimpinella saxifraga</i> L.	Apiaceae	+		H	Ap	ES	3
<i>Pinus sylvestris</i> L.	Pinaceae		+	M	Ap	ES	3
<i>Plantago lanceolata</i> L.	Plantaginaceae	+	+	H	Ap	M-ES-IT	3
<i>Poa nemoralis</i> L.	Poaceae	+		H	Sp	CB	3
<i>Poa palustris</i> L.	Poaceae	+		H	Sp	CB	3



cd. Table 1

Latin name	Family	Drainage ditch	Neighbouring phytocoenoses	Life form	Continental index	Historical-geographical group	Range group
<i>Poa pratensis</i> L.	Poaceae		+	H	Ap	CB	3
<i>Polygonatum multiflorum</i> (L.) All.	Convallariaceae		+	G	Sp	ES	3
<i>Populus tremula</i> L.	Salicaceae	+	+	M	Ap	ES	3
<i>Potentilla anserina</i> L.	Rosaceae	+		H	Ap	KOSM	3
<i>Potentilla erecta</i> (L.) Racusch.	Rosaceae	+		H	Sp	M-ES	3
<i>Potentilla reptans</i> L.	Rosaceae	+		H	Ap	M-E-IT	3
<i>Pteridium aquilinum</i> (L.) Kuhn	Dennstaedtiaceae	+	+	G	Sp	KOSM	3
<i>Quercus robur</i> L.	Fagaceae	+	+	M	Sp	E	3
<i>Ranunculus acris</i> L. s. str.	Ranunculaceae	+		H	Ap	ES	3
<i>Ranunculus flammula</i> L.	Ranunculaceae	+		H	Ap	ES	3
<i>Ranunculus lingua</i> L.	Ranunculaceae	+	+	H, Hy	Sp	ES	3
<i>Rorippa amphibia</i> (L.) Besser	Brassicaceae	+		H, Hy	Sp	ES	3
<i>Rubus caesius</i> L.	Rosaceae	+	+	N, li	Ap	ES-IT	3
<i>Rubus idaeus</i> L.	Rosaceae	+		N, li	Sp	CB	3
<i>Rumex hydrolapathum</i> Huds.	Polygonaceae	+		H, Hy	Sp	E	3
<i>Salix aurita</i> L.	Salicaceae	+		N	Sp	E	3
<i>Salix cinerea</i> L.	Salicaceae	+	+	N	Sp	ES	3
<i>Scirpus sylvaticus</i> L.	Cyperaceae	+		G	Sp	ES	3
<i>Scutellaria galericulata</i> L.	Lamiaceae	+		H	Sp	CB	3
<i>Solanum dulcamara</i> L.	Solanaceae	+		N, li	Sp	M-ES-IT	3
<i>Sorbus aucuparia</i> L. emend. Hedl.	Rosaceae	+	+	M, N	Sp	ES	3
<i>Stachys palustris</i> L.	Lamiaceae	+		G	Sp	CB	3
<i>Stellaria palustris</i> Retz.	Caryophyllaceae	+		H	Sp	M-CB	3
<i>Stratiotes aloides</i> L.	Hydrocharitaceae			Hy	Sp	ES	3
<i>Thelypteris palustris</i> Schott	Thelypteridaceae	+	+	G	Sp	KOSM	3
<i>Tilia cordata</i> Mill.	Tiliaceae		+	M	.	.	3
<i>Trientalis europaea</i> L.	Primulaceae	+	+	G	Sp	CB	3
<i>Triglochin palustre</i> L.	Juncaginaceae	+		H	Sp	KOSM	3
<i>Tussilago farfara</i> L.	Asteraceae	+		G	Ap	ES	3
<i>Typha angustifolia</i> L.	Typhaceae	+		H, Hy	Sp	ES-AM	3
<i>Typha latifolia</i> L.	Typhaceae	+		H, Hy	Sp	KOSM	3
<i>Urtica dioica</i> L.	Urticaceae	+	+	H	Ap	M-CB	3
<i>Utricularia vulgaris</i> L.	Lentibulariaceae	+		Hy	Sp	ES	3
<i>Vaccinium myrtillus</i> L.	Ericaceae	+	+	Ch	Sp	ES	3
<i>Vaccinium uliginosum</i> L.	Ericaceae		+	Ch	Sp	CB	3
<i>Vaccinium vitis-idaea</i> L.	Ericaceae		+	Ch	Sp	CB	3
<i>Veronica chamaedrys</i> L.	Scrophulariaceae	+	+	C	Ap	E	3
<i>Veronica scutellata</i> L.	Scrophulariaceae	+		H	Sp	CB	3
<i>Vicia angustifolia</i> L.	Fabaceae	+	+	T, H	.	.	3
<i>Vicia tetrasperma</i> (L.) Schreb.	Fabaceae		+	T	Arch	M-P	3
<i>Viola palustris</i> L.	Violaceae	+	+	H	Sp	E-AM	3
<i>Viola reichenbachiana</i> Jord. ex Boreau	Violaceae	+	+	H	Sp	E	3

**Explanations:**

**Life form** (Zarzycki et al., 2002); M – megaphanerophytes, trees generally growing to a height of over 5 m, N – nanophanerophytes, shrubs and small trees, from 0.5 up to 5 m in height, Ch – woody chamaephytes (buds > 25 cm above ground), C – herbaceous chamaephytes (buds < 25 cm above ground), H – hemicryptophytes (buds at ground level), G – geophytes (buds in soil), T – therophytes (annuals), Hy – hydrophytes and helophytes (buds in water), li – lianas (plants rooted in soil, requiring supports), pp – semiparasites,

**Historical-geographical group** (Chmiel, 1993 b); Sp – spontaneophytes, Ap – apophytes, Arch – archeophytes, Ken – kenophytes, D – diaphytes, • species of undetermined affinity,

**Range group** (Chmiel, 1993 b) CB – circumboreal, ES – Euro-Siberian, E – Central European, sOZ – sub-Atlantic, P – Pontian-Pannonian, ZAS – Central Asiatic, M – Mediterranean, IT – Irano-Turanian, AM – American, KOSM – cosmopolitan,

**Continental index** (Zarzycki et al., 2002); 2 – sub-Atlantic species, found mainly in the western part of Poland, 3 – species neutral to continentality, 4 – subcontinental species, found mainly in the eastern part of Poland, • species of undetermined affinity.

Table 2  
Proportions of main taxonomic groups in the flora of the studied drainage ditches and neighbouring phytocoenoses.

Taxa	Families				Genera				Species			
	Study area		Neighbouring phytocoenosis		Study area		Neighbouring phytocoenosis		Study area		Neighbouring phytocoenosis	
	number	%	number	%	number	%	number	%	number	%	number	%
<b>Phylum: Pteridophyta</b>												
Class: <i>Sphenopsida</i>	1	2.3	1	3.4	1	1.2	1	1.8	3	2.6	2	2.9
Class: <i>Filicopsida</i>	3	6.8	2	6.8	3	3.7	2	3.6	3	2.6	2	2.9
<b>Phylum: Spermatophyta</b>												
Subphylum: <i>Pinophytina</i>	0	0	1	3.4	0	0	1	1.8	0	0	1	1.4
Subphylum: <i>Magnoliophytina</i>												
Class: <i>Magnoliopsida</i>	30	68.2	23	79.3	57	70.4	41	74.6	71	61.7	49	71.1
Class: <i>Liliopsida</i>	10	22.7	2	6.8	20	24.7	10	18.2	38	33.1	15	21.7
<b>Total</b>	44	100	29	100	81	100	55	100	115	100	69	100

Table 3  
Proportions of life forms in the flora of the studied drainage ditches and neighbouring phytocoenoses.

Life forms	Study area		Neighbouring phytocoenosis	
	number of species	proportion in %	number of species	proportion in %
<b>M</b>	6	5.2	8	11.6
<b>N</b>	7	6.1	6	8.7
<b>Ch</b>	2	1.7	7	10.1
<b>C</b>	2	1.7	2	2.9
<b>H</b>	70	60.9	35	50.7
<b>G</b>	25	21.7	12	17.4
<b>T</b>	6	5.2	5	7.2
<b>Hy</b>	28	24.3	10	14.5
<b>li</b>	4	3.5	2	2.9

**M** – megaphanerophytes, trees generally growing to a height of over 5 m, **N** – nanophanerophytes, shrubs and small trees, from 0.5 up to 5 m in height, **Ch** – woody chamaephytes (buds > 25 cm above ground), **C** – herbaceous chamaephytes (buds < 25 cm above ground), **H** – hemicryptophytes (buds at ground level), **G** – geophytes (buds in soil), **T** – therophytes (annuals), **Hy** – hydrophytes and helophytes (buds in water), **li** – lianas (plants rooted in soil, requiring supports).

Table 4  
Proportions of historical and geographical groups in the flora of drainage ditches and neighbouring phytocoenoses.

Historical-geographical group		Study area		Neighbouring phytocoenosis	
		number of species	proportion in %	number of species	proportion in %
Spontaneous	<b>Sp</b> – non-synanthropic non-synanthropic	75	65.2	39	56.5
	<b>Ap</b> – apophytes	31	27.0	22	31.9
Anthropophytes	<b>Arch</b> – archeophytes	0	0	2	2.9
	<b>Ken</b> – kenophytes	0	0	0	0
	<b>D</b> – diaphytes	0	0	0	0
	• species of undetermined affinity	9	7.8	6	8.7
<b>Total</b>		115	100	69	100

Table 5  
Geographical elements in the flora of drainage ditches and neighbouring phytocoenoses.

Geographical (range) element	Study area		Neighbouring phytocoenosis	
	number of species	proportion in %	number of species	proportion in %
CB – circumboreal	15	13.0	12	17.4
ES – Euro-Siberian	39	33.9	20	29.0
E – Central European	10	8.7	8	11.6
sOZ – sub-Atlantic	1	0.9	2	2.9
overlapping elements	23	20.0	15	21.7
KOSM – cosmopolitan	18	15.7	6	8.7
• species of undetermined affinity	9	7.8	6	8.7
<b>Total</b>	115	100	69	100

## RESEARCH RESULTS

In all the sections of the studied drainage ditches intersecting forest phytocoenoses, the occurrence of 115 vascular plant species was found (Tab. 1), which represented 44 families and 81 genera (Tab. 2), whereas in the neighbouring phytocoenoses 69 species were recorded (Tab. 1), belonging to 29 families and 59 genera (Tab. 2). Both these habitats were characterised by the presence of only 46 common taxa.

In the flora of the studied drainage ditches, plants of the class *Magnoliopsida* were by far the dominant systematic group. Families of this class accounted for 68.2% of all families, genera – 70.4%, and species – 61.7% (Tab. 2). The family Cyperaceae was represented in the greatest number – 15 species, as well as Poaceae – 12 species and Rosaceae – 9 species. However, most families were represented by single taxa (Tab. 1).

The flora within the phytocoenoses neighbouring the ditches has a similar systematic composition. The predominance of plants of the class *Magnoliopsida* was also noted here, as families of this class accounted for as much as 79.3 % of all families, genera – 74.6%, whereas species for 71.1% of the total flora (Tab. 2). The greatest number of species was noted from the family Poaceae – 9 taxa. The families Rosaceae – 7 taxa – and Cyperaceae – 6 taxa – were also represented in great numbers (Tab. 1).

The flora of the studied drainage ditches and neighbouring phytocoenoses represents nine plant life-forms. Hemicryptophytes were decidedly the dominant group; 70 species were included in this category, i.e. 60.9% of the total ditch flora, and in the neighbouring phytocoenoses 35 taxa, which is 50.7% of their total

flora. Hydrophytes, represented by 28 species – 24.3% of the flora, were an important group in the drainage ditches, second in terms of population size, whereas geophytes had a significant share in the neighbouring phytocoenoses; 12 species were included in them, accounting for 17.4% of the flora (Tab. 3).

In the flora of the studied drainage ditches and neighbouring phytocoenoses, a clear dominance of native species, which spontaneophytes are, was found. Native species accounted for 92.2% of the total ditch flora and 88.4% of the flora of the neighbouring phytocoenoses. At the same time, a characteristic feature of the flora of the investigated ecosystems is a clear predominance of non-synanthropic spontaneophytes. Only in the neighbouring phytocoenoses were 2 anthropophyte species noted, that is, alien species (Tab. 4), which included *Consolida regalis* Gray and *Vicia tetrasperma* (L.) Schreb.

Based on the division adopted by Chmiel (1993b), the flora of the studied drainage ditches was classified in 4 phytochoria, included in the boreal elements – Boreal Subkingdom (Euro-Siberian-Boreo-American). These are as follows:

- circumboreal subelement (CB) – Circumboreal Region;
- Euro-Siberian subelement (ES) – Euro-Siberian Region;
- Central European geographical group sOZ-E (E) – Central European Province;
- sub-Atlantic geographical group (sOZ) – Sub-Atlantic Province (Tab. 5).

Species whose range was outside the boundaries of the abovementioned phytochoria were included in

overlapping elements. Cosmopolitan species (KOSM) are an element with the widest range, going beyond the boundaries of the Holarctic Kingdom.

In the flora of the studied drainage ditches, 65 species, accounting for 56.5% of the flora, belonged to a strictly defined phytochorion. Taxa of Euro-Siberian range were predominant among them – 39 species, i.e. 33.9% of the flora. Circumboreal and Central European elements, represented respectively by 15 species, i.e. 13%, and 10 species, i.e. 8.7% of the flora, had a smaller proportion. Only one species, accounting for 0.9% of the flora, which was *Carex elata* All, represented sub-Atlantic range plants. Cosmopolitan species make up a large percentage of the flora. This group is represented by 18 taxa accounting for 15.7% of the ditch flora (Tab. 5).

In the flora of the neighbouring forest phytocoenoses, only 42 species belonged to a strictly defined phytochorion, which accounted for 60.9% of the flora. Taxa of Euro-Siberian range, represented by 20 species, i.e. 29% of the recorded flora, also dominated here. Compared to the ditch flora, cosmopolitan species, represented in the neighbouring phytocoenoses only by taxa accounting 8.7% of the species composition, showed a significantly smaller proportion (Tab. 5).

An analysis of the flora of the drainage ditches in terms of the continentality index showed that species neutral to continentality were by far dominant, since they accounted for as much as 97.4% of the flora of the drainage ditches, being represented by 112 taxa, and for 95.5% of the flora of the neighbouring phytocoenoses, which corresponds to 68 species of their flora. Both in the drainage ditches and in their neighbourhood, one sub-Atlantic species was recorded, found mainly in the western part of Poland, notably *Genista pilosa*. In the drainage ditches, the presence of one subcontinental taxon was found, occurring primarily in the eastern part of Poland – *Carex lasiocarpa* (Tab. 1).

## DISCUSSION

Research studies on the biodiversity of mezzo- and microhabitats, which also include drainage ditches, are not sufficiently detailed, in particular that these habitats can be the place of occurrence of interesting biocenotic structures (Hillbricht-Ilkowska, 1998).

The species richness of the flora in the studied drainage ditches intersecting forest phytocoenoses, relative to the total flora of the Polesie National Park, is quite high. Species recorded in the study areas (115) were as much as 11.2% of the flora of the Polesie National Park. The species diversity of the flora of the

forest phytocoenoses was almost half lower, and the number of species noted in the patches of these phytocoenoses was only 69 taxa, which accounted for 6.7% of the Park's total flora (Fijałkowski and Izdebski, 2002).

In their floristic studies carried out in drainage ditches of a peat meadow area in Koszlewki (Garb Lubawski – the Lubawa Hummock), Zaluski and Kamińska (1999) found that greater flora richness was noted in drainage ditches, both at their bottom and on slopes, than in neighbouring phytocoenoses. This is also confirmed by the study presented in this paper.

Proportions of life-form groups in the flora of a studied area depend directly on climatic factors, but they can also be affected by anthropopressure (Chmiel, 1993a). An analysis of the life-form spectrum of the flora of the drainage ditches and their neighbourhood in the Polesie National Park showed that it is typical for this geographic zone. Hemicyptophytes were the dominant plant form in the ditches as well as in their neighbourhood. Due to greater moistening of the study areas, hydrophytes were an almost three time larger group – 28 taxa – in the drainage ditches than in their neighbourhood – 10 taxa.

One of the tasks set before research on flora is to explain the origin of taxa and to determine their status in autogenic and anthropogenic ecosystems, since the proportion, in terms of quality and quantity, of species of different historical-geographical groups can be a good indicator of the naturalness of the studied flora (Chmiel, 1993a). The analysis of the drainage ditch flora, in these terms, gave a quite clear, though not obvious picture that this special type of habitats, of only anthropogenic origin, was colonised by vegetation without the decisive human influence. Therefore, spontaneophytes – taxa which came to the study area or are native to it and can exist there without human participation – had the largest proportion in the ditch flora. This is indicated by the fact that as much as 92.2% of species recorded in the studied drainage ditches belong to the abovementioned group.

Similar correlations were observed in the flora of the phytocoenoses neighbouring the drainage ditches. Anthropophytes, that is, species which come from a given area or were introduced there and colonised the area only through human activity and persist thanks to that activity, were not found in the drainage ditches. Their presence was noted in the phytocoenoses neighbouring the ditches, but they occurred there in small numbers, since they accounted for as little as 2.9% of the total flora of the ditches' neighbourhood. Therefore, it can be stated that anthropogenic habitats of the drainage ditches were colonised by indigenous flora, characteristic for the study area, and man did not exert a strong pressure on their spe-



cies composition. The lack of maintenance of the channels of the ditches and, in the first place, the establishment of the national park decided about the natural character of the flora of the drainage ditches in question.

The geographic distribution of species is primarily related to their tolerance to the variability of environmental factors in time and space (Chmiel, 1993a). Euro-Siberian and cosmopolitan species were the dominant range elements of the flora of the studied drainage ditches. Similar correlations were observed in the flora of the neighbouring phytocoenoses, though cosmopolitan species were by far a smaller group there.

### CONCLUSIONS

1. In all the investigated sites of the drainage ditches, the occurrence of a total of 115 vascular plant species was found, which accounted for 11.2% of the Park's total flora. The drainage ditches are habitats important for the natural value of this area, and their richness and species diversity significantly enrich local biodiversity.
2. In the phytocoenoses neighbouring the drainage ditches, the occurrence of 69 vascular flora species was found, which accounted for 6.7% of the Park's flora. Hence, the species diversity of the drainage ditches was higher than that of the flora of the neighbouring habitats.
3. The analysis of the life-form spectrum of the flora of the drainage ditches in the Polesie National Park shows that it is typical for this geographic zone. Similar correlations were observed in the flora of the neighbouring phytocoenoses.
4. Spontaneophytes were the dominant historical-geographical group in the flora of the investigated watercourses. Anthropogenic habitats of the drainage ditches were colonised by native flora, characteristic for the study area, without significant human influence on their species composition.

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## **Flora naczyniowa rowów melioracyjnych na terenach leśnych Poleskiego Parku Narodowego**

### **Streszczenie**

Praca przedstawia wyniki badań florystycznych prowadzonych w latach 2003–2005 na terenie Poleskiego Parku Narodowego. Celem niniejszej pracy było porównanie flory inicjalnych stadiów sukcesyjnych w rowach melioracyjnych, z florą przekształcających się wskutek odwodnienia, sąsiadujących terenów leśnymi. Na czterech wyznaczonych powierzchniach badań, a także w fitocenozach leśnych sporządzono spisy florystyczne. Wyniki badań terenowych poddano analizie kameralnej pod kątem przynależności systematycznej flory, udziału form życiowych roślin, a także grup historyczno-geograficznych i grup zasięgowych.

W składzie gatunkowym, badanych rowów melioracyjnych dominującą grupą form życiowych roślin wyższych są hemikryptofity, podczas gdy w zbiorowiskach sąsiadujących z nimi florę reprezentują zarówno hemikryptofity jak i megafanerofity.

Pod względem historyczno-geograficznym flora rowów melioracyjnych, jak i zbiorowisk sąsiadujących, reprezentuje zdecydowanie grupę spontaneofitów. Antropogeniczne siedliska, jakie wykształciły się w obrębie rowów melioracyjnych zasiedlone zostały przez gatunki flory rodzimej charakterystyczne dla terenu Poleskiego Parku Narodowego.