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VASCULAR FLORA OF THE LĘBORK CLAYS EXCAVATIONS IN THE ŁEBA-REDA MARGINAL STREAM VALLEY (N POLAND)

Zbigniew Sobisz[1], Zbigniew Osadowski[1], Mariola Truchan[1], Anna Włodarczyk[2]

[1] *Department of Botany and Nature Protection, Institute of Biology and Environmental Protection, Pomeranian University,*
ul. Arciszewskiego 22b, 76-200 Słupsk, Poland
e-mail: zbigniew.sobisz@apsl.edu.pl, mariola.truchan@apsl.edu.pl
zbigniew.osadowski@apsl.edu.pl
[2] *Scientist Botanist Circle, Pomeranian University,*
ul. Arciszewskiego 22b, 76-200 Słupsk, Poland
e-mail: a.wlodarczyk@gmail.com

Abstract

This paper presents results of research vascular flora at the area of the excavation of the Lębork clays was conducted in the period 2014-2016. 227 species of vascular plants were found at five distinct microhabitats: heaps top, greensword initial stages, heaps grassy slopes, land hollows and forest edge communities. The rare species at the area of Gdańskie Pomerania is *Fumaria vaillantii* and potentially endangered at the area of Western Pomerania. The six species found in the area under consideration, according to the regional list, have the status of the rare and endangered ones, i.e.: *Alchemilla monticola*, *Alyssum alyssoides*, *Batrachium aquatile*, *Consolida regalis*, *Lathyrus tuberosus*, *Thlaspi perfoliatum* and *Veronica verna*.

Key words: excavation, microhabitats, rare and endangered plants, Pomerania

INTRODUCTION

The flora of excavations, sand and gravel pits, stone quarries as well as typical anthropogenic habitats due, among others, to their abundance, presence of rare objects and objects close to extinction and due to their economic importance, had already been an object of interest for botanists before (Woźniak and Sierka 2005, Bzdon 2006, Bzdon and Ciosek 2006). Elements of this type are specific objects of the landscape of all industrialized regions of Europe. Their management is complicated, since on one hand, due to industrial activity, flora and landscape have been permanently altered or even destroyed, and on the other hand, new valuable habi-

tats are created (Woźniak and Sierka 2005). Use of gravel, sand, aggregate and other raw materials has impact on the diversity of the surface feature forms such as: hollows, heaps, uncovered slope surfaces, elevations and slides. It has impact on the abundance of biotope conditions and diversity of plant associations. Diversity of phytocenoses is also dependent on the length of human activity in a given excavation and the period of time which passed since abandoning the exploitation (Borówka 2004). Post-industrial areas can seemingly be recognized as deficient, however, the results of numerous floristic research studies indicate that substantially deformed areas may comprise valuable habitats (biotopes) for many species. During plant succession, unique biocenotic systems are formed at unrecultivated parts of excavations, which often create habitats for rare, endangered and protected species (Bzdon and Ciosek 2006). Elements of this type, as well as other ecological margins, constitute alternative refugia for important taxa (Bzdon 2006). Post-exploitation excavations represent great natural importance as a consequence of abandonment of mining, which is often worth protection and research (Badora et al. 2003).

The aim of the study comprised characterization of the vascular flora found at the site of the Lębork clays excavation in the Łeba – Reda Marginal Stream Valley.

STUDY AREA

The according to the regional classification by Kondracki (2001) used in this study, the studied area is located within the Łeba and Reda Marginal Stream Valley. The borders of then study area ground in Lębork are: from the west Kossak Street, from the east Syrokomla Street and Kębłowska Street, from the north the administrative boundary of Nowa Wieś Lęborska village (Fig. 1).

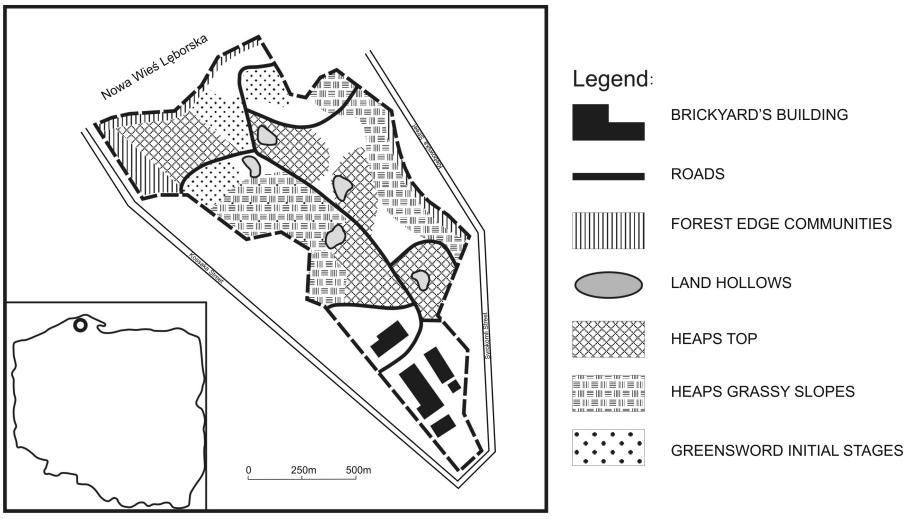

Fig. 1. Plan of the Lębork clays excavation

The total coverage of the studied area is 52.5 ha. With reference to geobotanical division of Western Pomerania (Szafer 1972) the study area belonging to Baltic Coastal Zone District. The area Łeba and Reda Marginal Stream Valley, included by Woś (1999) in the Northern-Pomeranian Region, remains under the clear influence of the Baltic Sea. The climate of this area is distinguished by warmer winters and cooler summer months, later spring and longer autumn, relatively high annual rainfall (650-700 mm) and high air humidity (annual average 11%). In this area the mean ambient temperature of January (-1.8°C, but in July it is 16.8°C – annual average 7.4°C (Friedrich et al. 1980).

The Lębork silts are an example of a sedimentation record of a spacious marginal lake at the foreground of the Vistulian continental glacier withdrawing towards the Baltic basin, created within the area of Łeba Postglacial Stream Valley (Rachlewicz 2010). The Łeba-Reda Marginal Stream Valley is a well formed valley form at the South Baltic Littoral Area formed during the recession of glaciation with the area of present Poland and outflow of the melt waters westwards. It covers the area of 350 km² and is 92 km long. Its width is from 1.2 km in the area of Wejherowo to 5.5 km at the outlet at the Słowińskie Coast. At present, it outflows into two directions: by the Łeba River to the North West and with Reda to the East into the Puck Bay. The bottom of the Marginal Stream Valley is covered with peat. It constitutes a natural border between the shoreline and the lakeland areas (Marsz 1984).

That area had already been identified and examined before the World War II by German geologists (Kohlhoff 1918, Schneider 1925). According to Morawski (1991), the Lębork marginal lake was created during retreat of the edge of the continental glacier towards Gardna-Łeba Lowland, when the main outflow of waters from the front of the head of the glacier went westward, and by the recently uncovered Reknica Tunnel Valley (from the North) and through the Kiszewa Tunnel Valley (from the North East). Directly to the West from the marginal lake, there were levels of earlier accumulated sands blocking outflow of waters through the proper bottom of the Łeba Marginal Stream Valley. The finest material was deposited in the center of the basin over the area of about 25 km^2, while at the bottoms of the connecting tunnel valleys silt and sand was deposited. During the subsequent stage of the recession of the Continental glacier, the water supply to the marginal lake area ended and the locally originating underflows (Reknica and Kiszewa) started to cut the surface of the marginal lakes sediments surface. At the same time, a dynamic outflow of waters through the main marginal lake course took place causing erosion of a substantial part of the southern part of the fragment of the marginal lake basin, transformation of the altitude levels and finally, covering of the bottom of the marginal stream valley with gravel and sand deposits took place. The surface layer sediments made of clay and fine sand are the remnants of the initial marginal lake with the thickness of 16 m. They comprise layer molded clays and fine slimes (Rachlewicz 2010).

At present, the Lębork silts has been used by Wienerberger Building Ceramics as a raw material for production of construction materials. This area has been completely transformed from anthropogenic point of view, very diversified as to biotope conditions for development of flora and vegetation.

MATERIAL AND METHODS

The research study of the vascular flora at the area of the excavation of the Lębork clays was conducted in the period 2014-2016. The names of the vascular plants were adopted after Mirek et al. (2002). The list of species and families was presented in the alphabetical order. By each taxa, the kind of a microhabitat was provided, as was earmarked at a given area of research. The place of taxa in geographical and historical classification, with consideration of a specific character of the region, was specified on a basis of the lists: Zając (1979), M. Zając and A. Zając (1992), Zając et al. (1998). Threat categories for Western Pomerania were given after Żukowski and Jackowiak (1995), for Gdańsk Pomerania after Markowski and Buliński (2004) and for Mecklenburg-Vorpommern after Voigtländer et al. (2005).

OVERVIEW OF RESULTS

At the area of the excavation of the Lębork clays, 227 species of vascular plants were found at five distinct microhabitats: heaps top, greensword initial stages, heaps grassy slopes, land hollows and forest edge communities (Table 1).

The species found at the study area belong to 158 genera and are representatives of 41 families. The number of species in particular families varies from 1 to 34. The most abundant families are: *Asteraceae* (34), *Brassicaceae* (22), *Poaceae* (20), *Fabaceae* (14), *Rosaceae* (13) and *Caryophyllaceae* (11), and 7 families are represented by 1 species. Among the recognized species 132 apophytes (Ap), 36 non-synanthropic spontaneophytes (Sp), 35 archaeophytes (Ar), 18 kenophytes (Ken), 6 diaphyta (D) were found. Among the Raunkiaer life forms, the dominant are hemicryptophytes (H) – 91 species and therophytes (T) – 78 species. In addition, 21 geophytes (G), 12 hydrophytes (Hy), 11 nano phanerophytes (N), 10 mega phanerophytes (M), 8 helophytes (Hel), 4 dendritic chamaephytes (Ch), and 4 hydrophytes (Hyd) were found. Similar tendencies as to domination of representatives of particular families, geographical-historical groups and life forms were found in other objects of this type in Poland. Konopska (2011) at the site of a closed sand and gravel excavation pit near the road Marszewo–Stargard Szczeciński and Piżuch et al. (2011) at the premises of a closed down "Bogucianka" quarry in Tyniec discovered dominance of species belonging to the families: *Asteraceae*, *Poaceae* and *Fabaceae*. At those two sites, the dominant geographic and historical groups were apophytes and archeophytes, and the life forms hemicryptophytes and therophytes, as at the area of the Lębork clays excavation.

The heaps grassy slopes formed by perennial plants with a big proportion of grasses are the most species abundant (Szweykowska and Szweykowski 2003). This habitat is represented by 82 species, which constitutes 36.12% of the examined flora. The grassy slopes are dominated by such plants as *Asteraceae* (18.29%) and *Fabaceae* (14.63%), apophytes are the geographic and historical group (67.07%), and among the life forms, the most numerous are hemicryptophytes (45.12%).

Land hollows, i.e. water holes – small artificial or natural water reservoirs which play an important role for ecotone in natural environment and in agrocenoses (Czachorowski 1993) are represented by 60 species which constitutes 26.43% of the examined flora.

Table 1

A list of vascular flora on the Lębork clays excavations

Family/taxa	Geographical-historical groups	Life form groups	Microhabitats	Category of threat		
				Żukowski and Jackowiak 1995	Markowski and Buliński 2004	Voigtländer et al. 2005
1	2	3	4	5	6	7
ACERACEAE						
Acer platanoides L.	Ap	M	forest edge communities	-	-	-
Acer pseudoplatanus L.	Ap	M	forest edge communities	-	-	-
ALISMATACEAE						
Alisma plantago-aquatica L.	Ap	Hel	land hollows	-	-	-
APIACEAE						
Aegopodium podagraria L.	Sp	H	heaps top	-	-	-
Aethusa cynapium L.	Ar	T	heaps grassy slopes	-	-	-
Anthriscus sylvestris (L.) Hoffm.	Ap	H	heaps grassy slopes	-	-	V
Daucus carota L.	Ap	T	heaps grassy slopes	-	-	-
Heracleum sibiricum L.	Ap	H	forest edge communities	-	-	-
Hydrocotyle vulgaris L.	Sp	H	land hollows	-	-	V
Peucedanum oreoselinum (L.) Moench	Sp	H	heaps grassy slopes	-	-	-
Torilis japonica (Houtt.) DC.	Ap	T	heaps grassy slopes	-	-	-
ASTERACEAE						
Achillea millefolium L.	Ap	G	heaps grassy slopes	-	-	-
Anthemis arvensis L.	Ar	T	greensword initial stages	-	-	V
Arctium lappa L.	Ap	T	land hollows	-	-	-
Artemisia vulgaris L.	Ap	H	land hollows	-	-	-
Aster novi-belgii L.	Ken	Ch	heaps grassy slopes	-	-	-
Bellis perennis L.	Sp	H	heaps grassy slopes	-	-	-
Bidens tripartita L.	Ap	T	land hollows	-	-	-
Centaurea cyanus L.	Ar	T	heaps top	-	-	V
Chamomilla suaveolens (Pursh) Rydb.	Ken	T	greensword initial stages	-	-	-
Cichorium intybus L.	Ar	H	heaps top	-	-	-
Cirsium arvensis (L.) Scop.	Ap	G	heaps grassy slopes	-	-	-
Conyza canadensis (L.) Cronquist	Ken	H	heaps top	-	-	-
Galinsoga parviflora Cav.	Ken	T	heaps top	-	-	-
Gnaphalium uliginosum L.	Ap	T	land hollows	-	-	-
Helianthus tuberosus L.	Ken	G	land hollows	-	-	-
Hieracium murorum L.	Sp	H	greensword initial stages	-	-	R
Hieracium pilosella L.	Ap	H	greensword initial stages	-	-	-
Hieracium umbellatum L.	Ap	H	heaps grassy slopes	-	-	-
Lactuca serriola L.	Ar	T	greensword initial stages	-	-	-
Leontodon autumnalis L.	Ap	H	heaps grassy slopes	-	-	-

1	2	3	4	5	6	7
Leucanthemum vulgare Lam.	Ap	H	heaps grassy slopes	-	-	-
Matricaria maritima L. subsp. *inodora* (L.) Dostál	Ar	T	greensword initial stages	-	-	-
Senecio jacobaea L.	Ap	H	greensword initial stages	-	-	-
Senecio vernalis Waldst. & Kit.	Ken	T	greensword initial stages	-	-	-
Senecio vulgaris L.	Ar	T	heaps grassy slopes	-	-	-
Solidago canadensis L.	Ken	H	heaps grassy slopes	-	-	-
Solidago gigantea Aiton	Ken	G	heaps grassy slopes	-	-	-
Solidago virgaurea L.	Sp	H	heaps grassy slopes	-	-	-
Sonchus arvensis L.	Ap	G	land hollows	-	-	-
Sonchus asper (L.) Hill	Ar	T	heaps grassy slopes	-	-	-
Tanacetum vulgare L.	Ap	H	heaps grassy slopes	-	-	-
Taraxacum officinale Web.	Ap	H	heaps grassy slopes	-	-	-
Tragopogon pratensis L.	Ap	T	heaps grassy slopes	-	-	-
Tussilago farfara L.	Ap	G	heaps top	-	-	-
BETULACEAE						
Alnus glutinosa (L.) Gaertn.	Sp	M	land hollows	-	-	-
Betula pendula Roth	Ap	M	forest edge communities	-	-	-
Betula pubescens Ehrh.	Sp	M	land hollows	-	-	-
BORAGINACEAE						
Anchusa officinalis (L.) M. Bieb.	Ap	H	greensword initial stages	-	-	-
Echium vulgare L.	Ap	T	heaps top	-	-	-
Myosotis arvensis (L.) Hill.	Ar	T	heaps grassy slopes	-	-	-
Symphytum officinale L.	Sp	H	land hollows	-	-	-
BRASSICACEAE						
Alyssum alyssoides (L.) L.	Ap	T	heaps top	-	-	3
Alliaria petiolata (M. Bieb.) Cavara & Grande	Ap	T	greensword initial stages	-	-	-
Arabidopsis thaliana (L.) Heynh.	Ap	T	heaps top	-	-	-
Armoracia rusticana P. Gaertn., B. Mey. & Scherb.	Ar	G	land hollows	-	-	-
Berteroa incana (L.) DC.	Ap	T	heaps top	-	-	-
Brassica napus L.	D	T	greensword initial stages	-	-	-
Bunias orientalis L.	Ken	H	greensword initial stages	-	-	-
Capsella bursa-pastoris (L.) Med.	Ar	T	greensword initial stages	-	-	-
Cardamine pratensis L.	Ap	H	heaps grassy slopes	-	-	3
Descurainia sophia (L.) Webb ex Prantl	Ar	T	heaps top	-	-	-
Diplotaxis muralis (L.) DC.	Ken	T	heaps top	-	-	-
Erophila verna (L.) Chevall.	Ap	T	greensword initial stages	-	-	-
Erysimum cheiranthoides L.	Ap	T	greensword initial stages	-	-	-
Lepidium ruderale L.	Ar	T	greensword initial stages	-	-	-
Raphanus raphanistrum L.	Ar	T	heaps top	-	-	V
Rorippa palustris (L.) Besser	Ap	T	land hollows	-	-	-
Sinapis arvensis L.	Ar	T	heaps grassy slopes	-	-	-
Sisymbrium altissimum L.	Ken	T	greensword initial stages	-	-	-
Sisymbrium loeselii L.	Ken	T	heaps grassy slopes	-	-	-
Sisymbrium officinale (L.) Scop.	Ar	T	greensword initial stages	-	-	-
Thlaspi arvense L.	Ar	T	greensword initial stages	-	-	-
Thlaspi perfoliatum L.	Ap	T	heaps grassy slopes	-	-	1

1	2	3	4	5	6	7
CAMPANULACEAE						
Campanula rotundifolia L.	Ap	H	greensword initial stages	-	-	-
CANNABACEAE						
Humulus lupulus L.	Sp	H	land hollows	-	-	-
CAPRIPHOLIACEAE						
Sambucus nigra L.	Ap	N	forest edge communities	-	-	-
Viburnum opulus L.	Ap	N	forest edge communities	-	-	-
CARYOPHYLLACEAE						
Cerastium arvense L.	Ap	H	heaps top	-	-	-
Cerastium holosteoides Fr. emend Hyl.	Ap	H	heaps grassy slopes	-	-	-
Cerastium semidecandrum L.	Ap	T	heaps grassy slopes	-	-	-
Herniaria glabra L.	Ap	H	initial stages	-	-	V
Melandrium album (Mill.) Garcke	Ap	H	heaps top	-	-	-
Melandrium noctiflorum (L.) Fr.	Ar	T	heaps grassy slopes	-	-	-
Saponaria officinalis L.	Ap	G	heaps grassy slopes	-	-	-
Scleranthus annuus L.	Ar	T	greensword initial stages	-	-	-
Spergula arvensis L.	Ar	T	heaps top	-	-	-
Spergularia rubra (L.) J. Presl & C. Presl	Ap	T	land hollows	-	-	-
Stellaria media (L.) Vill.	Ap	T	heaps top	-	-	-
CHENOPODIACEAE						
Atriplex patula L.	Ap	T	greensword initial stages	-	-	-
Chenopodium album L.	Ap	T	heaps top	-	-	-
Chenopodium hybridum L.	Ar	T	greensword initial stages	-	-	V
Corispermum leptopterum (Asch.) Iljin	Ken	T	greensword initial stages	-	DD	-
CONVOLVULACEAE						
Convolvulus arvensis L.	Ar	G	heaps top	-	-	-
CYPERACEAE						
Carex elongata L.	Sp	H	land hollows	-	-	-
Carex hirta L.	Ap	G	land hollows	-	-	-
Carex rostrata Stokes	Ap	G	land hollows	-	-	3
Carex vesicaria L.	Ap	H	land hollows	-	-	3
Eleocharis palustris (L.) Roem. et Schult.	Sp	Hel	land hollows	-	-	-
Scirpus sylvaticus L.	Sp	H	land hollows	-	-	-
EQUISETACEAE						
Equisetum arvense L.	Ap	G	land hollows	-	-	-
Equisetum palustre L.	Ap	G	land hollows	-	-	-
Equisetum pratense Ehrh.	Ap	G	heaps grassy slopes	-	-	-
EUPHORBIACEAE						
Euphorbia cyparissias L.	Sp/Ap	H	greensword initial stages	-	-	-
Euphorbia peplus L.	Ar	T	heaps grassy slopes	-	-	-
FABACEAE						
Lathyrus tuberosus L.	Ar	H	heaps grassy slopes	-	-	2
Lotus corniculatus L.	Ap	H	heaps grassy slopes	-	-	V
Medicago lupulina L.	Ap	H	heaps grassy slopes	-	-	-

1	2	3	4	5	6	7
Medicago falcata L.	Ap	H	heaps top	-	-	V
Medicago sativa L.	Ken	H	heaps grassy slopes	-	-	-
Melilotus alba Medik.	Ap	T	heaps grassy slopes	-	-	-
Melilotus officinalis (L.) Pallas	Ap	T	heaps grassy slopes	-	-	-
Robinia pseudoacacia L.	Ken	M	forest edge communities	-	-	-
Trifolium arvense L.	Ap	T	heaps grassy slopes	-	-	-
Trifolium incarnatum L.	D	H	heaps grassy slopes	-	-	-
Trifolium pratense L.	Ap	H	heaps grassy slopes	-	-	-
Trifolium repens L.	Ap	H	heaps grassy slopes	-	-	-
Vicia cracca L.	Ap	H	heaps grassy slopes	-	-	-
Vicia sepium L.	Ap	H	heaps grassy slopes	-	-	-
FUMARIACEAE						
Fumaria officinalis L.	Ar	T	heaps grassy slopes	-	-	V
Fumaria vaillantii Loisel.	Ar	T	heaps grassy slopes	R	VU	-
GERANIACEAE						
Erodium cicutarium (L.) L'Hérit.	Ar	T	heaps top	-	-	-
JUNCACEAE						
Juncus articulatus L. emend. K. Richt.	Sp/Ap	H	land hollows	-	-	-
Juncus conglomeratus L.	Ap	H	land hollows	-	-	3
Juncus effusus L.	Ap	H	land hollows	-	-	-
Juncus inflexus L.	Sp	H	land hollows	-	-	-
LAMIACEAE						
Ajuga reptans L.	Sp	H	heaps grassy slopes	-	-	-
Galeopsis speciosa Mill.	Sp/Ap	T	land hollows	-	-	-
Galeopsis tetrahit L.	Ap	T	heaps grassy slopes	-	-	-
Glechoma hederacea L.	Ap	H	heaps top	-	-	-
Lamium album L.	Ar	H	heaps grassy slopes	-	-	-
Lamium purpureum L.	Ar	T	heaps grassy slopes	-	-	-
Lycopus europaeus L.	Sp/Ap	Hel	land hollows	-	-	-
Mentha aquatica L.	Sp	Hel	land hollows	-	-	-
Prunella vulgaris L.	Sp/Ap	H	heaps grassy slopes	-	-	-
Stachys palustris L.	Sp	G	land hollows	-	-	-
LEMNACEAE						
Lemna trisulca L.	Sp	Hyd	land hollows	-	-	-
Spirodela polyrhiza (L.) Schleid.	Sp/Ap	Hyd	land hollows	-	-	-
LORANTHACEAE						
Viscum album L.	Ap	Ch	forest edge communities	-	-	3
LYTHRACEAE						
Lythrum salicaria L.	Sp	H	land hollows	-	-	-
ONAGRACEAE						
Chamaenerion angustifolium (L.) Scop.	Ap	H	greensword initial stages	-	-	-
Epilobium ciliatum Raf.	Ken	H	heaps top	-	-	-
Epilobium palustre L.	Sp	H	land hollows	-	-	-
Oenothera biennis L.	Ap	T	greensword initial stages	-	-	-
PAPAVERACEAE						
Chelidonium majus L.	Ap	H	heaps top	-	-	-

1	2	3	4	5	6	7
Papaver argemone L.	Ar	T	initial stages	-	-	V
Papaver somniferum L.	D	T	heaps grassy slopes	-	-	-
PINACEAE						
Picea pungens Engelm.	D	M	forest edge communities	-	-	-
Pinus sylvestris L.	Ap	M	forest edge communities	-	-	-
PLANTAGINACEAE						
Plantago intermedia Gilib.	Ap	H	heaps grassy slopes	-	-	-
Plantago lanceolata L.	Ap	H	heaps grassy slopes	-	-	-
Plantago major L.	Ap	H	heaps grassy slopes	-	-	-
POACEAE						
Agrostis gigantea Roth	Ap	H	land hollows	-	-	-
Agrostis stolonifera L.	Ap	H	land hollows	-	-	-
Alopecurus geniculatus L.	Ap	H	land hollows	-	-	-
Bromus hordaceus L.	Ap	T	heaps grassy slopes	-	-	-
Calamagrostis epigejos (L.) Roth	Ap	G	heaps grassy slopes	-	-	-
Dactylis glomerata L.	Ap	H	heaps grassy slopes	-	-	-
Elymus repens (L.) Gould.	Ap	G	greensword initial stages	-	-	-
Festuca pratensis Hudson	Ap	H	grassy slopes	-	-	-
Festuca rubra L.	Ap	H	greensword initial stages	-	-	-
Holcus lanatus L.	Ap	H	heaps grassy slopes	-	-	-
Lolium perenne L.	Ap	H	heaps grassy slopes	-	-	-
Phalaris arundinacea L.	Ap	H	land hollows	-	-	-
Phleum pratense L.	Ap	H	land hollows	-	-	-
Phragmites australis (Cav.) Trin. ex Steud.	Ap	Hel	land hollows	-	-	-
Poa annua L.	Ap	T	heaps top	-	-	-
Poa compressa L.	Ap	H	heaps grassy slopes	-	-	-
Poa nemoralis L.	Ap	H	heaps grassy slopes	-	-	-
Poa palustris L.	Ap	H	land hollows	-	-	-
Poa pratensis L.	Ap	H	heaps grassy slopes	-	-	-
Secale cereale L.	D	T	heaps grassy slopes	-	-	-
POLYGONACEAE						
Fallopia convolvulus (L.) Á. Löve	Ar	T	greensword initial stages	-	-	-
Polygonum amphibium L.	Ap	G	land hollows	-	-	-
Polygonum aviculare L.	Ap	T	heaps grassy slopes	-	-	-
Polygonum minus Huds.	Ap	T	land hollows	-	-	-
Reynoutria japonica Houtt.	Ken	G	land hollows	-	-	-
Rumex acetosa L.	Ap	H	forest edge communities	-	-	-
Rumex acetosella L.	Ap	G	greensword initial stages	-	-	-
Rumex crispus L.	Ap	H	forest edge communities	-	-	-
Rumex maritimus L.	Ap	T	land hollows	-	-	-
Rumex obtusifolius L.	Ap	H	forest edge communities	-	-	-
POTAMOGETONACEAE						
Potamogeton lucens L.	Ap	Hyd	land hollows	-	-	-
PRIMULACEAE						
Anagallis arvensis L.	Ar	T	heaps top	-	-	V
Lysimachia nummularia L.	Sp	H	land hollows	-	-	-

1	2	3	4	5	6	7
RANUNCULACEAE						
Batrachium aquatile (L.) Dumort.	Sp	Hyd	land hollows	-	-	3
Consolida regalis Gray	Ar	T	heaps top	-	-	3
Ranunculus auricomus L.	Ap	H	land hollows	-	-	V
Ranunculus repens L.	Ap	H	land hollows	-	-	-
Ranunculus sceleratus L.	Ap	T	land hollows	-	-	-
Thalictrum aquilegifolium L.	Sp	H	heaps grassy slopes	-	-	R
ROSACEAE						
Agrimonia eupatoria L.	Ap	H	heaps grassy slopes	-	-	-
Alchemilla monticola Opiz	Ap	H	greensword initial stages	-	-	1
Crataegus monogyna Jacq.	Ap	N	forest edge communities	-	-	-
Crataegus rhipidophylla Gand.	Sp/Ap	N	forest edge communities	-	-	-
Filipendula ulmaria (L.) Maxim	Sp	H	land hollows	-	-	-
Geum urbanum L.	Ap	H	heaps grassy slopes	-	-	-
Potentilla anserina L.	Ap	H	land hollows	-	-	-
Potentilla heptaphylla L.	Ap	H	heaps grassy slopes	-	-	3
Prunus spinosa L.	Ap	N	forest edge communities	-	-	-
Rosa canina L.	Ap	N	forest edge communities	-	-	-
Rosa rubiginosa L.	Ap	N	forest edge communities	-	-	-
Rubus caesius L.	Ap	Ch	heaps grassy slopes	-	-	-
Rubus idaeus L.	Ap	Ch	heaps grassy slopes	-	-	-
RUBIACEAE						
Galium aparine L.	Ap	T	heaps grassy slopes	-	-	-
Galium mollugo L.	Ap	H	heaps grassy slopes	-	-	-
Galium verum L.	Ap	H	heaps grassy slopes	-	-	-
SALICACEAE						
Salix acutifolia Willd.	D	M	heaps top	-	-	-
Salix alba L.	Ap	M	forest edge communities	-	-	-
Salix aurita L.	Sp	N	forest edge communities	-	-	-
Salix caprea L.	Ap	N	land hollows	-	-	-
Salix cinerea L.	Ap	N	land hollows	-	-	-
Salix vinimalis L.	Ap	N	forest edge communities	-	-	-
SCROPHULARIACEAE						
Chaenorhinum minus (L.) Lange	Ap	T	heaps grassy slopes	-	NT	-
Linaria vulgaris Mill.	Ap	G	heaps top	-	-	-
Verbascum nigrum L.	Ap	T	heaps grassy slopes	-	-	-
Veronica beccabunga L	Sp	H	land hollows	-	-	-
Veronica chamaedrys L.	Ap	H	heaps grassy slopes	-	-	-
Veronica hederifolia L.	Ap	T	heaps grassy slopes	-	-	-
Veronica persica Poir.	Ken	T	heaps grassy slopes	-	-	-
Veronica verna L.	Ap	T	heaps grassy slopes	-	-	3
SPARGANIACEAE						
Sparganium emersum Rehmann	Sp	Hel	land hollows	-	-	-
TYPHACEAE						
Typha angustifolia L.	Sp	Hel	land hollows	-	-	-
Typha latifolia L.	Sp/Ap	Hel	land hollows	-	-	-

1	2	3	4	5	6	7
URTICACEAE						
Urtica urens L.	Ar	T	heaps grassy slopes	-	-	-
Urtica dioica L.	Ap	H	heaps top	-	-	-
VIOLACEAE						
Viola arvensis Murray	Ar	T	heaps grassy slopes	-	-	-

At their habitat, representatives of the following families are found: *Lemnaceae*, *Cyperaceae*, *Juncaceae* and *Typhaceae* as well as the prevailing number of species representing the families: *Equisetaceae*, *Ranunculaceae* and *Poaceae*. Apophytes (60%) are the dominating geographic and historical group, and hemicryptophytes (38.33%) are the dominating life forms.

The greensword initial stages, the initial stages of succession of the plant communities are the place of appearance of 34 species. Here, the representatives of two families dominate: *Brassicaceae* (26.47%) and *Asteraceae* (23.52%). The most numerous geographic and historical groups are archeophytes (35.29%), and therophytes (55.88%) while hemicryptophytes (32.35%) are the most numerous life forms.

Heaps top, as the dumps sites of mining and industrial waste originating from exploitation of minerals or processing of raw materials in excavation and processing plants, are the anthropogenic forms of the shape of the Earth surface. At their sites, there were observed 30 species (13.22%). The most numerous in representation is the family *Brassicaceae* (20%). Apophytes (33.33%) and archeophytes (26.66%) are the dominating geographical and historical groups while therophytes (40%) are the dominating life form.

Forest edge communities as a collection of herbaceous plants typical for ecotone systems, in natural conditions usually takes a stripe in the contact area of forest communities or underbrushes with grassy communities. The sequences of the communities comprise forest, underbrush, forest edge shrubs, grass (fields, pasture land and meadows) (Matuszkiewicz 2005). At the area of forest edge the 21 species were found. In that habitat representatives of the following families appear: *Aceraceae*, *Caprifoliaceae*, *Pinaceae*, *Salicaceae*, *Rosaceae*. Apophytes (80.95%) are the dominating geographic-historical group and nano-phaenrophytes (42.85%) and mega phanerophytes are the dominating life forms.

No protective species were found at the site of the Lębork clays excavation site. The rare species and potentially endangered at the area of Western Pomerania (Żukowski and Jackowiak 1995) is *Fumaria vaillantii*. That archeophyte is also a vulnerable species (moderately endangered) at the area of the Gdańsk Pomerania (Markowski and Buliński 2004). According to Voigtländer et al. (2005) the species threatened to extinction are *Alchemilla monticola* and *Thlaspi perfoliatum*, and *Lathyrus tuberosus* is a strongly endangered species. The seven species found in the area under consideration have the status of the endangered ones on the Region, i.e.: *Alchemilla monticola*, *Alyssum alyssoides*, *Batrachium aquatile*, *Consolida regalis*, *Lathyrus tuberosus*, *Thlaspi perfoliatum* and *Veronica verna*. A very rare species is *Thalictrum aquilegifolium*, while 15 species belong to vulnerable ones, i.e.: *Aethusa cynapium*, *Anagalis arvensis*, *Anthemis arvensis*, *Carex rostrata*, *C. vesicaria*, *Centaurea cyanus*, *Chenopodium hybridum*, *Fumaria officinalis*, *Herniaria glabra*, *Hydrocotyle vulgaris*, *Lotus*

corniculatus, *Medicago falcata*, *Papaver argemone*, *Potentilla heptaphylla*, *Ranunculus auricomus* and *Raphanus raphanistrum*.

It is generally agreed that the closed excavations, left after exploitation of the area are connected with a destroyed, devastated landscape deprived of flora and fauna species living there hitherto. At the same time, levelling the effects of interference of the mining industry into the natural environment is connected with many years processes of revitalization and recultivation as well as plans of utilization of the areas left after exploitation. An additional advantage is a fact that such areas are often settled by new species of plants and animals which had not appeared at a given area before and which have more opportunity for adaptation.

In contemporary landscape, stone quarries are not new constituents, however the effectiveness hidden in them was only observed in the middle of the twentieth century. At present, space is scarce and each piece of it-even the seemingly unused or useless becomes valuable. It is worth mentioning that quarries a excavations of the mining industry are incorporated as a constituent of a widely understood mining heritage, and it has been analyzed globally as a cultural value and sometimes is entered into the List of Global Cultural Heritage and Natural UNSECO (Lorenc 2010, Lorenc and Janusz 2010, Lorenc and Cocks 2008, Pérez Sánchez and Lorenc 2008).

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FLORA NACZYNIOWA WYROBISKA IŁÓW LĘBORSKICH W PRADOLINIE ŁEBY-REDY

Streszczenie

Badania nad florą naczyniową wyrobiska iłów lęborskich prowadzono w latach 2014-2016. Zinwentaryzowano 227 roślin naczyniowych w obrębie pięciu mikrosiedlisk: wierzchowiny hałd, stadiów inicjalnych muraw, trawiastych zboczy hałd, zagłębień terenowych i okrajków. Fumaria vaillantii na Pomorzu Zachodnim należy do gatunków rzadkich, na Pomorzu Gdańskim do narażonych. Siedem taksonów zasługujących na szczególną uwagę zaliczono do rzadkich w regionie: *Alchemilla monticola*, *Alyssum alyssoides*, *Batrachium aquatile*, *Consolida regalis*, *Lathyrus tuberosus*, *Thlaspi perfoliatum* i *Veronica verna*.