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The flora of the former Łęczyca iron ore dumps

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Abstract: Iron ore mines of the Łęczyca region started operating in the sixties and seventies of the 20th century and brought about considerable changes in the agricultural landscape of the town of Łęczyca and its vicinity. As a result of the ore exploitation, rock dumps as well as local depressions were created there. The subject of the present research was flora occurring in areas transformed by iron ore mining in the Łęczyca region. The flora is of spontaneous and anthropogenic (as a result of planting – reclamation) character. The results of the conducted research indicate that areas transformed by mining significantly increase their biological diversity.

Key words: ore mine dumps, flora, Łęczyca, Middle Poland

1. Introduction

Geological drilling carried out at the town of Łęczyca and its vicinities in 1953-1954 testified to the occurrence of iron ore deposits there. In 1955 a mine of siderite iron ore started operating in the area. The towers of Łęczyca mines and high dumps that then appeared became a new element of the landscape of the town and its surroundings. Łęczyca became a new mining center in Poland. The mine functioned until 1992, when a demolition of buildings and liquidating of dumps, the slate of which was used for the production of cement in the Działoszyn and Kujawy cement works, began. Till today three dumps have remained, two at Łęczyca and one at the village of Topola Królewska (Borucki 1997; Grodzka 1963, 1972; Kłosiński & Kowalewski 1987; Liszewski 2001; Solarski 1992; Solarski *et al*. 2000; Ziomek 2008).

The present study documents the composition of the flora of the three post iron ore excavation dumps at Łęczyca and its neighbourhood (Fig. 1). Although one of the dumps is still being exploited it may be presumed that this characteristic component of the landscape of Łęczyca and its vicinities will disappear for ever in the near future. Thus, documenting the floristic composition of the still present dumps constitutes an important contribution to the knowledge of the Łęczyca region's flora (Siciński 2000; Warcholińska *et al*. 2001).

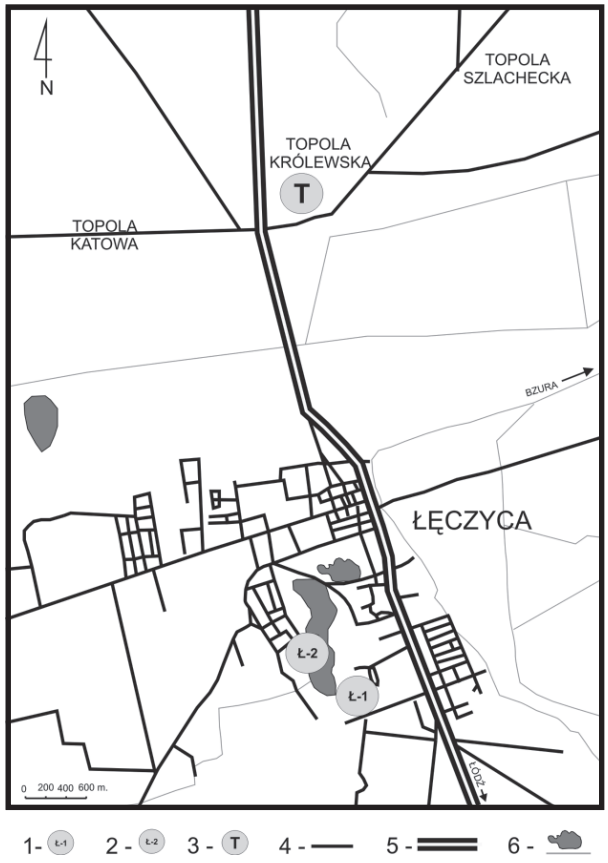

Fig.1. Localization of investigated dumps

Explanations: 1 – Łęczyca-ŁMWJ-SC (Łęczyca Mine Works Joint-Stock Company), 2 – Łęczyca – Town Reservior, 3 – Topola Królewska, 4 – routs, 5 – motorway, 6 – reservoirs, rivers and channels

CHOROLOGY

Fig. 2. Iron ore dump in Łęczyca at Górnicza Str.

2. Material and methods

The first of the three dumps is located in Łęczyca at Górnicza Str., to the west of the present Łęczyca Mine Works Joint-Stock Company (Fig. 2). The dump is a mountain with not very steep slopes, and a flat top. On its western side, it is partially exploited owing to high amounts of spoil (gob) rock that can be used in cement industry. However, a considerable amount of rocky material also causes that the habitat is unfavourable for plants.

The second dump at the town is located to the east of the Łęczyca Railway Station, towards the Town Reservoir. It is in a typical shape of a mine dump. It is a cone with steep slopes, rising from west to east. This dump is situated at the former ventilation shaft of a mine.

The third dump is located at the village of Topola Królewska, about 2 km to the north of Łęczyca, at Road No 1. It is located behind the former APAREL Metal-Electric Equipment Works. It is surrounded by agricultural fields on all its sides. It is cone-shaped with a small flat surface at its top.

Floristic investigations in the area of the three dumps at Łęczyca and Topola Królewska were carried out in 2001-2008. They consisted in making lists of vascular plants of given dumps. Both plant species that sporadically appeared on the dumps and those that were introduced there as a result of reclamation measures, sowing or planting, were considered. Plant names are given after Mirek *et al*. (2002).

3. Results

The vascular flora of the Łęczyca iron ore mines comprises 98 vascular plant species, belonging to 76 genera and 24 families (Table 1). The floristically richest

Table 1. List of vascular plant species recorded on the iron ore dumps at Łęczyca and Topola Królewska

Species name	Geographic-historical groups	Ł1	Ł2	T
Acer campestre L.	Kn	.	+	.
Acer negundo L.	Ap	+	+	.
Acer platanoides L.	Ap	+	.	+
Acer pseudoplatanus L	Ap	+	.	.
Achillea millefolium L.	Ap	.	+	+
Agrimonia eupatoria L.	Ap	.	.	+
Alopecurus pratensis L.	Ap	.	+	.
Arrhenatherum elatius (L.) P. Beauv. ex J. Presl & C. Presl	Ap	+	.	+
Artemisia campestris L.	Ap	+	.	.
Artemisia vulgaris L.	Ar	+	+	+
Asparagus officinalis L.	Ap	.	.	+
Avenula pubescens (Huds.) Dumort.	Ap	.	+	.
Bromus inermis Leyss.	Ar	.	+	.
Bromus tectorum L.	Ap	+	+	.
Calamagrostis epigeios (L.) Roth.	Ar	+	.	+
Camelina microcarpa Andrz.	Ap	+	.	.
*Carex hirt*a L.	Ap	+	.	.
Centaurea stoebe L.	Ap	+	.	+
Cerastium holosteoides Fr. emend. Hyl.	Kn	+	.	
Cerasus mahaleb (L.) Mill.	Ap	.	.	+
Cerasus vulgaris Mill.	Ar	+	.	.
Cichorium intybus L.	Ap	+	+	.
Cirsium arvense (L.) Scop.	Ap	+	.	+
Cirsium vulgare (Savi) Ten.	Ap	+	.	.
Convolvulus arvensis L.	Kn	+	+	+
Cornus alba L.	Ap	+	.	.
Crataegus monogyna Jacq.	Ap	+	+	+
Dactylis glomerata L.	Ap	+	+	+

Daucus carota L.	Kn	+	+	+
Diplotaxis muralis (L.) DC	Ar	+	+	+
Echium vulgare L.	Ap	+	.	+
Elymus hispidus (Opiz) Melderis	Ap	.	.	+
Elymus repens (L.) P.B.	Ap	+	+	.
Equisetum arvense L.	Ap	.	.	+
Erigeron acris L.	Kn	+	.	+
Erigeron annuus (L.) Pers.	Ap	+	+	+
Festuca pratensis Huds.	Ap	.	+	.
Festuca rubra L.	Kn	+	.	+
Fraxinus pennsylvanica Marschall	Ap	+	+	.
Galium mollugo L.	Ap	.	.	+
Geum urbanum L.	Ap	+	.	.
Hieracium pilosella L.	Ap	+	.	.
Hieracium umbellatum L.	Ar	.	.	+
Hordeum murinum L.	Ap	.	+	
Hypericum perforatum L.	Ap	+	.	+
Hypochoeris radicata L.	Ar	+	.	+
Lactuca serriola L.	Kn	+	+	.
Lathyrus tuberosus L.	Ar	+	.	.
Lepidium campestre (L.) R. Br.	Ap	+	.	.
Leucanthemum vulgare Lam.	Ap	.	.	+
Lolium perenne L.	Ap	+	+	.
Lotus corniculatus L.	Ap	+	.	.
Malus sylvestris Miller	Ar	+	+	+
Matricaria maritima L. subsp. *inodora* (L.) Dostal	Kn	+	.	.
Medicago sativa L.	Ar	+	+	+
Melilotus officinalis (L.) Pallas	Ap	+	.	.
Oenothera biennis L.	Ap	+	.	.
Padus avium Mill.	Kn	+	.	.
Padus serotina (Ehrh.) Borkn.	Ap	.	.	+
Pastinaca sativa L	Ap	+	+	+
Phleum pratense L.	Ap	.	.	+
Phragmites australis (Cav.) Trin. et Stendel	Ar	.	.	.
Plantago lanceolata L.	Ap	+	.	+
Poa compressa L.	Ap	+	+	+
Poa pratensis L.	Ap	+	+	+
Poa trivialis L.	Ap	.	+	.
Polygonum amphibium L. f. *terrestre*	Ap	+	.	.
Populus alba L.	Kn	.	.	+
Populus simonii Carriere	Ap	+	+	.
Populus tremula L.	Kn	.	.	+
Prunus cerasivera Ehrh.	Ar	+	.	+
Pyrus communis L.	Kn	+	+	.
Reseda lutea L.	Kn	+	+	.
Robinia pseudoacacia L.	Ap	+	.	.
Rosa canina L.	Ap	+	.	.
Rosa sp.	Ap	+	.	.
Rubus caesius L.	Ap	+	.	.
Rumex crispus L.	Ap	+	+	.
Salix alba L.	Ap	+	.	.
Sambucus nigra L.	Erg	+	.	+
Secale cereale L.	Ap	.	+	.
Sedum acre L.	Ap	+	.	.
Senecio jacobaea L.	Ap	.	.	+
Silene vulgaris (Moench) Garcke	Kn	+	.	.
Sisymbrium loeselii L.	Kn	+	.	.
Solidago gigantea Aiton	Ap	+	.	.
Sonchus arvensis L.	Ap	+	.	+
Sorbus aucuparia L. emend. Hedl.	Kn	+	+	.
Sorbus intermedia (Ehrh.) Pers.	Ap	+	+	+
Tanacetum vulgare L.	Ap	.	.	+
Taraxaum officinale F. H. Wigg.	Ap	.	+	.
Tragopogon dubius Scop.	Ap	+	+	.
Tragopogon orientalis L.	Ap	.	+	.

Trifolium pratense L.	Ap	+	+	+
Tussilago farfara L.	Ap	+	+	+
Vicia cracca L.	Ar	.	.	+
Vicia hirsuta (L.) S. F. Gray	Kn	.	.	+
Vicia villosa Roth.	Kn	+	.	+

Explanations: Ł1 – Łęczyca-ŁMWJ-SC (Łęczyca Mine Works Joint-Stock Company), Ł2 – Łęczyca-Town Reservoir, T – Topola Królewska; Ap – apophytes, Ar – archeaophytes, Kn – kenophytes, Erg – ergasiophytes

was the dump at the Łęczyca Mine Works, on which 70 species were recorded. Decidedly fewer species (47) were found on the dump at Topola Królewska and the lowest species number on the dump at the Town Reservoir, only 39 taxa.

15 taxa were recorded on all three objects, 29 on two of them and 54 on only one of them. Species observed at all the three sites should be considered the most strongly associated with this type of habitats. They include, among others: *Artemisia vulgaris*, *Convolvulus arvensis*, *Crataegus monogyna*, *Dactylis glomerata*, *Daucus carota*, *Diplotaxis muralis*, *Erigeron annuus*, *Poa compressa*, *Trifolium pratense*, *Tussilago farfara*. The difference in the number of species beetwen the investigated dumps are caused by a lot of factors: kinds of material and management of the dumps, and their localization. The above dependences and intraspecific competition are very important too. The first dump (Łęczyca at Górnicza Str.) is only partially covered by plants, and it has good conditions for the development of different plant species. The dump in the village of Topola Królewska is situated among agricultural fields. It is covered by vegetation in 90%. The third of the dumps (Łęczyca Railway Station) was reclaimed with different plants of *Papilionaceae*, especially *Medicago sativa*. This species is very effective in dumps reclamation.

In the flora of the dumps, the families *Asteraceae* (22%), *Poaceae* (19%) and *Rosaceae* (15%) were most frequently represented. Among vascular species dominated plants that spontaneously invade dumps as a result of secundary succession. Besides them, species that were artificially introduced onto the dumps during their reclamation, e.g. *Medicago sativa*, *Sorbus intermedia*, *Populus simonii*, *Acer campestre* and *Cornus alba*, were also recorded.

In terms of the participation of geographic-historic groups, native species decidedly dominated (67 species of apophytes). The others, such as kenophytes (17), archaeophytes (13) and ergasiophytes (1) contributed much less to the composition of the dumps' flora (Fig. 3).

In terms of morphological types of plants that are expressions of adaptation to living in particular conditions – hemicryptophytes (47), megaphanerophytes (17), therophytes (11) and geophytes (10) dominated in the flora (Fig. 4).

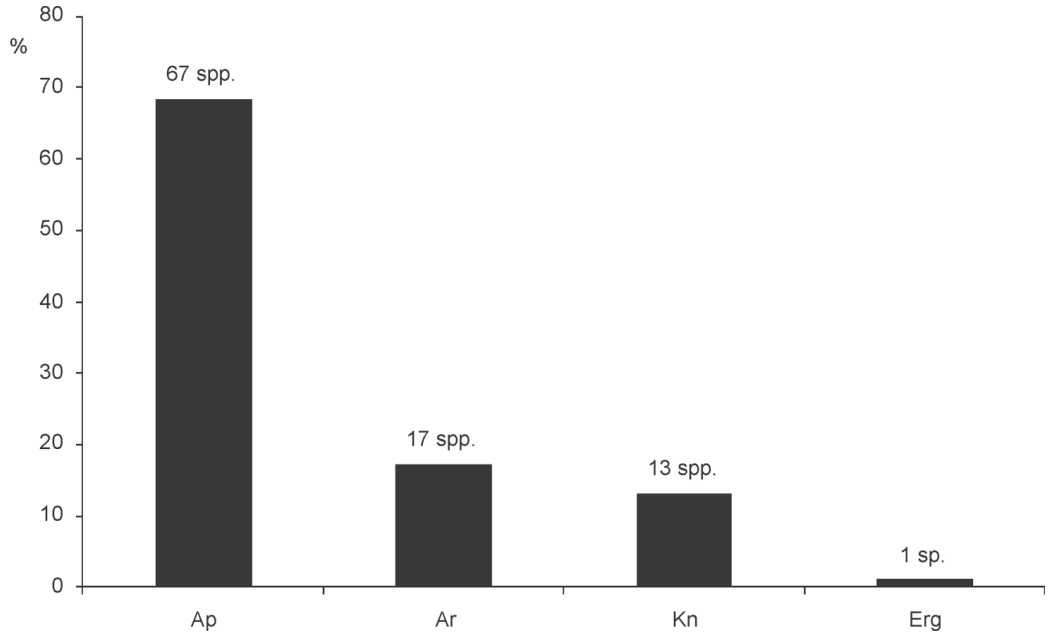

Fig. 3. The contribution of various geographic-historic groups to the flora of iron ore mine dumps of the Łęczyca region
Explanations: see Table 1

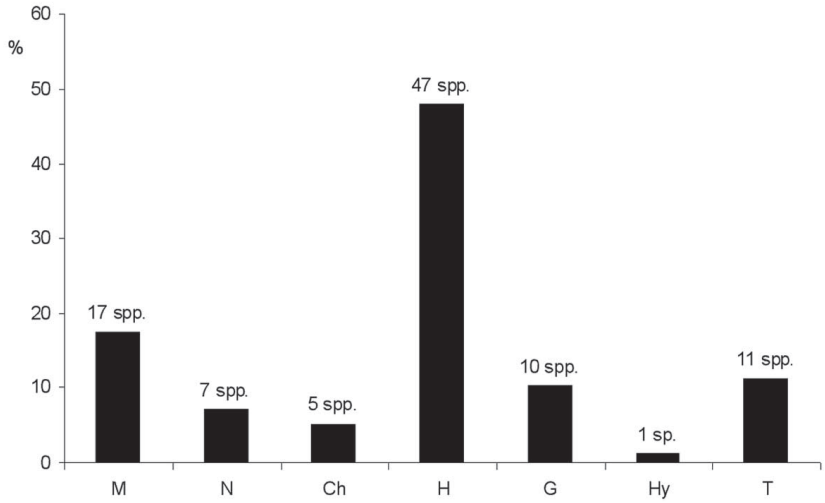

Fig. 4. Life forms of plants, according to Raunkiaer (1934), in the flora of iron ore mine dumps of the Łęczyca region
Explanations: M – megaphanerophytes, N – nanophanerophytes, Ch – chamaephytes, H – hemicryptophytes, G – geophytes, Hy – hydrophytes, T – therophytes

The study showed that in the flora of the dumps prevail species that are common in this part of the country, while there is a lack of rare and protected species.

4. Final remarks

The Łęczyca Mining Works operated in 1955-1992, causing changes in the landscape of the town and its vicinities. As a result of exploitation, dumps of gob rock appeared as well as local terrain depressions – synclines. The flora of these dumps is of a spontaneous character but also of an anthropogenic character (result of reclamation planting). Hence, two kinds of plant species are recorded in this area (Jochimsen 1982; Krzaklewski 1984; Siciński & Sowa 1986; Sieradzki 1998; Ziemnicki & Fijałkowski 1975). The obtained results testify to the fact that the dumps are good habitat for the development of different, common species of plants, which were also noted in the neighbouring areas.

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