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CHARACTERISTICS OF THE VASCULAR FLORA ON A LOCAL RAILWAY LINE IN WESTERN POLAND

Key words: vascular plants, Poland, railway line, frequency, origin, distribution, similarity coefficient

Abstract. The article contains results of geobotanical studies carried out in 2003–2004 and supplemented in the summer of 2009, in the area of a local railway line in the Wielkopolska region in Poland, between the railway stations of Czempin and Śrem, on the total line length about 20 km. The studies include vascular plants spontaneously occurring within the area.

In order to reveal the characteristic features of the flora, the studied railway line was divided into 37 equal segments and each segment was regarded as a separate locality. For each registered species, the total number of localities provided the basis for the determination of the occurrence frequency by a 5-degree scale.

The flora of the studied railway line includes 332 plant species. Among them, indigenous species (apophytes) distinctly dominate as compared to anthropophytes, while, in terms of species numbers, the richest groups are families *Asteraceae* and *Poaceae*. The most frequently encountered species were *Artemisia vulgaris* and *Hypericum perforatum*, found in all localities on the railway line. Our studies also have demonstrated that, despite the local character of the studied railway line, the identified flora also includes plants revealing a particular preference for occurring along main railway lines. Among others, they include *Aegilops cylindrica*, *Bromus japonicus*, *Bunias orientalis*, and *Lepidium virginicum*.

A comparison of the major part of the flora from six localities on the railway line between the first station Czempin and the last station Śrem has shown the highest similarity. Its value calculated with the use of the Steinhaus equation (similarity coefficient, similarity indices) showed 0.74.

Introduction

Railway lines belong to objects created artificially, and their functioning exerts an influence on the vegetation cover surrounding such lines, as it has been confirmed in several publications (Kornaś, Medwecka-Kornaś, 1986; Jehlik, 1998; Burda, Tokhtar, 1992; Latowski, 2007).

In the linear classification of anthropogenic objects, a railway line is a railway object, «a ferroviatic object», according to the nomenclature of Podbielkowski (1995).

The railway line Czempin–Śrem was constructed during the main period of railway development in the Wielkopolska region. The lines started to be used since 1885

(Dohnalowa, 1976; Zięba, 1980), so, it is almost 120 years before the start of any botanical studies of them. The regular functioning of the railway line was suspended in 1996. During the recent period, it was used only occasionally and only for the transportation of goods. Therefore, the actually encountered flora has started its development in earlier periods.

The main purpose of our studies was an inventory of vascular plants occurring along the whole railway line. The objectives associated with the main goal included an analysis of the frequency of occurrence of particular species.

Material and methods

Studies were carried out during two complete vegetation seasons (2003–2004), and they were additionally supplemented in the summer of 2009. The railway line Czempin–Śrem is about 20 km long and it was divided into 37 equal research units conventionally called *localities* (Fig. 1). Each locality was about 500 m long. In the linear structures, such distance is adequate for the intended studies, as and it has been proven by earlier experiments (Brandes, 1995). The area of each locality included the surface area of the railway line together with the surrounding embankment or drift of 1–3 m width. The studied railway line includes two larger terminal stations, Czempin and

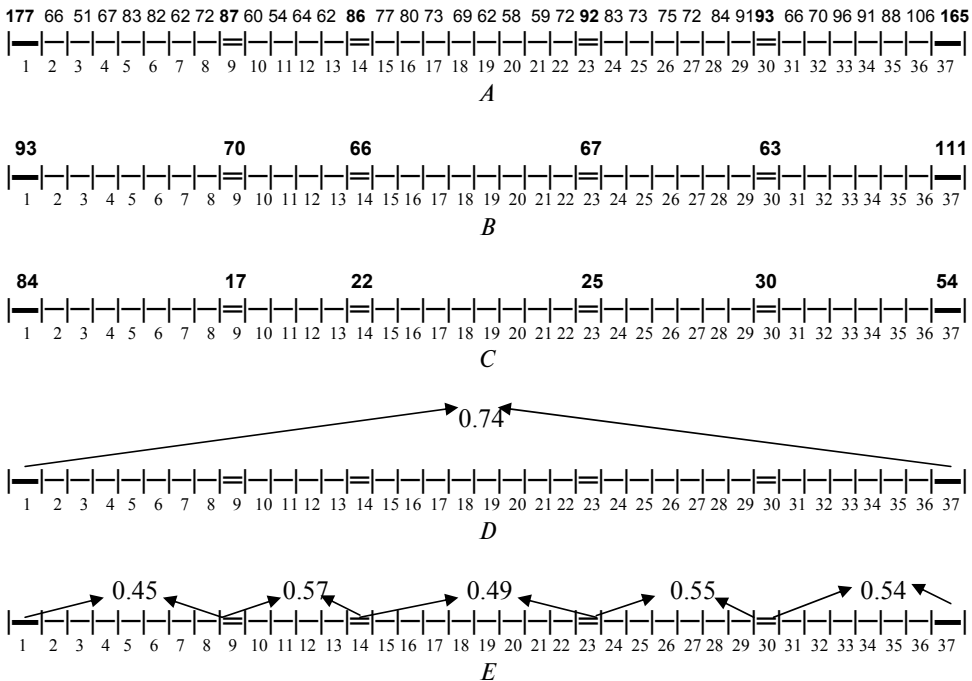


Fig. 1. Numerical indexes characteristic for microfloras of particular research sites (localities). *A* – total number of species in particular localities; *B* – number of apophytes; *C* – number of anthropophytes; *D* – similarity indices (CFS) between locality 1 (Czempin) and locality 37 (Śrem); *E* – similarity indices between 1 (Czempin) and 9 (Borowo), 9 and 14 (Szoldry); 14 and 23 (Grabianowo); 23 and 30 (Manieczki); 30 and 37 (Śrem)

Table 1. List of taxa and their characteristics

Taxon	RLF	NL	DF	Resources			G-H G
				1	2	3	
<i>Acer campestre</i> L.	F	2	rare	2			apo
<i>Acer platanoides</i> L.	F	17	oft	17			apo
<i>Acer negundo</i> L.	F	13	oft	10	3		ken
<i>Acer pseudoplatanus</i> L.	F	11	oft	10	1		apo?
<i>Achillea millefolium</i> L.	H	34	com	4	21	9	apo
<i>Acinos arvensis</i> (Lam.) Dandy	T/H	19	oft	4	15		apo
<i>Aegilops cylindrica</i> Host	T	1	vra	1			eph
<i>Aegopodium podagraria</i> L.	G/H	2	rare	1	1		apo
<i>Agrimonia eupatoria</i> L.	H	10	oft	8	2		apo
<i>Agrostis capillaris</i> L. (= <i>A. vulgaris</i> With.)	H	2	rare	1	1		apo
<i>Alliaria petiolata</i> (M. Bieb.) Cavara & Grande	H	2	rare	2			apo
<i>Allium oleraceum</i> L.	G	1	vra	1			apo
<i>Allium vineale</i> L.	G	3	rare	3			apo
<i>Amaranthus powellii</i> S. Wats.	T	1	vra	1			ken
<i>Amaranthus retroflexus</i> L.	T	9	sca	7	2		ken
<i>Anchusa officinalis</i> L.	H	24	com	19	5		apo
<i>Anethum graveolens</i> L.	T	1	vra	1			erg
<i>Angelica sylvestris</i> L.	H	1	vra	1			apo
<i>Antirrhinum majus</i> L.	T/C	1	vra	1			erg
<i>Anthemis arvensis</i> L.	T	2	rare	2			arch
<i>Anthriscus sylvestris</i> (L.) Hoffm.	H	27	com	18	9		apo
<i>Apera spica-venti</i> (L.) P. Beauv.	T	7	sca	5	2		arch
<i>Arabidopsis thaliana</i> (L.) Heynh.	T/H	1	vra	1			arch
<i>Arctium lappa</i> L.	H	2	rare	2			apo
<i>Arctium minus</i> (Hill) Bernh.	H	1	vra	1			apo
<i>Arctium tomentosum</i> Mill.	H	1	vra	1			apo
<i>Arenaria serpyllifolia</i> L.	T	8	sca	3	5		apo
<i>Armeria maritima</i> (Mill.) Willd.	H	5	sca	5			apo
<i>Arrhenatherum elatius</i> (L.) P. Beauv.	H	35	com		5	30	apo
<i>Artemisia absinthium</i> L.	C	1	vra	1			arch
<i>Artemisia campestris</i> L.	C	36	com	8	27	1	apo
<i>Artemisia vulgaris</i> L.	C	37	com	7	28	2	apo
<i>Asparagus officinalis</i> L.	G	4	rare	4			apo
<i>Asplenium trichomanes</i> L.	H	1	vra	1			ken
<i>Astragalus glycyphyllos</i> L.	H	4	rare	3	1		apo
<i>Atriplex hortensis</i> L.	T	1	vra	1			eph
<i>Atriplex sagittata</i> Borkh. (<i>A. nitens</i> Schkuhr)	T	1	vra	1			arch
<i>Atriplex patula</i> L.	T	3	rare	3			apo
<i>Avena fatua</i> L.	T	1	vra	1			arch
<i>Avenula pubescens</i> (Huds.) Dumort.	H	1	vra	1			apo
<i>Ballota nigra</i> L.	C/H	9	sca	8	1		arch
<i>Barbarea vulgaris</i> R. Br.	H	11	oft	9	2		apo
<i>Berteroa incana</i> (L.) DC.	T/H	29	com	16	13		apo
<i>Betula pendula</i> Roth	F	10	oft	10			apo
<i>Bidens frondosa</i> L.	T	1	vra	1			ken
<i>Brassica napus</i> L.	T	15	oft	14	1		erg
<i>Bromus japonicus</i> Thunb. ex Murr	H	3	rare	3			ken
<i>Bromus hordeaceus</i> L.	T	7	sca	3	4		apo
<i>Bromus inermis</i> Leys.	H	25	com	12	13		apo
<i>Bromus sterilis</i> L.	T	16	oft	13	3		arch
<i>Bromus tectorum</i> L.	T	19	oft	4	15		arch
<i>Bryonia alba</i> L.	H/G	3	rare	3			ken
<i>Buddleja davidii</i> Franch.	F	1	vra	1			erg
<i>Bunias orientalis</i> L.	H	1	vra	1			ken
<i>Calamagrostis epigeios</i> (L.) Roth	H	22	oft	16	6		apo

<i>Calendula officinalis</i> L.	T	1	vra	1		erg
<i>Camelina microcarpa</i> Andrz.	T	5	sca	4	1	apo
<i>Campanula rapunculoides</i> L.	H	6	sca	6		apo
<i>Campanula rotundifolia</i> L.	H	1	vra	1		apo
<i>Capsella bursa-pastoris</i> (L.) Medik.	T	17	oft	11	6	arch
<i>Cardaminopsis arenosa</i> (L.) Hayek	H	7	sca	7		apo
<i>Carduus acanthoides</i> L.	H	7	sca	7		arch
<i>Carex hirta</i> L.	G	9	sca	7	2	apo
<i>Carex praecox</i> Schreb.	G/H	8	sca	6	2	apo
<i>Carex spicata</i> Huds.	H	3	rare	3		apo
<i>Carpinus betulus</i> L.	F	1	vra	1		apo
<i>Centaurea cyanus</i> L.	T	12	oft	12		arch
<i>Centaurea jacea</i> L.	H	2	rare	2		apo
<i>Centaurea scabiosa</i> L.	H	17	oft	13	4	apo
<i>Centaurea stoebe</i> L.	H	12	oft	10	2	apo
<i>Cerastium arvense</i> L.	C	15	oft	10	5	apo
<i>Cerastium holosteoides</i> Fr. emend. Hyl.	C	14	oft	12	2	apo
<i>Cerastium semidecandrum</i> L.	T	1	vra		1	apo
<i>Cerastium tomentosum</i> L.	C	2	rare	1	1	erg
<i>Chaenorrhinum minus</i> (L.) Lange	T	2	rare		2	apo
<i>Chaerophyllum temulum</i> L.	T/H	2	rare	1	1	apo
<i>Chamaenerion angustifolium</i> (L.) Scop.	H	3	rare	3		apo
<i>Chamomilla recutita</i> (L.) Rauschert	T	1	vra	1		arch
<i>Chamomilla suaveolens</i> (Pursh) Rydb.	T	7	sca	6	1	ken
<i>Chelidonium majus</i> L.	H	9	sca	7	2	apo
<i>Chenopodium album</i> L.	T	28	com	22	6	apo
<i>Chenopodium glaucum</i> L.	T	2	rare	2		apo
<i>Chenopodium strictum</i> Roth	T	1	vra	1		apo
<i>Chondrilla juncea</i> L.	H	2	rare	2		apo
<i>Cichorium intybus</i> L.	H	22	oft	18	4	arch
<i>Cirsium arvense</i> (L.) Scop.	G	21	vra	20	1	apo
<i>Cirsium vulgare</i> (Savi) Ten.	H	1	vra	1		apo?
<i>Consolida ajacis</i> (L.) Schur	T	1	vra	1		erg
<i>Consolida regalis</i> Gray	T	7	sca	7		arch
<i>Convolvulus arvensis</i> L.	G/H	27	com	13	14	apo
<i>Conyza canadensis</i> (L.) Cronq.	T/H	13	oft	6	7	ken
<i>Cornus sanguinea</i> L.	F	9	sca	9		apo
<i>Coronilla varia</i> L.	H	34	com	18	15 1	apo
<i>Corylus avellana</i> L.	F	1	vra	1		apo
<i>Corynephorus canescens</i> (L.) P. Beauv.	H	1	vra	1		apo
<i>Crataegus pedicellata</i> Sarg.	F	1	vra	1		erg
<i>Crataegus monogyna</i> Jacq.	F	19	oft	19		apo
<i>Crepis biennis</i> L.	H	1	vra	1		apo
<i>Crepis tectorum</i> L.	T/H	29	com	17	12	apo
<i>Cystopteris fragilis</i> (L.) Bernh.	H	1	vra	1		apo
<i>Dactylis glomerata</i> L.	H	34	com	11	23	apo
<i>Daucus carota</i> L.	H	10	oft	8	2	apo
<i>Descurainia sophia</i> (L.) Webb ex Prantl	T	16	oft	8	8	arch
<i>Dianthus carthusianorum</i> L.	C	8	sca	7	1	apo
<i>Dianthus deltoides</i> L.	C	3	rare	3		apo
<i>Digitaria sanguinalis</i> (L.) Scop.	T	2	rare	2		apo?
<i>Diplotaxis muralis</i> (L.) DC.	T	3	rare	3		ken
<i>Dryopteris filix-mas</i> (L.) Schott	H	1	vra	1		apo
<i>Echinochloa crus-galli</i> (L.) P.Beauv.	T	2	rare	2		arch

<i>Echinocystis lobata</i> (Michx.) Torr. & A. Gray	T	2	rare	2			ken
<i>Echinops sphaerocephalus</i> L.	H	1	vra	1			ken
<i>Echium vulgare</i> L.	H	33	com	27	6		apo
<i>Elymus repens</i> (L.) Gould	G	11	oft	10	1		apo
<i>Epilobium ciliatum</i> Rafin.	H	3	rare		3		ken
<i>Epilobium hirsutum</i> L.	H	1	vra		1		apo
<i>Epilobium roseum</i> Schreb.	H	1	vra		1		apo
<i>Eragrostis minor</i> Host	T	2	rare			2	ken
<i>Equisetum arvense</i> L.	G	30	com	17	13		apo
<i>Erigeron acer</i> L.	H	1	vra	1			apo
<i>Erigeron annuus</i> (L.) Pers.	T	2	rare	2			ken
<i>Erodium cicutarium</i> (L.) L'Herit.	T/H	4	sca	2	2		apo
<i>Erysimum cheiranthoides</i> L.	T	1	vra	1			apo
<i>Erysimum hieracifolium</i> L.	H	7	vra	6	1		apo
<i>Euphorbia cyparissias</i> L.	G/H	32	com	13	19		apo?
<i>Falcaria vulgaris</i> Bernh.	H	4	rare	4			apo
<i>Fallopia convolvulus</i> (L.) Á.Löve	T	6	sca	6			arch
<i>Fallopia dumetorum</i> (L.) Holub	T	1	vra	1			apo
<i>Festuca pratensis</i> Huds.	H	1	vra	1			apo
<i>Festuca rubra</i> L.	H	3	rare		2	1	apo
<i>Festuca trachyphylla</i> (Hack.) Krajina	H	2	rare		2		apo
<i>Fragaria x ananassa</i> Duch.	H	1	vra	1			erg
<i>Fragaria vesca</i> L.	H	11	oft	5	4	2	apo
<i>Fraxinus excelsior</i> L.	F	18	oft	18			apo
<i>Fumaria officinalis</i> L.	T	1	vra	1			arch
<i>Gagea pratensis</i> (Pers.) Dumort.	G	5	sca	5			apo
<i>Galeopsis pubescens</i> Besser	T	1	vra	1			apo
<i>Galinsoga parviflora</i> Cav.	T	9	sca	9			ken
<i>Galium aparine</i> L.	T	8	sca	7	1		apo
<i>Galium mollugo</i> L.	H	33	com	5	17	11	apo
<i>Galium spurium</i> L.	T	1	vra	1			arch
<i>Galium verum</i> L.	H	34	com	7	23	4	apo
<i>Geranium molle</i> L.	T	3	rare	2	1		apo?
<i>Geranium pratense</i> L.	H	4	rare	3	1		apo
<i>Geranium pusillum</i> L.	T	4	rare	3	1		arch
<i>Geranium pyrenaicum</i> Burm. fil.	H	2	rare	1	1		ken
<i>Geranium robertianum</i> L.	T/H	9	sca	4	5		apo
<i>Geum urbanum</i> L.	H	9	sca	8	1		apo
<i>Glechoma hederacea</i> L.	G	5	sca	3	2		apo
<i>Helichrysum arenarium</i> (L.) Moench	H	2	rare	2			apo
<i>Heracleum mantegazzianum</i> Sommier & Levier	H	2	rare	2			ken
<i>Heracleum sphondylium</i> L.	H	13	oft	13			apo
<i>Hieracium caespitosum</i> Dumort.	H	1	vra	1			apo
<i>Hieracium</i> cf. <i>cymosum</i> L.	H	1	vra	1			apo
<i>Hieracium pilosella</i> L.	H	9	sca	8	1		apo
<i>Hieracium sabaudum</i> L.	H	2	rare	2			apo
<i>Holosteum umbellatum</i> L.	T	2	rare	1	1		apo
<i>Hordeum murinum</i> L.	T	3	rare	2	1		arch
<i>Humulus lupulus</i> L.	H	7	sca	5	2		apo
<i>Hypericum perforatum</i> L.	H	37	com	11	26		apo
<i>Knautia arvensis</i> (L.) Coult.	H	27	com	17	10		apo
<i>Lactuca serriola</i> L.	H	30	com	17	13		arch
<i>Lamium album</i> L.	H	4	rare	4			arch
<i>Lamium maculatum</i> L.	H	1	vra		1		apo?
<i>Lamium purpureum</i> L.	T/H	5	sca	4	1		arch
<i>Lapsana communis</i> L.	H/T	2	rare	2			apo

<i>Lathyrus pratensis</i> L.	H	1	vra	1		apo	
<i>Lathyrus sylvestris</i> L.	H	14	oft	9	5	apo?	
<i>Leontodon autumnalis</i> L.	H	2	rare	2		apo	
<i>Leontodon hispidus</i> L.	H	1	vra	1		apo	
<i>Lepidium campestre</i> (L.) R. Br.	T	2	rare	1	1	arch	
<i>Lepidium densiflorum</i> Schrad.	T	5	sca	4	1	ken	
<i>Lepidium ruderales</i> L.	T	6	sca	6		arch	
<i>Lepidium virginicum</i> L.	T	5	sca	4	1	ken	
<i>Leucanthemum vulgare</i> Lam. s.s.	H	3	rare	3		apo	
<i>Ligustrum vulgare</i> L.	F	8	sca	8		ken	
<i>Linaria vulgaris</i> Mill.	H	32	com	16	16	apo	
<i>Lolium perenne</i> L.	H	14	oft	4	10	apo?	
<i>Lotus corniculatus</i> L.	H	20	oft	13	7	apo	
<i>Lupinus polyphyllus</i> Lindl.	H	3	rare	3		ken	
<i>Lycium barbarum</i> L.	F	9	sca	9		ken	
<i>Malus sylvestris</i> Mill.	F	1	vra	1		apo	
<i>Malus domestica</i> Borkh.	F	16	oft	16		erg?	
<i>Malva neglecta</i> Wallr.	T/H	3	rare	3		arch	
<i>Malva pusilla</i> Sm.	T/H	1	vra	1		arch	
<i>Malva sylvestris</i> L.	H	1	vra	1		arch	
<i>Medicago falcata</i> L.	H	21	oft	18	3	apo	
<i>Medicago lupulina</i> L.	H	25	com	14	11	apo	
<i>Medicago sativa</i> L.	H	13	oft	9	3	1	ken
<i>Medicago x varia</i> Martyn	H	29	com	6	16	7	ken
<i>Melampyrum arvense</i> L.	T	1	vra	1		apo	
<i>Melampyrum pratense</i> L.	T	1	vra	1		apo	
<i>Melandrium album</i> (Mill.) Garcke	T/H	28	com	22	6	apo	
<i>Melilotus alba</i> Medik.	H/T	14	oft	12	2	apo?	
<i>Melilotus officinalis</i> (L.) Pall.	H	30	com	25	5	apo	
<i>Mentha arvensis</i> L.	H	1	vra	1		apo	
<i>Myosotis arvensis</i> (L.) Hill.	T/H	2	rare	2		arch	
<i>Myosotis stricta</i> Link ex Roem. & Schult.	H	1	vra	1		apo	
<i>Nepeta cataria</i> L.	H/C	1	vra	1		arch	
<i>Oenothera biennis</i> L.	H	5	sca	4	1	apo	
<i>Oenothera rubricaulis</i> Klebahn	H	1	vra	1		apo	
<i>Ononis spinosa</i> L.	H	1	vra	1		apo	
<i>Onopordum acanthium</i> L.	H	1	vra	1		arch	
<i>Origanum vulgare</i> L.	H/C	2	rare	1	1	apo	
<i>Padus avium</i> L.	F	4	rare	4		apo	
<i>Padus serotina</i> (Ehrh.) Borkh.	F	7	sca	7		ken	
<i>Papaver dubium</i> L.	T	23	com	16	7	arch	
<i>Papaver rhoeas</i> L.	T	18	oft	15	3	arch	
<i>Papaver somniferum</i> L.	T	1	vra	1		erg?	
<i>Parthenocissus quinquefolia</i> (L.) Planch.	L	5	sca	5		erg	
<i>Pastinaca sativa</i> L.	H	31	com	18	13	apo	
<i>Petroselinum crispum</i> (Mill.) A.W.Hill	H	2	rare	2		erg	
<i>Petrorhagia prolifera</i> (L.) P.W.Ball & Heyw.	T	1	vra		1	apo?	
<i>Phegopteris robertiana</i> (Hoffm.) A.Braun	G	1	vra	1		apo	
<i>Phleum pratense</i> L.	H	1	vra	1		apo	
<i>Phragmites australis</i> (Cav.) Trin. ex Steud.	G	6	sca	6		apo	
<i>Picris hieracioides</i> L.	H	24	com	18	6	apo	
<i>Picea abies</i> (L.) H.Karst.	F	1	vra	1		ken	
<i>Pimpinella nigra</i> Mill.	H	32	com	17	15	apo	

<i>Pimpinella saxifraga</i> L. s.s.	H	11	oft	11		apo
<i>Pinus sylvestris</i> L.	F	8	sca	8		apo
<i>Pyrus communis</i> L.	F	11	oft	11		apo?
<i>Plantago lanceolata</i> L.	H	16	oft	13	3	apo
<i>Plantago maior</i> L.	H	7	sca	7		apo
<i>Poa angustifolia</i> L.	H	1	vra	1		apo
<i>Poa annua</i> L.	H	6	sca	5	1	apo
<i>Poa compressa</i> L.	H	33	com	1	13	19
<i>Poa nemoralis</i> L.	H	2	rare	2		apo
<i>Poa pratensis</i> L.	H	32	com	4	25	3
<i>Polygonum aviculare</i> L.	T	13	oft	9	4	apo
<i>Polygonum amphibium</i> L. f. <i>terrestre</i>	G	5	sca	5		apo
<i>Polygonum lapathifolium</i> L.	T	3	rare	3		apo
<i>Polygonum persicaria</i> L.	T	1	vra	1		apo
<i>Populus x canadensis</i> Moench	F	2	rare	2		erg?
<i>Populus tremula</i> L.	F	1	vra	1		apo
<i>Portulaca oleracea</i> L.	T	1	vra	1		eph
<i>Potentilla anserina</i> L.	H	2	rare	2		apo
<i>Potentilla argentea</i> L.	H	18	oft	10	8	apo
<i>Potentilla collina</i> Wib.	H	1	vra	1		apo
<i>Potentilla recta</i> L.	H	1	vra	1		apo
<i>Potentilla reptans</i> L.	H	31	com	6	17	8
<i>Prunus cerasifera</i> Ehrh.	F	17	oft	17		ken
<i>Prunus domestica</i> L.	F	1	vra	1		erg?
<i>Prunus spinosa</i> L.	F	12	oft	12		apo
<i>Puccinellia distans</i> (Jacq.) Parl.	H	2	rare	1	1	apo
<i>Quercus robur</i> L.	F	4	sca	4		apo
<i>Ranunculus acris</i> L.	H	6	sca	4	2	apo
<i>Ranunculus arvensis</i> L.	T	1	vra	1		arch
<i>Ranunculus bulbosus</i> L.	G/H	2	rare	2		apo
<i>Ranunculus repens</i> L.	H	1	vra	1		apo
<i>Reseda lutea</i> L.	H	2	rare	1	1	apo?
<i>Rhamnus cathartica</i> L.	F	2	rare	2		apo
<i>Ribes uva-crispa</i> L.	F	19	oft	18	1	ken?
<i>Robinia pseudoacacia</i> L.	F	9	sca	8	1	ken
<i>Rosa canina</i> L.	F	27	com	27		apo
<i>Rosa rugosa</i> Thunb.	F	2	rare	2		ken
<i>Rosa sherardii</i> Davies	F	4	rare	4		apo
<i>Rubus caesius</i> L.	F	35	com	5	19	11
<i>Rubus idaeus</i> L.	F	3	rare	1	2	apo
<i>Rumex acetosa</i> L.	H	26	com	13	13	apo
<i>Rumex acetosella</i> L.	G/H	3	rare	3		apo
<i>Rumex crispus</i> L.	H	3	rare	3		apo
<i>Rumex thyrsoiflorus</i> Fingerh.	H	20	oft	4	15	1
<i>Salix cinerea</i> L.	F	8	sca	8		apo
<i>Salix fragilis</i> L.	F	2	rare	2		apo
<i>Salix purpurea</i> L.	F	6	sca	6		apo
<i>Salix viminalis</i> L.	F	1	vra	1		apo
<i>Salsola tragus</i> L.	T	2	rare	2		ken
<i>Salvia pratensis</i> L.	H	1	vra	1		apo?
<i>Sambucus nigra</i> L.	F	19	oft	17	2	apo
<i>Sanguisorba muricata</i> (Spach) Greml.	H	1	vra	1		ken?
<i>Saponaria officinalis</i> L.	H	13	oft	5	8	apo
<i>Saxifraga tridactylites</i> L.	T	1	vra			1
<i>Secale cereale</i> L.	T	12	oft	12		erg
<i>Sedum acre</i> L.	C	35	com		21	14
<i>Sedum album</i> L.	C	1	vra	1		erg
<i>Sedum maximum</i> (L.) Hoffm.	G/H	16	oft	12	4	apo
<i>Sedum reflexum</i> L.	C	5	sca		5	apo?

<i>Sedum sexangulare</i> L.	C	3	rare		3		apo
<i>Sedum spurium</i> M.Bieb.	C	1	vra	1			erg
<i>Senecio jacobaea</i> L.	H	8	sca	8			apo
<i>Senecio vernalis</i> Waldst. & Kit.	T/H	6	sca	6			ken
<i>Senecio viscosus</i> L.	T	12	oft	8	4		apo
<i>Senecio vulgaris</i> L.	T/H	8	sca	8			arch
<i>Setaria pumila</i> (Poir.) Roem. & Schult.	T	1	vra	1			arch
<i>Setaria viridis</i> (L.) P.Beauv.	T	8	sca	8			arch
<i>Silene vulgaris</i> (Moench) Garcke	H/C	36	com	5	28	3	apo
<i>Sisymbrium altissimum</i> L.	T/H	5	sca	3	2		ken
<i>Sisymbrium loeselii</i> L.	T	4	rare	2	2		ken
<i>Sisymbrium officinale</i> (L.) Scop.	T	2	rare	2			arch
<i>Sisymbrium wolgense</i> M.Bieb. ex Fourn.	H	1	vra	1			ken
<i>Solidago canadensis</i> L.	H/G	1	vra	1			ken
<i>Solidago gigantea</i> Aiton	H/G	1	vra	1			ken
<i>Solidago virga-aurea</i> L.	H	1	vra	1			apo
<i>Sonchus arvensis</i> L.	H	2	rare	2			apo
<i>Sonchus asper</i> (L.) Hill	T	3	rare	3			arch
<i>Sonchus oleraceus</i> L.	T/H	7	sca	4	3		arch
<i>Sorbus aucuparia</i> L.	F	6	sca	6			apo
<i>Sorbus intermedia</i> (Ehrh.) Pers.	F	3	rare	3			ken
<i>Stellaria media</i> (L.) Vill.	T	1	vra	1			apo
<i>Syringa vulgaris</i> L.	F	10	oft	10			ken?
<i>Tanacetum vulgare</i> L.	H	24	com	20	3	1	apo
<i>Taraxacum officinale</i> Wib. agg.	H	29	com	12	17		apo
<i>Thlaspi arvense</i> L.	T	4	rare	4			arch
<i>Thymus pulegioides</i> L.	C	2	rare		1	1	apo
<i>Tilia platyphyllos</i> Scop.	F	1	vra	1			apo?
<i>Torilis japonica</i> (Houtt.) DC.	T/H	1	vra		1		apo
<i>Tragopogon dubius</i> Scop.	H	25	com	19	6		apo
<i>Tragopogon pratensis</i> L. s.s.	H	14	oft	12	2		apo
<i>Trifolium arvense</i> L.	T	13	oft	9	4		apo
<i>Trifolium campestre</i> Schreb.	T	2	rare	1	1		apo
<i>Trifolium pretense</i> L.	H	9	sca	4	5		apo
<i>Trifolium repens</i> L.	H	8	sca	5	3		apo
<i>Tripleurospermum inodorum</i> (L.) Sch.Bip.	T	15	oft	13	2		arch
<i>Triticum aestivum</i> L.	T	3	rare	3			erg
<i>Ulmus glabra</i> Huds.	F	6	sca	6			apo
<i>Ulmus laevis</i> Pall.	F	3	rare	3			apo
<i>Urtica dioica</i> L.	H	23	com	16	7		apo
<i>Valerianella locusta</i> (L.) Laterr.	T	6	sca	2	4		arch
<i>Valeriana officinalis</i> L.	H	4	rare	3	1		apo
<i>Verbascum lychnitis</i> L.	H	11	oft	10	1		apo
<i>Verbascum nigrum</i> L.	H	3	rare	3			apo
<i>Verbascum thapsus</i> L.	H	5	sca	5			apo
<i>Veronica arvensis</i> L.	T	5	sca	3	2		arch
<i>Veronica chamaedrys</i> L.	C	12	oft	8	3	1	apo
<i>Veronica hederifolia</i> L.	T	2	rare	2			apo
<i>Vicia angustifolia</i> L.	T	2	rare	1	1		arch
<i>Vicia cracca</i> L.	H	9	sca	7	2		apo
<i>Vicia hirsuta</i> (L.) S.F.Gray	T	20	oft	14	6		arch
<i>Vicia tetrasperma</i> (L.) Schreb.	T	20	oft	15	5		arch
<i>Vicia villosa</i> Roth	T	10	oft	8	2		arch
<i>Viola arvensis</i> L.	T	17	oft	11	5	1	arch
<i>Viola odorata</i> L.	H	3	rare	1	2		arch

Explanations: RLF – Raunkiaer's life forms: F-phanerophyte, H-hemicryptophyte, G-geophyte, C-chamephyte, T-terophyte; NL- number of localities, DF-degree of species frequency: vra-very rare, rare-rare, oft-oft, sca- scattered, com-common; G-H G- geographical-historical group: apo-apophyte, arch-archeophyte, ken-kenophyte, erg-ergasiophyte, eph- ephemrophyte.

Śrem, treated as separate localities, and four smaller railway stops (Borowo, Szoldry, Grabianowo, and Manieczki), which constitute parts of the outlined research localities. A database was developed by records made during the route of the researchers along the line and the plant collection (150 herbarium sheets), which has been deposited in the Herbarium of Plant Taxonomy Department, Adam Mickiewicz University. The taxonomically verified collections permitted to compile a total list of plant species found along the railway line, as well as a list of «locality floras» (floristic lists) in reference to each of 37 distinguished localities. In the species card file, next to the locality number, there is recorded the numbers of particular species growing there, and they are arranged according to our 3-degree scale (1. single or several specimens, 2. from 10 to several tens of specimens, 3. specimens occurring in groups or in masses).

Plant nomenclature used in the study corresponds to the new version of *Plant Checklist* (Mirek et al., 2002). The affiliation to the geographical-historical classification for metaphytes (archeophytes and kenophytes) agrees, with a few exceptions, with the commonly accepted sources (Zajac, 1979; Zajac et al., 1998). The diaphytes category (efemerophytes and ergasiophytes) has been given to species which appear only transitionally on a given terrain and in a given region. A list of the identified species containing phytogeographical and ecological data is provided in Table 1.

Results and discussion

By its taxonomic structure, the flora is represented by ferns (4 species), horsetail (1 sp.), gymnosperms (2 sp.), and angiosperms (325 sp.). Totally, during our studies, the occurrence of 332 species has been registered, including 2 established hybrids (Table 1).

In particular research localities we registered from 51 to 177 species (fig. 1, A). However, a more detailed analysis of the species richness allows making several further observations. The highest and at the same time similar numbers of species are characteristic of the railway stations, as e.g. in the Czempin railway station locality (177 species) and in the Śrem railway station locality (165 sp.). On the other hand, railway stops show less abundant floras, with the following values: locality 9 — Borowo (87 sp.); locality 14 — Szoldry (86 sp.), locality 10 — Grabianowo (92 sp.) and locality 30 — Manieczki (93 sp.) (Fig. 1, A).

Distribution of species in the frequency classes agrees with the generally known tendency; however, comparatively unified ecological conditions make the variability between the frequency classes distinctly lower. It ranges from 26.8 % in the group of very rare species to 12.6 % among common species (Table 2). In comparison with the local flora (Żukowski et al. 1995), or regional floras, the number of rare species is lower, while the number of common species is significantly higher.

Floristic similarity patterns are rather interesting. Using the Steinhaus similarity coefficient, we found that the highest similarity (0.74) exists between the terminal stations Czempin and Śrem (Fig. 1, D), while the similarity coefficients of the remaining locality pairs (1:9; 9:14; 14:23; 23:30, and 30:37) range between 0.45 and 0.58 (Fig. 1, E). Values for the particular locality floras defined by the number of compared common species on the railway stops are shown in Table 3.

The comparison of the Raunkiaer's basic life forms also is rather not typical for this type of objects in Middle Europe (Piskorz, Czarna, 2006; Wrzesień, Świąś, 2006; Latowski, 2007). The greatest number of participants belongs to hemicyptophytes (43.7 %) and to therophytes (31.3 %), making together 3/4 of the total flora. The rest belongs to phanerophytes (13.6 %), geophytes (6.3 %), chamaephytes (4.8 %) and lianes (0.3 %). By the geographical-and-historical classification (Table 4), indigenous species (65.1 %) very dis-

Table 2. Frequency of occurrence of species

Qualification of frequency	Number of localities	Number of species	%
Very rare	1	89	26.8
Rare	2—4	81	24.4
Scattered	5—9	62	18.7
Oft	10—20	57	17.5
Common	21—37	42	12.6
Total		332	100.0

Table 3. Coefficient of floristic similarity (CFS*) between railway stations and way stations (upper part) and number of common species (lower part)

Number of locality – station	1 -Cz	9 -Bo	14 -Sz	23 -Gr	30 -Ma	37 -Śr
1 — Czempiń	1.0	0.45	0.42	0.53	0.53	0.74
9 — Borowo	60	1.0	0.57	0.50	0.45	0.48
14 — Szoldry	54	49	1.0	0.49	0.43	0.47
23 — Grabianowo	71	44	43	1.0	0.55	0.54
30 — Manieczki	72	40	38	50	1.0	0.54
37 — Śrem	126	61	59	69	70	1.0

*CFS = $2c/a+c$ (a-number of species in a given locality; b-number of species different locality; c-number of common species)

Table 4. The participation of geographical-historical groups

Name of group	Number of species	%
Apophytes	216	65.1
Antropohytes	116	34.9
Total	332	100.0
Metaphytes:	94	28.3
Archeophytes	52	15.7
Kenophytes	42	12.6
Diaphytes:	22	6.6
Ergasiophytes	19	5.7
Ephemerophytes	3	0.9

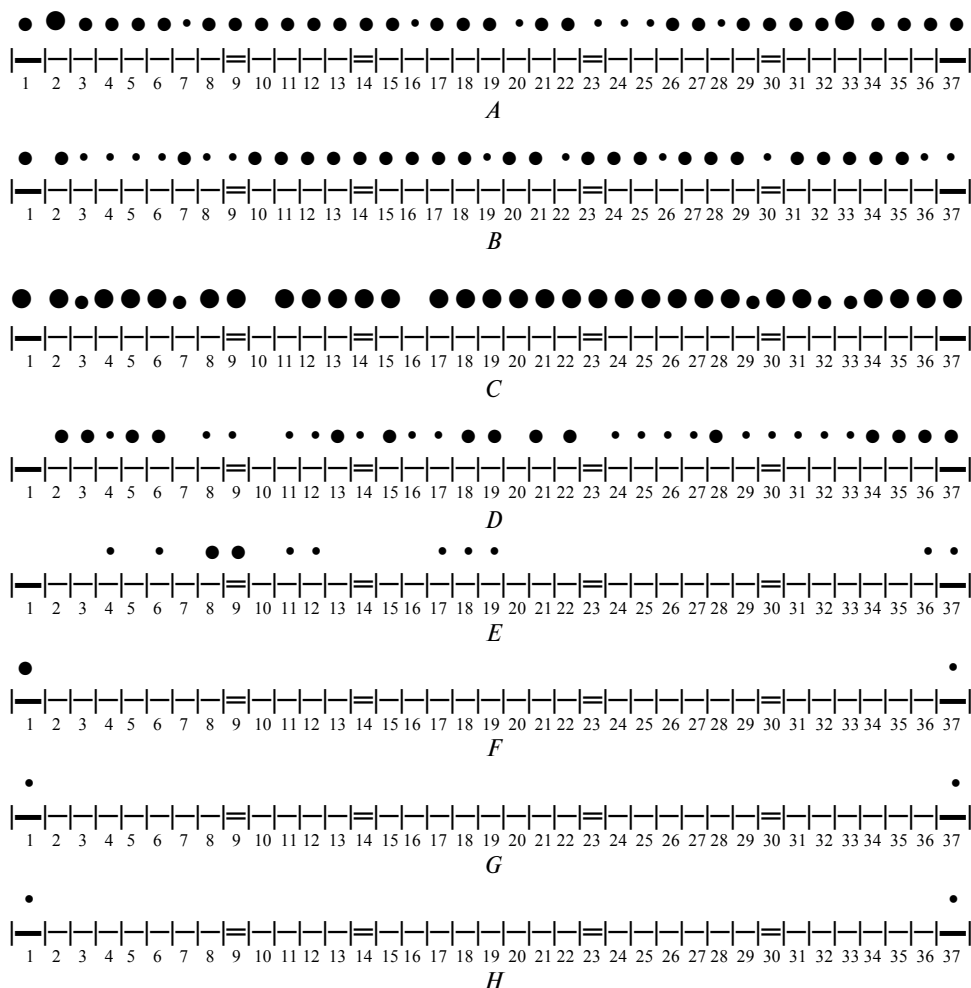


Fig. 2. Distribution of selected species: *A* — *Artemisia vulgaris*, *B* — *Hypericum perforatum*, *C* — *Arrhenatherum elatius*, *D* — *Pimpinella nigra*, *E* — *Barbarea vulgaris*, *F* — *Geranium pyrenaicum*, *G* — *Salsola tragus*, *H* — *Diplotaxis muralis*. Explanation of signs: • single (up to 10 plants), ● quite frequently, ● in groups (numerous)

tinctly dominate over all anthropophytes (34.9 %), and they exceed more than twice the group of alien species (28.3 %) being permanently domesticated in Poland.

For the analysis of anthropogenic transformations of the synanthropic flora described in the literature (Kornaś, 1977), the coefficient of modernization (M) was also applied. It is expressed by the quotient of domesticated kenophytes in relation to archeophytes ($M = \text{kenophytes}/\text{archeophytes}$). The value calculated from this formula is 0.81. The modernization coefficient of flora, calculated according to Kornaś (1977), is very similar (0.77). It has been calculated for a similar railway line: Dąbrowa Górnicza — Olkusz in the Śląsko-Krakowska Upland (Nowak, 1997), which is several hundred kilometers away from the area of our studies.

Among the common species, the most frequent ones include *Artemisia vulgaris* and *Hypericum perforatum*, which were registered in all localities (Fig. 2, A, B). There also occur in a decreasing succession the following common species: *Artemisia campestris* and *Silene vulgaris* (36 localities), *Arrhenatherum elatius*, *Rubus caesius* and *Sedum acre* (35 loc.), *Achillea millefolium*, *Securigera varia* (*Coronilla varia*), *Dactylis glomerata* and *Galium verum* (34 loc.), *Echium vulgare*, *Galium mollugo* and *Poa compressa* (33 loc.), *Euphaorbia cyparissias*, *Linaria vulgaris*, *Pimpinella nigra* and *Poa pratensis* (32 loc.), *Pastinaca sativa* and *Potentilla reptans* (31 loc.), and *Equisetum arvense*, *Lactuca serriola* and *Melilotus officinalis* (30 loc.) (Fig. 2).

The greatest biomass resources in the flora refer to species which in the majority of localities reach the 2nd and the 3rd degree. They include *Acinos arvensis*, *Arrhenatherum elatius* (Fig. 2, C), *Galium mollugo*, *Galium verum*, *Medicago x varia*, *Poa compressa*, *Potentilla reptans*, *Sedum acre*, *Silene vulgaris* (Table 1).

In the floras of the studied railway line, species of singular occurrence have been found, which include *Aegilops cylindrica*, *Asplenium trichomanes* (found on an overloading ramp wall), *Bromus japonicus*, *Heracleum mantegazzianum*, *Lepidium virginicum*, *Phegopteris robertiana* (overloading ramp wall), *Pimpinella nigra*, *Sanguisorba muricata*, *Sisymbrium wolgensense*. Distribution of a repetitive type of occurrence, although different, is represented, for example, by *Barbarea vulgaris* (Fig. 2, E), *Geranium pyrenaicum*, *Salsola tragus* (*S. kali* ssp. *ruthenica*) and *Diplotaxis muralis* (Fig. 2, F, G, H).

Conclusions

Floristic studies carried out on the Czempień — Śrem local railway line located in the Wielkopolska region (NW Poland) permit to outline the following observations:

1. Taking into consideration a rather narrow belt of the studied area (total about 10 ha) occupied by the railway line and the adjacent shoulders and railway stations, the vascular plant flora is comparatively rich.

2. Frequency distribution agrees with the principle of the highest participation by very rare species and a gradual frequency decrease of the remaining plant classes.

3. In the geographical-and-historical division of the flora, indigenous species (apophytes) distinctly dominate, while the structures of Raunkiaer's life forms are decidedly dominated by hemicryptophytes.

4. A comparative analysis demonstrated that the highest similarities are shown by plants in the first and in the terminal localities, i.e. locality 1 — Czempień railway station and locality 37 — Śrem railway station.

5. Next to the species most frequently encountered on the studied railway line, a number of floristic singularities have been met and some of them have demonstrated a particular predilection for railway areas.

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ХАРАКТЕРИСТИКА ФЛОРИ СУДИННИХ РОСЛИН ПОБЛИЗУ ЗАЛІЗНИЧНОЇ ЛІНІЇ (ЗАХІДНА ПОЛЬЩА)

У статті висвітлені результати геоботанічних досліджень, проведених у 2003—2004 рр. і влітку 2009 р., поблизу залізничної колії у Великопольському регіоні Польщі, між залізничними станціями Чемпіон і Стрем, загальною протяжністю близько 20 км. Вивчено видовий склад судинних рослин, які спонтанно попадають на обстежувану територію.

Флора залізничних колій нараховує 332 види; в їхньому складі домінують апофіти над антропофітами. За таксономічним складом найчисельнішими є види родин *Asteraceae* та *Poaceae*. Так, *Artemisia vulgaris* і *Hypericum perforatum* найчастіше трапляється у всіх локалітетах.

Наші дослідження також показали, що, незважаючи на локальний характер видового складу території залізниці, в ньому відмічені рослини, які характерні для залізниць. Серед них — *Aegilops cylindrica*, *Bromus japonicus*, *Bunias orientalis*, *Lepidium virginicum*.

Порівняння флори з шести локалітетів на залізничній колії між першою станцією (Чемпі) та останньою (Стрем) свідчить про високий ступінь їхньої подібності (коефіцієнт подібності 0,74 — за Стейнхаусом).

К л ю ч о в і с л о в а: судинні рослини, Польща, частота, розповсюдження, коефіцієнт подібності.

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ХАРАКТЕРИСТИКА ФЛОРЫ СОСУДИСТЫХ РАСТЕНИЙ ВБЛИЗИ ЖЕЛЕЗНОДОРОЖНОЙ ЛИНИИ (ЗАПАДНАЯ ПОЛЬША)

В статье представлены результаты геоботанических исследований, проведенных в 2003—2004 гг. и летом 2009 г., вблизи железнодорожной линии в Великопольском регионе Польши, между железнодорожными станциями Чемпион и Стрем, общей протяженностью около 20 км. Изучен видовой состав сосудистых растений, которые спонтанно попадают на исследуемую территорию.

Флора железнодорожных путей насчитывает 332 вида, в их составе четко доминируют апофиты над антропофитами. По таксономическим составом самыми многочисленными являются представители семейств *Asteraceae* и *Poaceae*. *Artemisia vulgaris* и *Hypericum perforatum* чаще всего встречается у всех локалитетов.

Наши исследования также показали, что, несмотря на локальный характер видового состава железной дороги, в нем представлены частично растения, характерные для территории железных дорог. Среди них — *Aegilops cylindrica*, *Bromus japonicus*, *Bunias orientalis*, *Lepidium virginicum*.

Сравнение флоры с шести локалитетов на железнодорожном пути между первой станцией (Чемпи) и последней (Стрем) показывает высокую степень их сходства (коэффициент сходства 0,74 — по Стейнхаусу).

К л ю ч е в ы е с л о в а: сосудистые растения, Польша, частота, распространение, коэффициент сходства.