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CONSERVATION OF VEGETATION COVER IN THE GŁUSZEC STREAM VALLEY IN POZNAŃ (POLAND) IN THE AGRI-ENVIRONMENTAL PROGRAM

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ABSTRACT. The vegetation cover of the Głuszec stream valley was investigated. The article presents a list of 294 recorded species of vascular plants from 65 families and, also, 47 plant associations from nine classes, from three dynamic vegetation circles: *Carici elongatae-Alnetum*, *Fraxino-Alnetum* and *Querco-Ulmetum minoris*. Six types of vegetation complexes were documented. Their phytocoenotic structure was shown in a table containing 18 relevés made in sigmassociations. The preliminary results of research on the dynamics of *Dactylorhiza incarnata* population, occurring in one of meadow complexes, were presented. The Głuszec stream valley was recognised as the region of exceptional natural plant cover within the city of Poznań and proposed to be incorporated into the green network of the Poznań Agglomeration. The valley was also included in the agri-environmental program. An active protection of grassland ecosystems is achieved by adhering to the requirements of this program and additional recommendations of an expert botanist.

KEY WORDS: agri-environmental program, biomonitoring, *Dactylorhiza incarnata*, grassland ecosystem, phytosociology, plant association, sigmassociation, symphytosociology, vascular flora, vegetation complex

INTRODUCTION

The program 'Active recreation in Poznań' is a part of the 'Development Strategy for the City of Poznań to 2030' (Strategia [Development Strategy]... 2010). One of its main aims is preservation of recreation areas, achieved by passing a bill on the Poznań Network of Valuable Natural Areas by the Poznań City Council. Numerous areas of high natural value are protected by the regulations of the Study of conditions and directions of spatial development for Poznań (Studium [Study]... 2008). Many of them are situated within a green network of the Poznań Agglomeration (Mizgajski and Zwierzchowska 2012). In general, these areas are excluded from development. Only a few of them are legally protected. They include three Natura 2000 habitat areas, two nature reserves and four ecological sites. Despite numerous works prepared for the needs of the 'Study', concerning identification of the areas of high natural value, no sufficient ecophysiographic documentation has been provided to create the Poznań Network of Valuable Natural Areas and many diagnosed sites had been degraded before they were covered by legal protection measures. An example of devastation is the ecological site UE-16 at Miętowa Street, proposed by J. Borysiak and W. Stachnowicz (own materials), or alluvial areas along the Warta river in the Szeląg district, which were planned to be a part of the Naramowice-Radojewo Natural Landscape Complex, designated by B. Jackowiak (Adam Mickiewicz University in Poznań) in the materials prepared for the Municipal Urban Planning Office. New places of key importance for the preservation of natural biodiversity are still discovered. Frequently, they are found in the course of local projects realisation, when the plan of a given area is diagnosed in a large scale, in connection with the realised prognosis, i.e., a document used in the strategic evaluation procedure. One of places discovered in such a way is the Głuszec stream valley. Together with the Kopel stream valley, it is a structural element of the Poznań green wedge of NW-SE orientation. General geobotanical diagnosis, prepared in connection with the prognosis, showed that the Głuszec stream valley is one of the most valuable natural areas in Poznań and its vegetation has not been studied in detail so far. Vascular flora was investigated by Jackowiak (1990, 1993). The author published his results only in the form of a general floristic list for Poznań and species carthograms, without information which specific species were found in the Głuszec stream valley. Filipek (1955) published only two phytosociological relevés, made in meadow phytocoenoses in the course of his study in the Kopel stream valley.

The enacted local plan of spatial development 'The Głuszynka Valley – part B' in Poznań (Uchwała [Resolution]... 2010) admits the construction of a storage reservoir, which is intended to include the Głuszec stream valley. Thus, from the scientific point of view, it is important to document the state of the threatened natural, biodiversity of the valley and to advance arguments against the investment. This article presents the results of geobotanical studies: floristic, phytosociological and vegetation landscape. The threats to the area's natural values and the ways of their elimination have been discussed.

MATERIAL AND METHODS

Study area

The study covered the Głuszec stream valley, of 50 ha area (Fig. 1). It is situated in the south-eastern part of Poznań. According to the physical and geographical division of Kondracki (2002), it belongs to the mesoregion Wrzesińska Plain, macroregion Wielkopolska-Kujawy Lakeland and province Central European Lowland.

According to the WGS 84 system, the Głuszec stream begins at N52°19′44.12″/W16°56′54.13″ and finishes at N52°19′5.23″/W16°56′29.55″, where it disgorges to the Kopel stream, a right-bank tributary of the Warta river (see www.geoportal.gov.pl; date of entry: 28-09-2012). The Głuszec stream is of 1.6 km in length and has three short, left-bank tributaries. Flow fluctuations in the Kopel stream significantly influence hydrological conditions in the Głuszec stream valley. Choiński (2001) reported that the average maximum monthly water level in the Kopel watercourse occurs in February and March, while minimum in September. Furthermore, he found that the Kopel drainage basin (of the III-order) lies in the zone of the lowest outflow per unit area in Poland.

According to the climate division by Woś (1994), the study area is situated in the Region of Central Poland, on the Wielkopolska Lowland, in a transitional climate zone between an oceanic and continental climate. The temperature values for a 30-year period show that the coolest month is January, with the mean temperature –2.2°C, while the warmest is July with the average of 18°C. The mean annual air temperature exceeds slightly 8°C. Ground frosts occur as early as October and can be noted till May. The average annual precipitation sum in Poznań is 507 mm (in 1977-2000, acc. to Central Statistical Office data, Warsaw). A scientific note

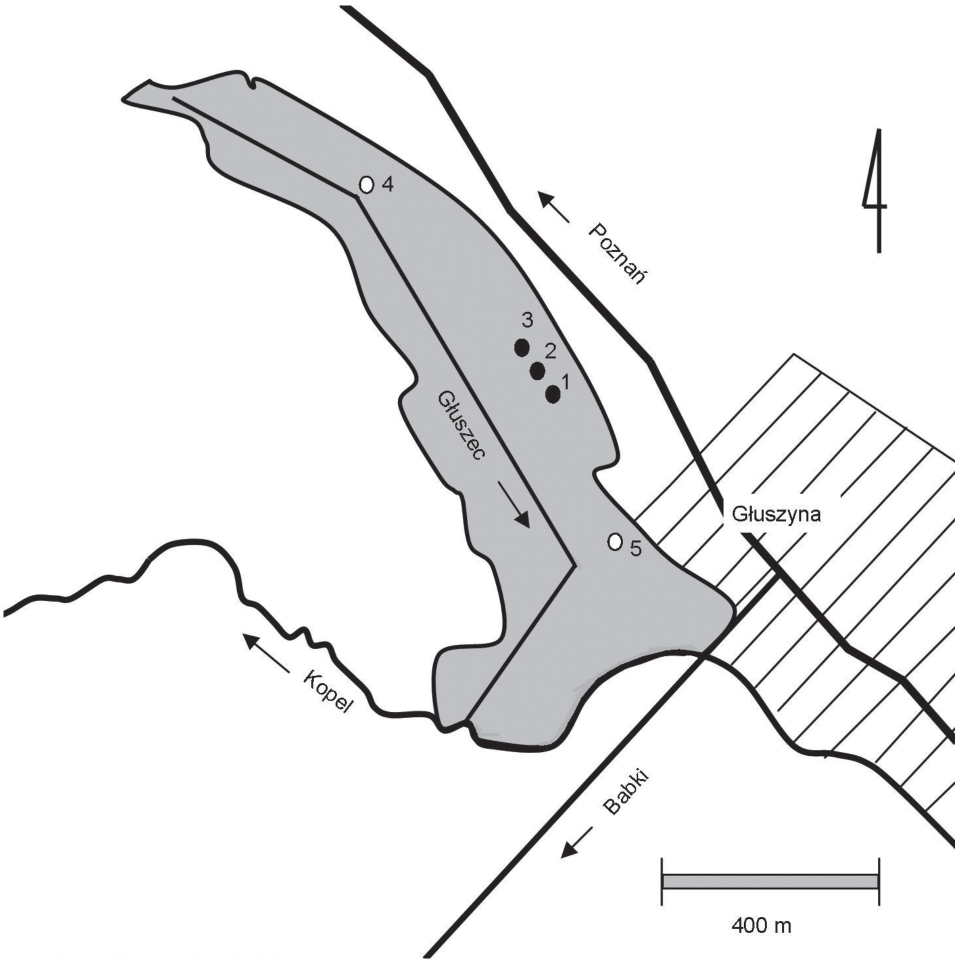

Fig. 1. Localities of *Dactylorhiza incarnata* in the Głuszec stream valley in Poznań: biomonitoring plot 1 – N52°19′25.70″/W16°56′33.80″ (WGS 84 system), biomonitoring plot 2 – N52°19′27.50″/W16°56′32.60″, biomonitoring plot 3 – N52°19′20.90″/W16°56′29.70″, 4 – N52°19′39.13″/W16°56′12.05″, 5 – N52°19′18.03″/W16°56′40.41″

by Kozacki et al. (2004) indicates that over the area of Głuszec stream valley predominate polar maritime air masses, arriving from the west. Weak and very weak westerly winds prevail. The snow cover stays for about 50 days and vegetation season for almost 220 days.

The bottom of the Głuszec stream valley lies at the altitude of ca. 60 m a.s.l. The hydro-geographic map 1:50 000 (Choiński 2001) shows that the first water-bearing stratum is situated at the depth of 1 m, while the slopes of the valley lie within the hydroisobath of 2 m. On the sozological map 1:50 000 (Kozacki et al. 2004), the whole valley and its nearest neighbourhood were classified as the area susceptible to infiltration of contaminations into underground waters. Floristic and phytosociological studies showed that the valley is mostly covered with fen peat soils and black earths, drained by the network of drainage ditches of 260 lm/ha in density. Ditches are strongly silted and overgrown. They do not have gates that would allow to manage water flow. In 2009, silt was removed from the Głuszec stream, ranked as a watercourse of primary drainage.

The Głuszec stream valley is almost completely occupied by permanent grasslands, which are the property of the State Treasury. The parcels of record No. 306401_1.0012.AR_01.5 and 306401_1.0012.AR_01.6 are leased by a farmer from the village of Babka. They are under an extensive (traditional) grassland management. In the left-bank Głuszec stream valley, loose clusters of trees and bushes and a small arable area occur, while in the right-bank part – a small energetic willow (*Salix* sp.) plantation. An educational and recreational trail, named 'Głuszynka Valley', and a bicycle path run around the valley. They were established by the Forest Inspectorate of Babki.

The Głuszec stream valley is surrounded by *Pinus sylvestris* stands. The geological map 1:50 000 (507 – Mosina N-33-142-B) shows that in the western and northern parts, they occur on the Baltic Glaciation formations that originated during the Poznań phase of the Leszno-Pomerania stadial. On the western side of the valley, these formations include fluvioglacial sands and gravels of the lower sandr level, while on the northern side – of the higher sandr level. On the sozological map 1:50 000 (Kozacki et al. 2004), these formations were marked as grounds prone to naturogenic denudation. On the eastern side of the valley, stands of pine occupy soils formed from deluvial sands, while in the higher localities – from glacial sands or boulder clay from the Leszno phase of the aforementioned stadial (cf. the quoted sozological map). In the immediate vicinity of the study area, Wojterski et al. (1983) delimited the potential natural vegetation *Pino-Quercetum* on the eastern side of the Głuszec stream valley, while on the western side – *Leucobryo-Pinetum*/*Cladonio-Pinetum* and on the bottom of the valley – *Circaeo-Alnetum* (syn. *Fraxino-Alnetum*). According to the geobotanical regionalization by Matuszkiewicz (1995), based on the quoted map of potential natural vegetation, the Głuszec stream valley is situated within the following units: Mid-European Province, South Baltic Subprovince, Brandenburgia-Wielkopolska Division (B), Central Wielkopolska Region (B.2) and Śrem District (B.2.2.).

Field studies and data analysis

Floristic, phytosociological and vegetation landscape field investigations were carried out in the Głuszec stream valley in the years 2010-2011.

Vascular flora was charted on the foundation of the topographic map 1:10 000, on a one-off basis, in the localities evenly distributed over the valley area. The composition of the flora was analysed in terms of taxonomic structure, phytosociological rank of species and biological traits of plants. Taxonomic data were taken from the work by Mirek et al. (2002) and Takhtajan (1997). Phytosociological studies were conducted using the Braun-Blanquet method, in all types of phytocoenoses. 126 phytosociological relevés were made. They were used for the identification of plant associations, following Brzeg and Wojterska (2001). Monographies of these authors provided also data on the syntaxonomic rank of species, syngenesis of plant communities and the degree of threat and spread of the examined associations in the Wielkopolska region. In the study of vegatation landscape, the symphytosociological method of Tüxen (1977) was used. 18 relevés were made in sigmassociations. They were used in typification of vegetation complexes; the method was proposed by Wojterska (2003). The data on life forms are after Zarzycki et al. (2002). Archaeophytes classified according to Zając (1979) and kenophytes from the list by Zając et al. (1998). The data on apophytization follow Jackowiak (1990).

The Głuszec stream valley is the place of occurrence of *Dactylorhiza incarnata*. The orchid's locality has been covered by biomonitoring. At three sites of highest species density biomonitoring plots were established (Fig. 1), used for the observation of the dynamics of population and influence of mowing on its condition. They were divided into squares of 2 × 2 m, used for the spatial presentation of the population. The place of occurrence of each specimen was labelled and numbered. In spring 2011, on June 2, leaves and flowers on each shoot were counted. Afterwards, in autumn 2011, on October 19, capsules with mature seeds were counted.

RESULTS

Vascular flora

Vascular flora of the Głuszec stream valley comprised 294 species (Table 1). They belonged to 182 genera and 65 families, including two families from *Monilophyta* (2 genera), one from *Pinophyta* (1) and 62 from *Magnoliophyta* (179). The latter class was represented by 51 families from *Magnoliopsida* (141 genera) and 11 from *Liliopsida* (38). Among the families richest in species were: *Poaceae* (37 species, 23 genera), *Asteraceae* (36, 26), *Cyperaceae* (19, 4), *Rosaceae* (17, 10), *Lamiaceae* (16, 10), *Fabaceae* (13, 6), *Apiaceae* (11, 11), *Caryophyllaceae* (11, 8), *Ranunculaceae* (10, 4) and *Polygonaceae* (10, 3). In the Raunkiaer's life form spectrum, the largest share had hemicryptophytes (192 species, 65% of the total flora), then, terophytes (42, 14%), geophytes (43, 15%), hydrophytes and helophytes (35, 12%), megaphanerophytes (20, 7%), nanophanerophytes (20, 7%), herbaceous chamephytes (8, 3%), lianas (6, 2%) and one each of lignified chamephyte and semiparasite. The flora

Table 1. Vascular flora in the Głuszec stream valley in Poznań

Species	Family	1	2	3	4
Acer campestre L.	*Aceraceae*	Ap	M	Q-F	–
Acer negundo L.	*Aceraceae*	Kn	M	–	–
Acer platanoides L.	*Aceraceae*	Ap	M	Q-F	–
Acer pseudoplatanus L.	*Aceraceae*	Ap	M	Q-F	–
Achillea millefolium L. s. str.	*Asteraceae*	Ap	H	M-A	–
Adoxa moschatellina L.	*Adoxaceae*	Sp	G	Q-F	P1
Aegopodium podagraria L.	*Apiaceae*	Ap	G, H	A	–
Aesculus hippocastanum L.	*Hippocastanaceae*	Kn	M	–	–
Agrostis capillaris L.	*Poaceae*	Ap	H	C-U	–
Agrostis gigantea Roth	*Poaceae*	Ap	H	M-A	–
Agrostis stolonifera L.	*Poaceae*	Ap	H	M-A	–
Alisma plantago-aquatica L.	*Alismataceae*	Ap	Hy	P	–
Alliaria petiolata (M. Bieb.) Cavara & Grande	*Brassicaceae*	Ap	H	A	–
Alnus glutinosa (L.) Gaernt.	*Betulaceae*	Ap	M	Ag	–
Alopecurus geniculatus L.	*Poaceae*	Ap	H	M-A	–
Alopecurus pratensis L.	*Poaceae*	Ap	H	M-A	–
Angelica sylvestris L.	*Apiaceae*	Ap	H	M-A	P3
Anthoxanthum odoratum L. s. str.	*Poaceae*	Ap	H	–	–
Anthriscus sylvestris (L.) Hoffm.	*Apiaceae*	Ap	H	A	–
Apera spica-venti (L.) P. Beauv.	*Poaceae*	Ar	T, H	S	–
Armeria maritima (Mill.) Willd. subsp. *elongata* (Hoffm.) Bonnier	*Plumbaginaceae*	Ap	H	K-C	–
Arrhenatherum elatius (L.) P. Beauv. ex J. Presl & C. Presl	*Poaceae*	Ap	H	M-A	–
Artemisia campestris L.	*Asteraceae*	Ap	Ch	F-B	–
Artemisia vulgaris L.	*Asteraceae*	Ap	H	A	–
Atriplex prostrata Boucher ex DC.	*Chenopodiaceae*	Ap	T	B	–
Ballota nigra L.	*Lamiaceae*	Ar	C, H	A	–
Bellis perennis L.	*Asteraceae*	Ap	H	M-A	–
Berteroa incana (L.) DC.	*Brassicaceae*	Ar	H, T	A	–
Berula erecta (Huds.) Coville	*Apiaceae*	Sp	Hy	P	P2
Betula pendula Roth	*Betulaceae*	Ap	M	–	–
Bidens frondosa L.	*Asteraceae*	Kn	T	B	–
Bidens tripartita L.	*Asteraceae*	Ap	T	B	–
Brachypodium sylvaticum (Huds.) P. Beauv.	*Poaceae*	Sp	H	Q-F	P1
Briza media L.	*Poaceae*	Sp	H	M-A	P2
Bromus carinatus Hook. & Arn.	*Poaceae*	Kn	T, H	–	–
Bromus hordeaceus L.	*Poaceae*	Ap	T	M-A	–
Bromus inermis Leyss.	*Poaceae*	Ap	H	A	–
Calamagrostis epigejos (L.) Roth	*Poaceae*	Ap	G, H	E	–
Calamagrostis stricta (Timm) Koeler	*Poaceae*	Sp	H	S-C	VU
Callitriche cophocarpa Sendtn.	*Callitrichaceae*	Ap	Hy	Po	P1
Caltha palustris L.	*Ranunculaceae*	Sp	H	M-A	P3
Calystegia sepium (L.) R. Br.	*Convolvulaceae*	Ap	G, H, li	A	–
Campanula glomerata L.	*Campanulaceae*	Sp	H	F-B	–
Capsella bursa-pastoris (L.) Medik.	*Brassicaceae*	Ar	H, T	S	–
Cardamine pratensis L. s. str.	*Brassicaceae*	Ap	H	M-A	–
Cardaminopsis arenosa (L.) Hayek	*Brassicaceae*	Ap	H	–	–
Carduus crispus L.	*Asteraceae*	Ap	H	A	–

Table 1 – cont.

Species	Family	1	2	3	4
Carex acutiformis Ehrh.	*Cyperaceae*	Sp	G, Hy	P	P2
Carex cespitosa L.	*Cyperaceae*	Sp	H	M-A	E
Carex disticha Huds.	*Cyperaceae*	Sp	G	P	V
Carex elata All.	*Cyperaceae*	Sp	H, Hy	P	V
Carex flava L.	*Cyperaceae*	Sp	H	S-C	V
Carex gracilis Curtis	*Cyperaceae*	Sp	G, Hy	P	P2
Carex hirta L.	*Cyperaceae*	Ap	G	M-A	–
Carex panicea L.	*Cyperaceae*	Sp	G, H	S-C	P1
Carex paniculata L.	*Cyperaceae*	Sp	H	P	P1
Carex praecox Schreb.	*Cyperaceae*	Ap	G, H	–	–
Carex pseudocyperus L.	*Cyperaceae*	Sp	Hy, H	P	V
Carex riparia Curtis	*Cyperaceae*	Sp	Hy, H	P	P1
Carex rostrata Stokes	*Cyperaceae*	Sp	Hy, H	P	P1
Carex vesicaria L.	*Cyperaceae*	Sp	Hy, H	P	V
Carex vulpina L.	*Cyperaceae*	Ap	H, G	P	–
Centaurea jacea L.	*Asteraceae*	Ap	H	M-A	–
Cerastium arvense L. s. str.	*Caryophyllaceae*	Ap	C	K-C	–
Cerastium holosteoides Fr. emend. Hyl.	*Caryophyllaceae*	Ap	C, H	M-A	–
Chaerophyllum temulum L.	*Apiaceae*	Ap	T, H	A	–
Chelidonium majus L.	*Papaveraceae*	Ap	H	A	–
Chenopodium album L.	*Chenopodiaceae*	Ap	T	S	–
Chenopodium polyspermum L.	*Chenopodiaceae*	Ap	T	S	P1
Cichorium intybus L.	*Asteraceae*	Ar	H	A	–
Cirsium arvense (L.) Scop.	*Asteraceae*	Ap	G	A	–
Cirsium oleraceum (L.) Scop.	*Asteraceae*	Ap	H	M-A	P3
Cirsium palustre (L.) Scop.	*Asteraceae*	Sp	H	M-A	P2
Cirsium vulgare (Savi) Ten.	*Asteraceae*	Ar	H	A	–
Convolvulus arvensis L.	*Convolvulaceae*	Ap	G, H, li	A	–
Conyza canadensis (L.) Cronquist	*Asteraceae*	Kn	T, H	S	–
Cornus sanguinea L.	*Cornaceae*	Sp	N	R-P	P1
Corynephorus canescens (L.) P. Beauv.	*Poaceae*	Ap	H	K-C	–
Crataegus monogyna Jacq.	*Rosaceae*	Ap	N	R-P	–
Crepis biennis L.	*Asteraceae*	Ap	H	M-A	–
Crepis paludosa (L.) Moench	*Asteraceae*	Sp	H	M-A	P1
Dactylis glomerata L.	*Poaceae*	Ap	H	M-A	–
Dactylorhiza incarnata (L.) Soó	*Orchidaceae*	Sp	G	S-C	LC
Daucus carota L.	*Apiaceae*	Ap	H	M-A	–
Deschampsia caespitosa (L.) P. Beauv.	*Poaceae*	Ap	H	M-A	–
Dryopteris carthusiana (Vill.) H.P. Fuchs	*Dryopteridaceae*	Ap	H	–	–
Echinocystis lobata (F. Michx.) Torr. & A. Gray	*Cucurbitaceae*	Kn	T, li	A	–
Echinops sphaerocephalus L.	*Asteraceae*	Kn	H	–	–
Echium vulgare L.	*Boraginaceae*	Ap	H	A	–
Eleocharis palustris (L.) Roem. & Schult.	*Cyperaceae*	Ap	Hy, G	P	P2
Eleocharis uniglumis (Link) Schult.	*Cyperaceae*	Sp	Hy, G	–	V
Elodea canadensis Michx.	*Hydrocharitaceae*	Kn	Hy	Po	–
Elymus repens (L.) Gould	*Poaceae*	Ap	G	A	–
Epilobium hirsutum L.	*Onagraceae*	Ap	H	A	–
Epilobium parviflorum Schreb.	*Onagraceae*	Ap	H	–	–

Table 1 – cont.

Species	Family	1	2	3	4
Epipactis helleborine (L.) Crantz s. str.	*Orchidaceae*	Ap	G	Q-F	–
Equisetum arvense L.	*Equisetaceae*	Ap	G	A	–
Equisetum fluviatile L.	*Equisetaceae*	Sp	Hy, G	P	P2
Equisetum palustre Ehrh.	*Equisetaceae*	Ap	G	M-A	–
Eragrostis minor Host	*Poaceae*	Kn	T	S	–
Eriophorum angustifolium Honck.	*Cyperaceae*	Sp	G, Hy	S-C	P1
Euonymus europaea L.	*Celastraceae*	Sp	N	R-P	P1
Eupatorium cannabinum L.	*Asteraceae*	Sp	H	A	P2
Euphorbia cyparissias L.	*Euphorbiaceae*	Ap	H, G	F-B	–
Fallopia dumetorum (L.) Holub	*Polygonaceae*	Ap	T	A	–
Festuca gigantea (L.) Vill.	*Poaceae*	Sp	H	Q-F	P2
Festuca pratensis Huds.	*Poaceae*	Ap	H	M-A	–
Festuca rubra L. s. str.	*Poaceae*	Ap	H	M-A	–
Ficaria verna Huds.	*Ranunculaceae*	Ap	G	Q-F	–
Filipendula ulmaria (L.) Maxim	*Rosaceae*	Sp	H	M-A	P2
Frangula alnus Mill.	*Rhamnaceae*	Sp	N	R-P	P1
Fraxinus excelsior L.	*Oleaceae*	Ap	M	Q-F	–
Galeopsis bifida Boenn.	*Lamiaceae*	Ap	T	A	–
Galeopsis tetrahit L.	*Lamiaceae*	Ap	T	A	–
Galium aparine L.	*Rubiaceae*	Ap	T, H	A	–
Galium mollugo L. s. str.	*Rubiaceae*	Ap	H	M-A	–
Galium palustre L.	*Rubiaceae*	Sp	H	P	P3
Galium verum L. s. str.	*Rubiaceae*	Ap	H	T-G	–
Geranium palustre L.	*Geraniaceae*	Sp	H	M-A	P1
Geranium pratense L.	*Geraniaceae*	Ap	H	A	–
Geranium pusillum Burm. f. ex L.	*Geraniaceae*	Ar	T	S	–
Geranium robertianum L.	*Geraniaceae*	Ap	H, T	A	–
Geum rivale L.	*Rosaceae*	Sp	H	M-A	P2
Geum urbanum L.	*Rosaceae*	Ap	H	A	–
Glechoma hederacea L.	*Lamiaceae*	Ap	G, H	A	–
Glyceria fluitans (L.) R. Br.	*Poaceae*	Sp	Hy	P	P2
Glyceria maxima (Hartm.) Holmb.	*Poaceae*	Sp	Hy	P	P1
Glyceria notata Chevall.	*Poaceae*	Ap	Hy	P	PR
Heracleum sibiricum L.	*Apiaceae*	Ap	H	A	–
Herniaria glabra L.	*Caryophyllaceae*	Ap	H	K-C	–
Hieracium pilosella L.	*Asteraceae*	Ap	H	C-U	–
Hieracium umbellatum L.	*Asteraceae*	Sp	H	C-U	V
Holcus lanatus L.	*Poaceae*	Ap	H	M-A	–
Humulus lupulus L.	*Cannabaceae*	Ap	H, Ii	A	–
Hydrocotyle vulgaris L.	*Hydrocotylaceae*	Sp	H	S-C	V
Hypericum tetrapterum Fr.	*Hypericaceae*	Sp	H	M-A	P1
Impatiens parviflora DC.	*Balsaminaceae*	Kn	T	A	–
Inula salicina L.	*Asteraceae*	Ap	H	M-A	LC
Iris pseudacorus L.	*Iridaceae*	Sp	Hy, G	P	P2
Juncus articulatus L. emend. K. Richt.	*Juncaceae*	Ap	H	S-C	–
Juncus bufonius L.	*Juncaceae*	Ap	T	I-J	–
Juncus compressus Jacq.	*Juncaceae*	Ap	G	M-A	–
Juncus effusus L.	*Juncaceae*	Ap	H	M-A	–

TABLE 1 – cont.

Species	Family	1	2	3	4
Juncus inflexus L.	*Juncaceae*	Ap	H	M-A	–
Lactuca serriola L.	*Asteraceae*	Ar	H	S	–
Lamium album L.	*Lamiaceae*	Ar	H	A	–
Lamium maculatum L.	*Lamiaceae*	Sp	H	A	V
Lamium purpureum L.	*Lamiaceae*	Ar	T, H	S	–
Lapsana communis L. s. str.	*Asteraceae*	Ap	H, T	A	–
Lathyrus palustris L.	*Fabaceae*	Sp	H	M-A	V
Lathyrus pratensis L.	*Fabaceae*	Ap	H	M-A	–
Lemna minor L.	*Lemnaceae*	Ap	Hy	L	–
Leontodon autumnalis L.	*Asteraceae*	Ap	H	M-A	–
Leontodon hispidus L.	*Asteraceae*	Ap	H	M-A	–
Leonurus cardiaca L.	*Lamiaceae*	Ar	H	A	–
Leucanthemum vulgare Lam. s. str.	*Asteraceae*	Ap	H	M-A	–
Ligustrum vulgare L.	*Oleaceae*	Ap	H	R-P	–
Linaria vulgaris Mill.	*Scrophulariaceae*	Ap	G	A	–
Lolium perenne L.	*Poaceae*	Ap	H	M-A	–
Lotus uliginosus Schkuhr	*Fabaceae*	Sp	H	M-A	P3
Lupinus polyphyllus Lindl.	*Fabaceae*	Kn	H	–	–
Luzula campestris (L.) DC.	*Juncaceae*	Sp	H	C-U	P2
Lychnis flos-cuculi L.	*Caryophyllaceae*	Sp	H	M-A	P3
Lycium barbarum L.	*Solanaceae*	Kn	N	A	–
Lycopus europaeus L.	*Lamiaceae*	Ap	H, Hy	Ag	–
Lysimachia nummularia L.	*Primulaceae*	Sp	C	M-A	P3
Lysimachia vulgaris L.	*Primulaceae*	Sp	H	M-A	P3
Lythrum salicaria L.	*Lythraceae*	Ap	H	M-A	–
Medicago falcata L.	*Fabaceae*	Ap	H	F-B	–
Medicago lupulina L.	*Fabaceae*	Ap	T, H	A	–
Melandrium album (Mill.) Garcke	*Caryophyllaceae*	Ar	T, H	A	–
Mentha aquatica L.	*Lamiaceae*	Sp	H, Hy	P	P2
Mentha arvensis L.	*Lamiaceae*	Ap	G, Hy	–	–
Mentha ×verticillata L.	*Lamiaceae*	Sp	H	–	P1
Moehringia trinervia (L.) Clairv.	*Caryophyllaceae*	Sp	H, T	A	P2
Molinia caerulea (L.) Moench s. str.	*Poaceae*	Sp	H	M-A	P1
Myosotis arvensis (L.) Hill.	*Boraginaceae*	Ar	T, H	S	–
Myosotis palustris (L.) L. emend. Rchb.	*Boraginaceae*	Sp	H	M-A	P3
Myosoton aquaticum (L.) Moench	*Caryophyllaceae*	Ap	G, H	A	–
Nuphar lutea (L.) Sibth. & Sm.	*Nymphaeaceae*	Sp	Hy	Po	V
Oenothera biennis L. s. str.	*Onagraceae*	Ap	H	A	–
Padus avium Mill.	*Rosaceae*	Sp	M	Ag	P2
Padus serotina (Ehrh.) Borkh.	*Rosaceae*	Kn	N, M	-	–
Papaver rhoeas L.	*Papaveraceae*	Ar	T	S	–
Parnassia palustris L.	*Parnassiaceae*	Sp	H	S-C	VU
Phalaris arundinacea L.	*Poaceae*	Ap	G, H	P	–
Phleum pratense L.	*Poaceae*	Ap	H	M-A	–
Phragmites australis (Cav.) Trin. ex Steud	*Poaceae*	Ap	G, Hy	P	–
Picris hieracioides L.	*Asteraceae*	Ap	H	A	–
Pimpinella major (L.) Huds.	*Apiaceae*	Sp	H	M-A	P1
Pinus sylvestris L.	*Pinaceae*	Sp	M	V-P	P2

Table 1 – cont.

Species	Family	1	2	3	4
Plantago intermedia Gilib.	*Plantaginaceae*	Ap	H, T	I-J	–
Plantago lanceolata L.	*Plantaginaceae*	Ap	H	M-A	–
Plantago major L. s. str.	*Plantaginaceae*	Ap	H	M-A	–
Plantago media L.	*Plantaginaceae*	Ap	H	F-B	–
Poa angustifolia L.	*Poaceae*	Ap	H	C-U	–
Poa annua L.	*Poaceae*	Ap	T, H	P-P	–
Poa palustris L.	*Poaceae*	Ap	H	M-A	–
Poa pratensis L. s. str.	*Poaceae*	Ap	H	M-A	–
Poa trivialis L.	*Poaceae*	Ap	H	M-A	–
Polygonum amphibium L.	*Polygonaceae*	Ap	Hy, G	–	–
Polygonum aviculare L.	*Polygonaceae*	Ap	T	P-P	–
Polygonum bistorta L.	*Polygonaceae*	Sp	G, H	M-A	P1
Polygonum hydropiper L.	*Polygonaceae*	Ap	T	B	–
Populus alba L.	*Salicaceae*	Ap	M	Sp	–
Populus tremula L.	*Salicaceae*	Ap	M	R-P	–
Potentilla anserina L.	*Rosaceae*	Ap	H	M-A	–
Potentilla arenaria Borkh.	*Rosaceae*	Ap	H	F-B	–
Potentilla argentea L. s. str.	*Rosaceae*	Ap	H	K-C	–
Potentilla erecta (L.) Raeusch.	*Rosaceae*	Sp	H	C-U	P1
Potentilla reptans L.	*Rosaceae*	Ap	H	M-A	–
Prunella vulgaris L.	*Lamiaceae*	Ap	H	M-A	–
Prunus spinosa L.	*Rosaceae*	Ap	N	R-P	–
Pyrus pyraster (L.) Burgsd.	*Rosaceae*	Ap	M	R-P	–
Quercus robur L.	*Fagaceae*	Ap	M	–	–
Ranunculus acris L. s. str.	*Ranunculaceae*	Ap	H	M-A	–
Ranunculus auricomus L. s. l.	*Ranunculaceae*	Sp	H	Q-F	P1
Ranunculus flammula L.	*Ranunculaceae*	Sp	H	S-C	V
Ranunculus lingua L.	*Ranunculaceae*	Sp	H, Hy	P	V
Ranunculus repens L.	*Ranunculaceae*	Ap	H	M-A	–
Ranunculus sceleratus L.	*Ranunculaceae*	Ap	T	B	–
Rhamnus cathartica L.	*Rhamnaceae*	Sp	N	R-P	P1
Rhinanthus serotinus (Schönh.) Oborný	*Scrophulariaceae*	Ap	T, pp	M-A	–
Ribes spicatum E. Robson	*Grossulariaceae*	Sp	N	Q-F	P1
Rorippa amphibia (L.) Besser	*Brassicaceae*	Ap	H, Hy	P	–
Rorippa palustris (L.) Besser	*Brassicaceae*	Ap	T, H	B	–
Rorippa sylvestris (L.) Besser	*Brassicaceae*	Ap	G, H	M-A	–
Rorippa ×armoracioides (Tausch) Fuss	*Brassicaceae*	Ap	H	-	–
Rosa canina L.	*Rosaceae*	Ap	N, Ii	R-P	–
Rubus caesius L.	*Rosaceae*	Ap	N	A	–
Rubus idaeus L.	*Rosaceae*	Ap	N	E	–
Rumex acetosa L.	*Polygonaceae*	Ap	H	M-A	–
Rumex acetosella L.	*Polygonaceae*	Ap	G, H, T	K-C	–
Rumex crispus L.	*Polygonaceae*	Ap	H	M-A	–
Rumex hydrolapathum Huds.	*Polygonaceae*	Sp	H, Hy	P	P2
Rumex obtusifolius L.	*Polygonaceae*	Ap	H	A	–
Salix alba L.	*Salicaceae*	Ap	M	Sp	–
Salix cinerea L.	*Salicaceae*	Ap	N	Ag	–
Salix fragilis L.	*Salicaceae*	Ap	M	Sp	–

TABLE 1 – cont.

Species	Family	1	2	3	4
Salix purpurea L.	*Salicaceae*	Ap	N	Sp	–
Salix triandra L.	*Salicaceae*	Ap	N	Sp	–
Sambucus nigra L.	*Sambucaceae*	Ap	N	R-P	–
Sambucus racemosa L.	*Sambucaceae*	Ap	N	R-P	–
Saponaria officinalis L.	*Caryophyllaceae*	Ap	H	A	–
Scirpus sylvaticus L.	*Cyperaceae*	Sp	G	M-A	P2
Scrophularia umbrosa Dumort.	*Scrophulariaceae*	Sp	H, Hy	P	P1
Scutellaria galericulata L.	*Lamiaceae*	Sp	H	Ag	P2
Sedum acre L.	*Crassulaceae*	Ap	C	K-C	–
Senecio jacobaea L.	*Asteraceae*	Ap	H	–	–
Silaum silaus (L.) Schinz. & Thell.	*Apiaceae*	Sp	H	M-A	LC
Sium latifolium L.	*Apiaceae*	Sp	H, Hy	P	P1
Solanum dulcamara L.	*Solanaceae*	Ap	N, Ii	Ag	–
Solidago canadensis L.	*Asteraceae*	Kn	H, G	A	–
Solidago gigantea Aiton	*Asteraceae*	Kn	H, G	A	–
Solidago virgaurea L. s. str.	*Asteraceae*	Sp	H	C-U	P1
Sonchus arvensis L.	*Asteraceae*	Ap	G, H	–	–
Sorbus aucuparia L. emend. Hedl.	*Rosaceae*	Ap	N, M	–	–
Sparganium emersum Rehmann	*Sparganiaceae*	Sp	Hy	P	V
Sparganium erectum L. emend. Rchb.	*Sparganiaceae*	Sp	Hy	P	P1
Stachys palustris L.	*Lamiaceae*	Ap	G	A	–
Stachys sylvatica L.	*Lamiaceae*	Sp	H	Q-F	P1
Stellaria graminea L.	*Caryophyllaceae*	Ap	H	M-A	–
Stellaria media (L.) Vill.	*Caryophyllaceae*	Ap	T, H	S	–
Stellaria palustris Retz.	*Caryophyllaceae*	Sp	H	M-A	P1
Succisa pratensis Moench	*Dipsacaceae*	Sp	H	M-A	P1
Symphytum officinale L.	*Boraginaceae*	Ap	G, H	M-A	–
Tanacetum vulgare L.	*Asteraceae*	Ap	H	A	–
Taraxacum officinale F.H. Wigg.	*Asteraceae*	Ap	H	M-A	–
Thalictrum flavum L.	*Ranunculaceae*	Sp	H	M-A	P1
Thalictrum minus L.	*Ranunculaceae*	Sp	H	F-B	P1
Torilis japonica (Houtt.) DC.	*Apiaceae*	Ap	H, T	A	–
Tragopogon pratensis L. s. str.	*Asteraceae*	Ap	H	M-A	–
Trifolium arvense L.	*Fabaceae*	Ap	T	K-C	–
Trifolium fragiferum L.	*Fabaceae*	Ap	H	M-A	–
Trifolium pratense L.	*Fabaceae*	Ap	H	M-A	–
Trifolium repens L.	*Fabaceae*	Ap	C, H	M-A	–
Triglochin palustre L.	*Juncaginaceae*	Sp	H	S-C	P1
Tussilago farfara L.	*Asteraceae*	Ap	G	A	–
Typha latifolia L.	*Typhaceae*	Ap	Hy, H	P	P2
Ulmus laevis Pall.	*Ulmaceae*	Ap	M	Q-F	–
Ulmus minor Mill. emend. Richens	*Ulmaceae*	Ap	M	Q-F	–
Urtica dioica L.	*Urticaceae*	Ap	H	A	–
Valeriana dioica L. s. str.	*Valerianaceae*	Sp	H	S-C	LC
Valeriana officinalis L.	*Valerianaceae*	Sp	H	M-A	P1
Verbascum lychnitis L.	*Scrophulariaceae*	Ap	H	F-B	–
Veronica arvensis L.	*Scrophulariaceae*	Ap	T	S	–
Veronica beccabunga L.	*Scrophulariaceae*	Sp	Hy, C	M-C	V

Table 1 – cont.

Species	Family	1	2	3	4
Veronica chamaedrys L. s. str.	*Scrophulariaceae*	Ap	C	M-A	–
Veronica serpyllifolia L.	*Scrophulariaceae*	Ap	H	M-A	PR
Viburnum opulus L.	*Viburnaceae*	Sp	N	R-P	P1
Vicia angustifolia L.	*Fabaceae*	Ap	T	S	–
Vicia cracca L.	*Fabaceae*	Ap	H	M-A	–
Vicia sepium L.	*Fabaceae*	Sp	H	–	P1
Viola canina L. s. str.	*Violaceae*	Sp	H	C-U	P1

Explanations:
Col. 1. Geographical-historical element: Ap – apophyte, Ar – archeophyte, Kn – kenophyte, Sp – half synanthropic spontaneophyte (acc. to Jackowiak 1990);
Col. 2. Life form sensu Raunkiaer 1934: C – herbaceous chamephyte, Ch – lignified chamephyte, G – geophyte, H – hemicryptophyte, Hy – hydrophyte and helophyte, li – liana, N – nanophanerophyte, M – megaphanerophyte, pp – semiparasite, T – therophyte (acc. to Zarzycki et al. 2002);
Col. 3. Phytosociological rank: A – *Artemisietea*, Ag – *Alnetea glutinosae*, B – *Bidentetea*, C-U – *Calluno-Ulicetea*, F-B – *Festuco--Brometea*, I-J – *Isoëto-Juncetea*, K-C – *Koelerio-Corynephoretea*, L – *Lemnetea*, M-A – *Molinio-Arrhenatheretea*, P – *Phragmitetea*, Po – *Potametea*, P-P – *Polygono-Poetea*, Q-F – *Querco-Fagetea*, R-P – *Rhamno-Prunetea*, S – *Stellarietea mediae*, S-C – *Scheuchzerio-Caricetea*, Sp – *Salicetea purpureae*, T-G – *Trifolio-Geranietea*, V-P – *Vaccinio-Piceetea* (acc. to Brzeg and Wojterska 2001);
Col. 4. Threat in Poznań: E – endangered, V – vulnerable, P1/P2/P3 – frequent and potential vulnerable hemerophobe, PR – rare and potential vulnerable hemerophobe (acc. to Jackowiak 1990); red list of Wielkopolska: VU – vulnerable, LC – least concern (acc. to Jackowiak et al. 2007).

was characterized by a low level of synantropization. Antropophytes (29 spp.) constituted 10% of the total flora. Among them there were 14 archaeophytes and 15 kenophytes. Strongly prevailed apophytes (180, 61%), then, spontaneophytes (85, 29%). The largest role in composition of plant communities was played by species characteristic for *Molinio-Arrhenatheretea* (82 spp.), *Artemisietea* (54) and *Phragmitetea* (31).

Vegetation

Vegetation of the Głuszec stream valley consisted of phytocoenoses of 47 plant associations (Table 2) from: *Alnetea glutinosae* – 2, *Querco-Fagetea* – 1, *Rhamno--Prunetea* – 1, *Lemnetea minoris* – 2, *Potametea* – 2, *Phragmitetea australis* – 16, *Scheuchzerio-Caricetea fuscae* – 1, *Molinio-Arrhenatheretea* – 13 and *Artemisietea vulgaris* – 9. Natural associations (N + NA + NP = 74%) prevail on the list. Eight represent seminatural associations (SN = 20%), one is synantropic ruderal (SR) and two – xenospontaneous (X). Seminatural associations occupied majority of the valley's grasslands. Seven plant communities were classified as rare in the region and the rest as frequent (43%) or common (43%). Six plant associations represent three Natura 2000 habitats, identified in accordance with the Regulation of the Minister of Environment (Rozporządzenie [Regulation]... 2010), one of them – ash-alder carr *91E0 (*Fraxino-Alnetum*), one – 6410 (*Selino carvifoliae-Molinietum caeruleae*) and four – tall herbs 6430 (*Epilobio hirsuti-Convolvuletum sepium*, *Eupatorietum cannabini*, *Fallopio-Humuletum* and *Urtico-Convolvuletum sepium*).

Vegetation complexes

Landscape differentiation of the Głuszec stream valley consisted of six types of vegetation complexes, two rush and four meadow complexes (Table 3). Both rush complexes showed an above-ground dominance of the *Magnocaricion* phytocoenoses (rel. 1-4), three complexes represented the *Calthion* meadow (rel. 5-16) and one – the *Molinion* meadow (rel. 17-18). Rush complexes developed mainly in the left-bank part of the valley, on the soils abundantly fed by underground water, where water sometimes seeps to the surface. They occurred also at the outlet of the Głuszec stream and were connected with the areas of potential natural vegetation *Carici elongatae-Alnetum*, characterized by a dense network of secondary drainage ditches, strongly silted and overgrowing. Almost the whole right-bank valley and a large fragment of the left-bank part occupied meadow complexes developed within the limits of potential biochores of *Fraxino-Alnetum*. They showed the above--ground dominance of either *Angelico-Cirsietum oleracei* phytocoenoses (rel. 5-12) or *Ranunculo repentis-Alopecuretum pratensis* (rel. 14-16) and *Caricetum cespitosae* (rel. 13). Similarly like in the case of rush complexes, these areas were strongly cut by silted and overgrowing ditches. In many regions, the process of paludification was observed. It manifested by the invasion of swamp species into meadow communities, particularly, *Carex acutiformis* to the phytocoenoses of *Angelico-Cirsietum oleracei*. From the upland side, a patch of the sigmassociation *Caricetum cespitosae* (rel. 13) bordered a patch of *Angelico-Cirsietum oleracei* with *Dactylorhiza incarnata*, distinguished by such species of habitats with shallow near-surface runoffs as the aforementioned orchid, *Carex panicea* and *Juncus inflexus*. Only in one site, in the south-east, left-bank Głuszec stream valley, next to a school sport stadium, the *Selino-Molinietum* complex (rel. 17-18) was recorded. In this place, the potential natural vegetation is *Querco-Ulmetum minoris*. Recently, those meadows were mowed only sporadically. They disappear, being replaced by tall herbs. Among the rare plants for Wielkopolska, *Briza media*, *Campanula glomerata*, *Carex panicea*, *Dactylorhiza incarnata*, *Inula*

TABLE 2. Plant associations in the Głuszec stream valley in Poznań

Syntaxa	1	2	3
Alnetea glutinosae Br.-Bl. & R. Tx. 1943			
Carici elongatae-Alnetum W. Koch 1926 ex R. Tx. 1931	I	N	F
Salicetum cinereae Kobendza 1930	I	NA	F
Querco-Fagetea Br.-Bl. & Vlieger 1937			
Fraxino-Alnetum W. Mat. 1952	I	N	F
Rhamno-Prunetea Rivas-Goday & Borja Carbonell 1961 ex R. Tx. 1962			
Aegopodio-Sambucetum nigrae Doing 1962 em. M. Wojterska 1990	I	NA	C
Lemnetea minoris (R. Tx. 1955) de Bolós & Masclans 1955			
Callitricho-Lemnetum minoris (Weber-Oldecop 1969) Pass. 1978	I	NA	R
Lemnetum minoris Soó 1927	–	NA	C
Potametea R. Tx. & Prsg. 1942 ex Oberd. 1957			
Elodeetum canadensis Eggler 1933	–	X	F
Nymphaeo albae-Nupharetum luteae Nowiński 1928	V	NP	F
Phragmitetea australis (Klika in Klika & Novák 1941) R. Tx. & Prsg. 1942			
Cardamino amarae-Beruletum erecti Turoňová 1985	I	NA	R
Caricetum acutiformis Eggler 1933	I	NA	C
Caricetum distichae Nowiński 1928 ex Steffen 1931	V	NP	R
Caricetum elatae W. Koch 1926	I	N	C
Caricetum gracilis Almquist 1929	I	NA	C
Caricetum paniculatae Wangerin 1916 ex von Rochow	V	NP	F
Caricetum ripariae Soó 1928	–	NA	C
Caricetum rostratae Rübel 1912 ex Osvald 1923	I	NA	F
Cicuto-Caricetum pseudocyperi Boer & Sissingh in Boer 1942	V	NP	F
Glycerietum maximae (Allorge 1922) Hueck 1931	–	NA	C
Glycerietum fluitantis (Nowiński 1928) Wilzek 1935	–	NA	F
Iridetum pseudoacori Eggler 1933 ex Brzeg & M. Wojterska 2001	I	NA	C
Phalaridetum arundinaceae Libbert 1931	–	NA	C
Phragmitetum communis (W. Koch 1926) Schmale 1939	–	NA	C
Sparganietum erecti Roll 1938	–	NA	C
Typhetum latifoliae Soó 1927 ex Lang 1973	–	NA	C
Scheuchzerio-Caricetea fuscae (Nordhagen 1936) R. Tx. 1937			
Caricetum paniceo-lepidocarpae (Steffen 1931) W. Braun 1968	V	NA	R
Molinio-Arrhenatheretea R. Tx. 1937 em. 1970			
Angelico-Cirsietum oleracei R. Tx. 1937 em. 1947	V	SN	F
Caricetum cespitosae Steffen 1931	V	N	R
Lolio-Plantaginetum Beger 1932 em. Sissingh 1969	–	SN	C
Lysimachio vulgaris-Filipenduletum Bal.-Tulačková 1978	I	N	F
Mentho longifoliae-Juncetum inflexi Lohmeyer 1953 nom. invers.	V	SN	R
Poo palustris-Lathyretum palustris Walther in R. Tx. 1955 ex Walther 1977	V	SN	R
Potentilletum anserinae Rapaics 1927 em. Pass. 1964	–	SN	C
Ranunculo repentis-Alopecuretum geniculati R. Tx. 1937 em. 1950	–	SN	F
Ranunculo repentis-Alopecuretum pratensis Krisch 1974	–	SN	F
Scirpetum sylvatici Ralski 1931	V	N	F
Scutellario hastifoliae-Veronicetum longifoliae Walther 1955 em. Pass. 1964	V	N	F
Selino carvifoliae-Molinietum caeruleae Kuhn 1937	E	SN	F
Stellario palustris-Deschampsietum cespitosae Freitag 1957	–	SN	C

TABLE 2 – cont.

Syntaxa	1	2	3
Artemisietea vulgaris Lohmeyer, Prsg. & R. Tx. in R. Tx. 1950			
Aegopodio-Geranietum pratensis Hadač 1978	I	NA	F
Agropyro repentis-Aegopodietum podagrariae R. Tx. 1967 em. Neuhäuslová--Novotná & al. 1969	–	NA	C
Anthriscetum sylvestris Hadač 1978	–	NA	C
Convolvulo arvensis-Agropyretum repentis Felföldy (1942) 1943	–	SR	C
Epilobio hirsuti-Convolvuletum sepium Hilbig, Heinrich & Niemann 1972	–	NA	C
Eupatorietum cannabini R. Tx. 1937	–	NA	F
Fallopio-Humuletum lupuli Brzeg 1989 ex Brzeg & M. Wojterska 2001	–	NA	C
Impatientetum parviflorae Brzeg 1989 ex Borysiak 1994	–	X	F
Urtico-Convolvuletum sepium Görs & Th. Müller 1969	–	NA	F

Explanations:
Col. 1. E – endangered, I – data deficient, V – vulnerable association which resources are clearly decreasing in Wielkopolska;
Col. 2. Syngenesis of community: N – natural, NA – auxochoric natural, with tendency to expand its range, NP – perdochoric natural, with tendency to decrease its range, SN – seminatural, SR – synanthropic ruderal, X – xenospontanic, composed by alien species spreading into natural biotopes;
Col. 3. Frequency in Wielkopolska: F – frequent, C – common, R – rare;
Col. 1-3. According to BRZEG and WOJTERSKA (2001).

salicina, *Lathyrus palustris*, *Parnassia palustris*, *Succisa pratensis*, *Ulmus minor* var. *suberosa* and *Valeriana dioica* were recorded in the sigmassociations No. 17 and 18.

Biomonitoring plots with Dactylorhiza incarnata

In the area of the Głuszec stream valley, three spatially isolated places of occurrence of *Dactylorhiza incarnata* were localized (Fig. 1). These are new records in Poznań. Two specimens of the orchid were recorded in the *Selino-Molinietum* phytocoenosis on May 2, 2011. The geographic coordinates (WGS 84) of this place are: N52°19′18.03″/W16°56′40.41″. Five other plants were noted in *Angelico-Cirsietum oleracei* (N52°19′39.13″/W16°56′12.05″). The richest site contained three groups of specimens: N52°19′25.70″/W16°56′33.80″ (plot 1, 440 m² – 30 shoots), N52°19′27.50″/W16°56′32.60″ (plot 2, 624 m² – 26 shoots) and N52°19′20.90″/W16°56′29.70″ (plot 3, 72 m² – 9 shoots); in the biomonitoring year 2013 – total 185 shoots. In this site, the orchid grew in the patches that floristically alluded to the communities of *Agropyro-Rumicion* and *Calthion* (Table 4). They were extensively used meadow phytocoenoses with numerous species of *Molinietalia* (8 taxa) and *Molinio--Arrhenatheretea* (15). All were distinguished by the presence of *Carex panicea* from *Caricion davallianae*. Local soils were of light, grey colour. They developed from slope washed sands, strongly soaked with underground water.

In total, 65 specimens of *Dactylorhiza incarnata* were found on the three monitored plots. The length of shoots ranged from 13.5 to 33 cm. There were 4-6 leaves on a single shoot. The length of the longest leaf ranged from 7.5 to 19.5 cm and the number of flowers in a raceme was 6-36. Three shoots were sterile. The highest mean number of flowers was recorded on shoots in the plot 2 (Fig. 2). In this site, the highest mean percentage of pollinated and fertilized flowers (86%) was noted. The lowest

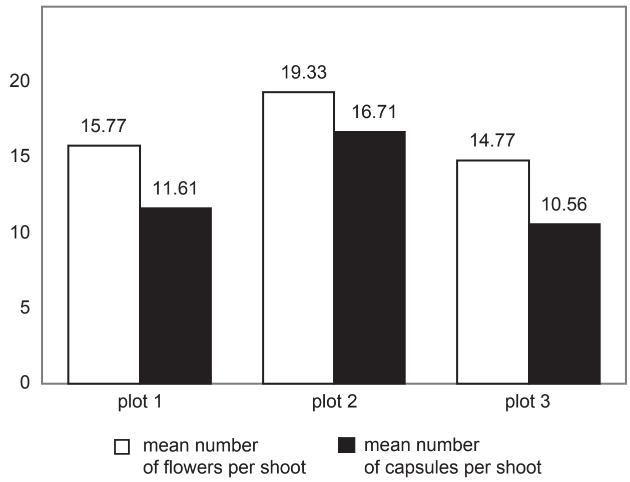

FIG. 2. Mean number of flowers and capsules per shoot of *Dactylorhiza incarnata* at biomonitoring plots 1-3 in the Głuszec stream valley

mean number of flowers was found on plot 3. At the same time, this area was characterised by the lowest average percentage of pollinated and fertilized flowers (71.5%). The highest number of leaves was found on shoots in plot 3, while the lowest in plot 1 (Fig. 3). The obtained data indicate lack of correlation between the number of leaves and flowers per plant. On average, the highest plants occurred in plot 3 and the lowest in plot 2 (Fig. 4). The highest mean number of flowers was recorded on shoots in plot 2, and the lowest in plot 3. In the studied population of *Dactylorhiza incarnata*, the number of flowers on a plant is inversely proportional to its height. The condition of generative shoots with mature capsules indicates optimal development conditions in plot 2.

Table 3. Sigmassociations in the Głuszec stream valley in Poznań

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
Day/month 2011 year	8.06	9.07	6.08	3.09	8.06	8.06	8.06	3.09	9.07	9.07	9.07	3.09	8.06	8.06	8.06	3.09	3.09	9.07
Water communities with floating leaves (%)	5	5	–	–	+	+	+	+	–	+	+	+	+	+	–	5	–	–
Reeds and fens (%)	95	95	98	98	20	10	5	5	15	5	5	5	35	5	5	10	–	–
Meadows (%)	+	+	+	+	80	90	95	90	85	95	95	90	65	85	95	85	70	75
Tall forbs (%)	–	–	–	+	+	+	+	5	–	+	+	5	–	10	–	+	30	25
Thicket and single shrubs (%)	–	–	–	–	–	–	+	–	–	–	–	–	–	–	–	–	–	+
Area of sigmassociation (ha)	0,3	0,3	0,4	0,3	0,4	0,4	0,3	0,3	0,4	0,3	0,4	0,4	0,3	0,4	0,3	0,4	0,1	0,1
Number of associations	9	12	5	5	12	10	12	14	8	11	12	7	11	10	7	12	8	8
Caricetum elatae	5o	5o	1:	.	.	1:	.	.	2:	.	.	.	2:	.	.	.	.	.
Caricetum acutiformis	1.	.	5o	5o	2o	1.	1.	1.	+o	+.	.	1.	1o	.	.	.	.	.
Angelico-Cirsietum oleracei	.	.	1.	.	4o	4o	5o	4o	4o	4o	4o	5o	.	.	.	.	.	.
Potentilletum anserinae	.	.	.	.	.	1.	+.	1.	.	2.	1.	1.	.	.	.	+.	.	.
Caricetum cespitosae	.	.	.	.	.	2o	.	.	2o	.	.	.	4o		.	.		.
Caricetum paniceo-lepidocarpae	.	.	.	.	.	.	+.	+.	1.	.	.	.	3o	.	.	.	.	.
Ranunculo repentis-Alopecuretum pratensis	.	.	.	.	1.	.	.	.	.	.	.	.	.	4o	4o	4o	.	.
Poo palustris-Lathyretum palustris	+o	.	.	.	.	.	.	.	.	.	.	.	.	2o	1.	1.	.	.
Selino carvifoliae-Molinietum caeruleae	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	4o	4o
Aegopodio-Geranietum pratensis	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	2o	2:
Phalaridetum arundinaceae	1/	1/	+.	1/	+.	1.	.	.	1.	1.	+.	.	+.	1/	1/	2/	.	.
Stellario palustris-Deschampsietum cespitosae	.	.	.	.	1.	.	1.	2o	3o	2o	2o	.	2.	2.	3o	2o	.	.
Cardamino amarae-Beruletum erecti	1:	1/	.	.	1:	1/	+.	+.	.	+.	+.	.	1/	+.	.	.	.	.
Caricetum rostratae	+.	2.	.	1/	1/	1/	.	+.	1/	.	.	.	1/	.	.	.	.	.
Scutellario hastifoliae-Veronicetum longifoliae	.	+.	+.	.	2o	.	.	.	.	2o	.	.	.	.	+.	+.	1.	+.
Lysimachio vulgaris-Filipenduletum	.	.	.	.	1.	+.	+.	.	.	.	+.	1:	.	+.	.	+.	.	.
Epilobio hirsuti-Convolvuletum sepium	.	.	.	.	+.	.	.	1.	.	.	1.	1:	.	.	.	.	+.	+.

Table 3 – cont.

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
Eupatorietum cannabini	.	.	.	+.	.	.	+.	1.	.	1.	.	.	.	.	.	.	+.	1.
Lemnetum minoris	+.	1.	.	.	.	.	.	+.	.	1/	+.	.	.	+.	.	.	.	.
Glycerietum maximae	+.	+.	.	.	.	.	.	.	.	.	.	.	.	1/	1/	+.	.	.
Anthriscetum sylvestris	.	.	.	.	.	.	1.	.	.	.	.	.	.	2/	.	+.	1.	.
Urtico-Convolvuletum sepium	.	.	.	.	.	.	.	.	.	.	.	1/	.	2:	.	.	2:	2/
Ranunculo repentis-Alopecuretum geniculati	.	.	.	.	.	.	2o	.	.	.	2o	.	+.	.	+.	.	.	.
Iridetum pseudoacori	.	+.	.	.	.	1:	.	.	.	.	+.	.	+.	.	.	.	.	.
Lolio-Plantaginetum	.	.	.	.	1/	.	.	1/	.	1/	.	.	.	.	.	.	.	.
Cicuto-Caricetum pseudocyperi	.	.	.	.	+.	.	.	+.	.	.	+.	.	.	.	.	.	.	.
Caricetum gracilis	.	.	.	.	.	.	+.	.	.	2o	1.	.	.	.	.	.	.	.
Scirpetum silvatici	.	+.	.	.	.	.	2o	+.	.	.	.	.	.	.	.	.	.	.
Mentho longifoliae-Juncetum inflexi	.	.	.	+.	.	.	.	.	.	.	.	.	+.	.	.	.	.	.
Elodeetum canadensis	.	+.	.	.	.	.	.	.	.	.	.	.	.	.	.	1:	.	.
Sparganietum erecti	.	+.	.	.	.	.	.	.	.	.	.	.	.	.	.	+.	.	.
Glycerietum fluitantis	.	.	.	.	.	.	.	1.	.	.	.	.	.	.	.	.	.	.
Typhetum latifoliae	.	.	.	.	.	.	.	.	.	.	.	1.	.	.	.	.	.	.
Nymphaeo albae-Nupharetum luteae	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1:	.	.
Agropyro repentis-Aegopodietum podagrariae	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1.	.
Aegopodio-Sambucetum nigrae	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1.
Fallopio-Humuletum lupuli	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1.
Callitricho-Lemnetum minoris	1:	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Phragmitetum communis	.	1.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.

Explanations:
Occurrence way of community in vegetation complex: o – over great surface, / – in long, narrow linear form, : – dispersed in linear form, . – single or dispersed in irregular form; quantity – Braun-Blanquet scale.

TABLE 4. Phytosociological diagnosis of monitoring plots with *Dactylorhiza incarnata* in the Głuszec stream valley in Poznań

Number of monitoring plot	1	2	3
Date of relevé	02.06.2011		
Area of the plot with *Dactylorhiza incarnata* (m^2)	440	624	72
Cover of herb layer (%)	100	100	98
Number of species	46	36	36
Number of *Dactylorhiza incarnata* schoots	30	26	9
Ch. *Caricion davallianae* et *Scheuchzerio-Caricetea**			
Dactylorhiza incarnata	2.1	2.1	1.1
Carex panicea	1.2	2.2	1.1
*Juncus articulatus**	+	.	2.2
Parnassia palustris	+	.	.
Ch. *Calthion*			
Cirsium oleraceum	2.2	+	1.1
Caltha palustris	+	+.2	1.1
Carex cespitosa	+	+	+
Deschampsia caespitosa	+	+	+
Myosotis palustris	.	.	+
Ch. *Agropyro-Rumicion*			
Carex hirta	2.2	2.2	1.1
Potentilla anserina	1.1	1.2	1.1
Juncus inflexus	+	1.1	2.1
Rumex crispus	1.1	+	+
Potentilla reptans	1.1	+	.
Trifolium fragiferum	+	.	.
Ch. *Molinietalia*			
Lotus uliginosus	+	1.1	2.2
Cirsium palustre	+	1.1	2.1
Angelica sylvestris	1.1	+	+
Lythrum salicaria	+	+	1.1
Lychnis flos-cuculi	.	+	+
Equisetum palustre	.	.	2.1
Cardamine pratensis	.	.	1.1
Inula salicina	+	.	.
Ch. *Trifolio-Plantaginetalia** et *Molinio-Arrhenatheretea*			
Festuca rubra	2.2	2.2	1.2
Ranunculus repens	1.1	2.2	2.2
Poa trivialis	1.2	1.2	2.2
Holcus lanatus	2.2	1.2	+
Achillea millefolium	1.1	1.1	+
Cerastium holosteoides	1.1	1.1	+
Rumex acetosa	2.1	+	+
Ranunculus acris	1.1	+	+
Plantago lanceolata	2.2	2.2	.
Rhinanthus serotinus	2.2	2.2	.
*Plantago major**	1.1	+	.
Trifolium pratense	+	+.2	.
Briza media	1.1	.	+

Table 4 – cont.

Number of monitoring plot	1	2	3
*Trifolium repens**	+	.	+
Taraxacum officinale	+	.	.
Ch. *Phragmitetea*			
Galium palustre	+	+	2.2
Carex acutiformis	2.2	.	1.1
Carex gracilis	.	+	+
Phalaris arundinacea	.	.	+
Ch. *Artemisietea*			
Daucus carota	2.2	+	.
Heracleum sibiricum	2.2	+	.
Medicago lupulina	+	+	.
Cirsium arvense	1.1	.	.
Geranium pratense	+	.	.
Urtica dioica	+	.	.
Others			
Polygonum amphibium f. *terrestre*	1.1	+	1.1
Anthoxanthum odoratum	1.2	+	.
Mentha arvensis	.	1.1	+
Eleocharis uniglumis	.	.	2.2
Ranunculus auricomus	+	.	.
Plantago media	+	.	.

Explanations:
Plot 1. WGS 84: N52°19′25.70″/W16°56′33.80″ (±5 m);
Plot 2. WGS 84: N52°19′27.50″/W16°56′32.60″ (±5 m);
Plot 3. WGS 84: N52°19′20.90″/W16°56′29.70″ (±7 m).

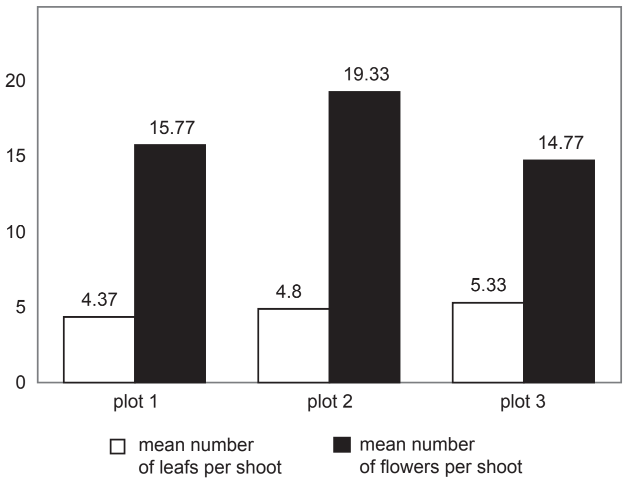

Fig. 3. Mean number of leafs and flowers per shoot of *Dactylorhiza incarnata* at biomonitoring plots 1-3 in the Głuszec stream valley

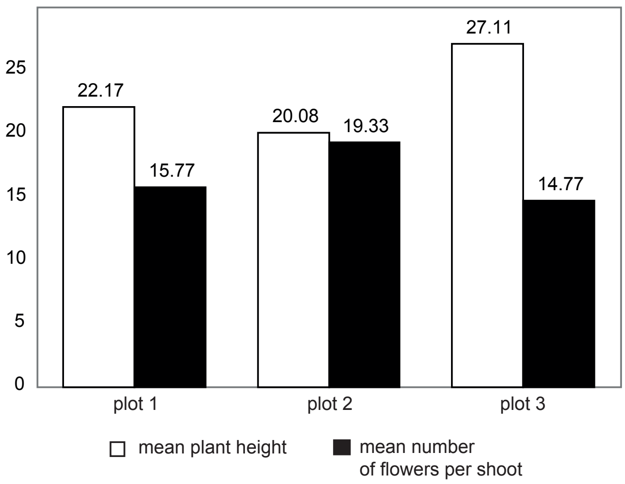

Fig. 4. Mean plant height (cm) and mean number of flowers per shoot of *Dactylorhiza incarnata* at biomonitoring plots 1-3 in the Głuszec stream valley

DISCUSSION AND CONCLUSIONS

Threats

The local plan of spatial development 'Głuszynka Valley – part B' passed by the Poznań City Council (Uchwała [Resolution]... 2010) permits the construction of a storage reservoir that includes the Głuszec stream valley. This investment poses threat to the existing vegetation landscape, resulting in its degradation within the limits of the ordinate of maximum damming of water in the reservoir. This landscape consists of six types of vegetation complexes, made up of 47 plant associations, including three Natura 2000 habitats (*91E0, 6410, 6430). It is the landscape of low anthropization level, extensively used for agriculture, with natural and seminatural syngenesis of component plant communities, of rush-meadow physiognomy and, in terms of habitat, of alder-carr type. 294 species of vascular plants, which represent as much as 22% of the flora of Poznań investigated by Jackowiak (1990) and 19% of the flora of central Wielkopolska recognized by Jackowiak (2001) are at risk of being destroyed. The reservoir construction was planned in the area of occurrence of two plants under strict species protection, based on the Regulation of the Minister of Environment (Rozporządzenie [Regulation]... 2012) – *Dactylorhiza incarnata* and *Epipactis helleborine* (29 shoots at WGS 84: N52°19′5.23″/W16°56′29.55″), and also of three plants under partial species protection – *Frangula alnus*, *Nuphar lutea* and *Viburnum opulus*. Furthermore, it is the area of six species threatened with extinction in the Wielkopolska region, which are included in the red list by Jackowiak et al. (2007): with the VU category – *Calamagrostis stricta* and *Parnassia palustris*, LC – *Dactylorhiza incarnata*, *Inula salicina*, *Silaum silaus* and *Valeriana dioica*. Analogically, it is the area of occurrence of 22 (47% of all noted in the Głuszec stream valley) associations threatened with extinction. One of them has the status of endangered (E) and 11 – vulnerable (V). The level of threat to other 10 associations is still unknown (E or V), due to their poor investigation.

The construction of a storage reservoir will result in destroying the *Dactylorhiza incarnata* locality. Jackowiak (1990) recognised this species as being under high risk of extinction in the area of Poznań, based on his studies conducted in 1980-1985. He found the species in eight squares of 1 × 1 km (only in the northern part of the town), as a spontaneophyte of natural and semi-natural, forests and meadow biotopes. A new site of this orchid was found in 1996 in the south-western part of Poznań (Kluza and Maciejewska 1998). Since 1997 that local population had been monitored (Kluza-Wieloch and Maciejewska-Rutkowska 2009).

The Głuszec valley has a very dense network of secondary drainage ditches – 260 lm/ha. Ditches are strongly silted and overgrown. Their present condition contributes to the floristic and phytocoenotic richness of the area. Ditches differ from one another in their vegetation cover. In their beds, various aquatic and swamp plant communities have developed. Majority of them do not occur in other habitats of the Głuszec stream valley. The condition of the ditches deteriorates and, along with lowering of the water level, their hydrophyte flora becomes poorer. This will cause an increase in landscape retention and a secondary swamp development over the large part of the valley. Even today, the replacement of *Calthion* meadows with rushes from *Magnocaricion* is being observed as a result of paludification. In the vicinity of ditches deeply filled with bottom sediments, there are places in which water stagnates for almost entire vegetation season, which hinders mowing. Free outflow of water has been observed only for the Głuszec stream, from which silt was removed in 2009.

In the south-eastern, left-bank part of the Głuszec stream valley, two additional threats to biodiversity were recognised. One of them is abandoning of mowing practices of the *Selino-Molinietum* meadow, situated in the southern part of the parcel of record No. 7, and the second, pouring out living sewage onto the parcel No. 9. Lack of mowing results in the replacement of different forms of the *Selino-Molinietum* association with the communities of the dynamic circle of *Querco-Ulmetum minoris*. On wetter soils, *Selino-Molinietum* is replaced with the plant communities from *Filipendulion ulmariae*, and in drier soils – with the tall herbs of *Urtico-Convolvuletum sepium* and *Aegopodio-Geranietum pratensis* and thickets of *Aegepodio-Sambucetum nigrae*. Only a small phytocoenose of *Selino-Molinietum* has survived. It is the place of occurrence of many rare species for the Głuszec stream valley, such as: *Briza media*, *Campanula glomerata*, *Carex panicea*, *Dactylorhiza incarnata*, *Inula salicina*, *Lathyrus palustris*, *Parnassia palustris*, *Plantago media*, *Sonchus arvensis* and *Succisa pratensis*. In the outpour area, the *Selino-Molinietum* meadow changed into a formation with *Urtica dioica*. This is the place of occurrence of *Echinocystis lobata* – a kenophyte from the list of Zając et al. (1998) – which is very expansive in the Wielkopolska region.

Conservation

Various threats to ecosystem services (Borysiak 2012) and natural biodiversity of the Głuszec stream valley, resulting from the planned construction of a storage reservoir, negligence in the maintenance of secondary drainage ditches and abandoning of mowing practices in the part of the valley, triggered the search for the ways of threat elimination.

The construction of the storage reservoir can be stopped only by incorporation of the valley grasslands into the agri-environmental program, covered by the Rural Areas Development Program 2007-2013 (Rozporządzenie [Regulation]... 2009) and realisation of Package No. 4 – Protection of the threatened bird species and natural habitats outside the Natura 2000 areas. A user of the valley has been identified. He is a farmer from the village of Babki, a leaseholder of local meadows. He got acquainted with the package. The farmer commissioned an expert botanist to prepare habitat documentation, obligatorily required for the package realisation, and entered the program. Since 2011, he has been realising three variants of Package: 4.3 – *Magnocaricion* rushes, 4.6 – Seminatural wet meadows and 4.10 – Ecological lands. The farmer is obliged to obey the basic requirements for the package and the detailed requirements for the variants. The basic requirements include a ban on ploughing, rolling, resowing, using sewage and sewage sediments and levelling from 1 April to 1 September, construction and extension of drainage facilities and usage of plant protection measures. The detailed requirements for variants 4.3 and 4.6 comprise: mowing from 15 July to 30 September in the way which does not destroy meadow sward and soil cover (with the mowing height above 5-15 cm), stacking cut biomass two weeks after harvest and the dictate to mow in a circular motion – from the centre outwards. In variant 4.3, he can mow only 20% of the parcel area, each year a different part. In variant 4.6, he has to leave 5-10% of the area not mowed, similarly, each year another section. He also cannot fertilize *Magnocaricion* rushes, while seminatural wet meadows – only up to the level of 60 kg/ha/year. An ecological site, which has been incorporated into the agri-environmental program, is a phytocoenotic complex consisting of the *Magnocaricion* rushes (among others, *Caricetum paniculatae*), tall herbs with *Calystegion sepium* and thickets of *Aegopodio-Sambucetum*. During the realization of variant 4.10, the farmer has to preserve the site in a non-deteriorated condition and to apply cultivation measures indicated by the contractor for habitat documentation. In this area, fertilization, drainage, peat excavation and sedge tussocks removal are forbidden. Once every five years, the site has to be mown before 31 October, with dense thickets left over.

Irrespective of basic requirements for Package No. 4 and detailed requirements for variants 4.3, 4.6 and 4.10, an expert botanist is entitled to the formulation of additional protective recommendations. In the case of variant 4.6, recommendations concern the locality of *Dactylorhiza incarnata*. The biomonitoring program of the orchid population was drawn up. It has been implemented since 2011, in cooperation with the farmer and a group of specialists under the management of an expert botanist (J. Borysiak). It is aimed at the effect of diversification the mowing rhythm on the dynamics of *D. incarnata* population. In 2011, the monitored area was not mowed. Individuals of the orchid went through the whole development cycle, including dispersal of generative diaspores. In the subsequent years, mowing will be performed after seeds get ripe. Population studies will be conducted until the end of the program in 2014. Simultaneously, phytosociological and soil investigation will be carried out in the monitored area.

In the course of preparation of habitat documentation, the expert botanist analysed the condition of drainage system, paying a special attention to the proper protection of natural habitats. She recognised the need for the system restoration and presented the ways of ditches conservation. She also found that silt should be removed from the ditch beds; within the *Calthion* phytocoenoses – to the extent ensuring typical for carr meadows changeability in the ground water level, and within *Magnocaricion* rushes – to the extent allowing for haying. Some ditches should be equipped in gates that will regulate soil retention. Soil acquired during the reconstruction of ditches should be transported outside the valley and not laid out by the ditch margins, as it is usually done. This will protect the ecotone zone between a ditch bed and a mowed part of the meadow. The south border of the area is delimited by the right bank of the Kopel stream. In one of the places, within the belt of about 5 m in width, silt material removed from the bed was deposited. In this area, the ruderal phytocoenoses of *Convolvulo arvensis-Agropyretum repentis*, the subassociation with *Bromus inermis* developed. It was a single synantrophic plant community found in the studied area of the Głuszec stream valley. For this type of a technical procedure, it is quite a frequent phenomenon in situation when waste material contains large amounts of clay and sand deposits. It was found in the valleys (in the Wielkopolska region) of such streams as: Bolemka, Lutynia, Ołobok, Orla, Piwonka, Rdęca, Rów Śląski, Samica Kierska, Swędrnia and others (J. Borysiak own studies).

The farmer, who realizes Package No. 4 in the Głuszec stream valley, breeds horses and operates a stud farm in the village of Babka. In exceptionally wet years he suffers from the shortage of hay due to water stagnation in the *Magnocaricion* rushes, which makes mowing impossible. To supplement fodder resources, the farmer, out of courtesy, mows the *Selino-Molinietum* meadow for his own use. Beforehand, he had been trained by an expert botanist to recognise geobotanical peculiarities of this area. Finally, the meadow should mandatorily become a part of the protected area, within the Poznań Network of Valuable Natural Areas.

Participation of the meadow user in Package No. 4, prevents the construction of a storage reservoir only during the period of realization of the agri-environmental program, i.e. until 2014. It is advisable to continue this program under the supervision of an expert botanist in the subsequent years, if the Rural Areas Development Program is resumed after 2013. However, a permanent protection of natural biodiversity of the Głuszec stream valley will be guaranteed only when one of nature protection forms, anticipated by the article No. 6 of the Act on Nature Protection (Ustawa [Act]... 2004), gets legislated.

In the introduction to this article, it was mentioned that one of the aims of the "Development Strategy for the City of Poznań to 2030" (Strategia [Development Strategy]... 2010) is establishment of the Poznań Network of Valuable Natural Areas. This network is expected to be an element of the city's recreation system. Even today, the Głuszec stream valley plays a recreational and tourist functions. Along its whole edge, including the outlet of the Głuszec stream to Kopel stream, the Forest Inspectorate of Babki established an educational and recreational trail, named 'Głuszynka Valley', equipped with eight carefully prepared boards that give information on the area's nature, and a bicycle path, discretely integrated into the landscape.

The study results presented in the article indicate that the Głuszec stream valley, with its natural and seminatural microlandscapes, being an example of permanent green land extensive management, should be obligatorily included in the network. The best active protection of natural biodiversity of this landscape will be a continuous participation of the local farmer in the agri-environmental program under the supervision of an expert botanist.

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