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THE SPECIES RICHNESS OF THE FLORA OF SELECTED SECTIONS OF THE MIETIUŁKA RIVER IN THE POLESIE NATIONAL PARK

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A b s t r a c t

The aim of the study was to conduct an environmental evaluation of 6 selected sections of the improved Mietiułka River, which included an inventory and analysis of the vascular flora associated directly with this watercourse. The results of the study have shown that the flora of the study area is diverse in taxonomic, syntaxonomic and ecological terms, and that it comprises both typical aquatic plants and species characteristic of the habitats surrounding the river. In the flora found in the study sectors, a total of 114 vascular plant species was identified, which come from 42 botanical families, 15 syntaxonomic classes and belong to different ecological groups. Hemicryptophytes, spontaneophytes, species neutral to continentality as well as species included in the phytochorion with boreal elements: Euro-Siberian subelement, were clearly predominant in the species composition of the flora of all the study sectors. The macrophytes commonly found in Poland had the largest proportion. One species with a small number of stands in the country – water dropwort (*Oenanthe fistulosa*) – as well as two species threatened with extinction, *Sagittaria sagittifolia* and *Hypochoeris glabra*, were recorded.

Key words: vascular flora, improved river, Mietiułka River, Polesie National Park

INTRODUCTION

The Mietiułka River is a small, anthropogenically transformed watercourse, flowing through the northern part of the Polesie National Park (PNP). This river is situated on the eastern side of the watershed running through the Park (in the Bug River basin), and its catchment area is estimated to be 3,965.8 ha. The river originates in the area of Pieszowola, right by the Park boundary, and it feeds into the Włodawka River upstream of Lake Wytyckie. The total length of the river within the Park is 9.25 km (C e b r y k o w et al. 2001; M i c h a l c z y k et al. 2002).

Little direct information on the Mietiułka River itself can be found in literature. The typically anthropogenic nature of its channel is a result of land drainage improvements carried out in the second half of the 20th century (Ł o ś, 1992; 1995). The Mietiułka belongs to the rivers in which the banks have been levelled out and most of the river bank shrubs, which protect against overheating in the summer period and overcooling outside the growing season, have been removed (K o r n i j ó w, 1999). Due to the location of the river in a natural depression in the land surface and agricultural use of the area around the Park, the waters carried by the Mietiułka River are characterized by a high content of dietary minerals and anthropogenic substances, which has a negative effect on its natural values (J a n i e c, 1994; M i c h a l c z y k et al. 1999).

It was only in 1994 that the Mietiułka River, together with its adjacent area, was included in the Polesie National Park. Since that time, renaturalization work has been carried out, designed to gradually increase water storage and to improve the quality of the waters. The aim of these efforts is to create appropriate habitat conditions for different flora and fauna species in the river and within the area adjacent to the river channel (C h m i e l e w s k i and S i e l e w i c z, 1994; P i a s e c k i, 2005).

The aim of the presented pilot study was to conduct an environmental evaluation of 6 selected sections of the improved Mietiułka River, which included an inventory and analysis of the vascular flora associated directly with this watercourse.

MATERIALS AND METHODS

The pilot field study was carried out in May and July 2006 in the Polesie National Park. The study area covered the northern part of the Park, through which the Mietiułka River flows.

During the first stage of the field investigations, a site visit was conducted in the study area, which was designed to make a preliminary identification of vegetation cover and its variation along the studied watercourse. Subsequently, six study sectors were established (I – VI; Fig. 1), each with a length of 25 m. The selection of the location of the sectors was guided by the variation in the vegetation cover and the habitats bordering the investigated watercourse (Figs 2, 3, 4).

The status of the flora in particular study sectors was documented, by making and analysing species inventories. The plant species were identified using the key of Rutkowski (2001). Botanical nomenclature followed Mirek et al. (2002). The plant species present in the study sectors were assigned to syntaxonomic classes (Matuszkiewicz, 2001). In office investigations, Ekologiczne liczby wskaźnikowe roślin naczyniowych (Ecological indicator values of vascular plants) (Zarzycki et al. 2002) was used to determine the proportion of species of different ecological groups, life forms and the degree of their endangerment. The species were assigned to historical-geographical groups and range groups according to Chmiel (1993). Jaccard's formula (Wysocki and Sikorski, 2002) was used to calculate the index of species similarity in the flora of the study sectors.

RESULTS

In the phytocoenoses of all the study sectors, a total of 114 vascular plant species was identified, representing 42 botanical families. The most numerous was the group of species from the families Poaceae (14 species) and Asteraceae (10 species). The greatest species richness of the vascular flora was noted in sectors I and II (47 species in each – 52.8% of all the taxa). In sector I, *Calluna vulgaris, Vicia cracca, Arrhenatherum elatius, Lysimachia vulgaris* as well as *Filipendula ulmaria* occurred in greatest numbers. *Carex rostrata, Equisetum fluviatile, Stratiotes aloides,* and *Lemna* minor predominated in sector II (Table 1).

The lowest species richness was noted in sector IV (19 species), which was attributable to extensive shading of the surface of this sector's area by the forest neighbouring with the watercourse in question. There was noted a clear dominance of Urtica dioica on the slopes of the watercourse, as well as of *Lemna minor* and *Spirodela polyrhiza* in the water.

The species such as *Elodea canadensis, Lemna minor, Filipendula ulmaria* and *Urtica dioica* were found in all the study sectors. The species similarity index for the flora in most of the study sectors was low (between 0.09 and 0.38); only the phytocoenoses of sectors V and VI showed a significant similarity at a level of 0.57 (Table 2).

The species of the syntaxonomic class *Molinio-Arrhenatheretea* were clearly predominant in the species composition of the flora in sector I; this class had twice more representatives in this sector than the second ranking *Phragmitetea*. Almost a half of the taxa found in sector II belonged to the class *Molinio-Arrhenatheretea*. In sector III, the classes *Phragmitetea* and *Molinio-Arrhenatheretea* were represented in greatest numbers. The species of the class *Lemnetea minoris* had a large proportion in the phytocoenosis of this sector (11.8%), similarly in sector IV (10.5%). It was likewise in the case of the class *Potametea* (the proportion of the characteristics species in the flora of sector III – 11.8%, in sector IV – 21.1%).

In sector IV, the largest number of species was recorded from the class Potametea (21.1%). There were fewer representatives of the following classes (15.8% of each class): *Phragmitetea, Molinio-Arrhenetheretea* and *Querco-Fagetea* (with no clear dominance of the species of any of these classes). In sectors V and VI, the species characteristic of the classes *Molinio-Arrhenetheretea* and *Phragmitetea* clearly dominated.

The results of the analysis of the floristic composition and the proportions of particular species in the flora of the investigated sites did not allow an exact classification of the syntaxa to be made due to the absence of characteristic combinations of species. The associations of the aquatic macrophytes *Lemno-Spirodeletum polyrhizae*, encountered in sectors III, V and VI, were the only exception.

The analysis of the life-form spectrum of the flora showed that it was typical of this geographical zone. Hemicryptophytes (plants with perennating buds at the soil surface) clearly dominated in the species composition of the flora of all the sectors located on the Mietiułka River. Geophytes (plants with perennating buds lying in dry ground), together with hydrophytes and helophytes classified as cryptophytes (plants with perennating buds lying beneath the ground or submerged under water), accounted for a relatively small percentage of the taxa identified. The taxa belonging to phanerophytes (plants with perennating buds borne on aerial shoots) occurred only in three sectors, with the most numerous group noted in sector IV (Table 3)

Few chamaephytes (plants with perennating buds borne close to the ground) occurred in five sectors, and the only recorded representative of woody chamaephytes was *Calluna vulgaris*.

In addition to the life-forms distinguished by Raunkiaer, with reference to the adaptation of plants to survive the unfavourable season (Szafer, 1964; Falińska, 2004), the classification adopted for the purpose of the analysis (Zarzycki et al. 2002) also comprised other groups, including semi-autrotrophs, the only representative of which is *Melampyrum pratense* (a species also belonging to the group of therophytes) found in sector II.

Table 1
The species composition of the vascular flora of the phytocoenoses of particular study sectors

Species	Sectors					
	I	II	III	IV	V	VI
Achillea millefolium		+				
Acorus calamus			+			
Alisma plantago aquatica	+				+	+
Alnus glutinosa				+		
Alopecurus pratensis			+			+
Anthoxanthum odoratum	+					
Arrhenatherum elatius	+	+	+			
Artemisia vulgaris			+			
Batrachium aquatile	+					
Berula erecta					+	+
Betula pendula	+					
Calamagrostis canescens			+			+
Calluna vulgaris	+					
Caltha palustris	+	+				
Capsella bursa-pastoris	+				+	+
Cardamine pratensis	+		+		+	+
Carex hirta	+					
Carex pseudocyperus	+		+			
Carex rostrata		+	+			
Carpinus betulus				+		
Ceratophyllum demersum		+	+	+		
Chamaenerion angustifolium	+	+				
Cirsium palustre	+	+				
Comarum palustre		+				+
Conyza canadiensis	+					
Cynosurus cristatus		+				
Dactylis glomerata					+	
Eleocharis palustris			+			
Elodea canadensis	+	+	+	+	+	+
Epilobium palustre					+	+
Equisetum fluviatile		+				
Equisetum palustre	+		+			
Eupatorium cannabinum					+	
Fectuca rubra					+	
Filipendula ulmaria	+	+	+	+	+	+
Galeobdolon luteum				+		
Galium aparine		+				
Galium mollugo	+					

Species	Sectors					
	I	II	III	IV	V	VI
Geranium robertianum				+		
Glechoma hederaceae					+	+
Helichrysum arenarium	+					
Hieracium pilosella	+					
Hydrocharis morsus ranae			+		+	+
Hypericum perforatum	+	+				
Hypocheris glabra	+					
Juncus conglomeratus		+				
Juncus effusus	+	+		+		
Lamium maculatum		+				
Lathyrus pratensis		+				
Lemna minor	+	+	+	+	+	+
Lemna trisulca		+	+		+	+
Lolium perenne		+			+	
Lychnis flos-cuculi	+					
Lycopus europaeus	+	+				
Lysimachia nummularia		+			+	
Lysimachia vulgaris	+	+	+		+	+
Lythrum salicaria	+	+	+		+	+
Medicago lupulina					+	
Melampyrum pratense		+				
Melandrium album	+		+		+	+
Molinia coerulea					+	
Myosotis palustris	+	+			+	+
Myriophyllum verticillatum		+				
Nuphar lutea					+	+
Oenanthe fistulosa					+	+
Oxalis fontana				+		
Paris quadrifolia				+		
Peucedanum palustre	+					
Phalaris arundinaceae	+		+		+	+
Phleum pratense		+	+			+
Phragmites australis				+	+	+
Pinus sylvestris	+					
Plantago lanceolata		+				
Plantago major		+				
Poa palustris			+			+
Poa trivialis		+				

cd. Table 1

Species	Sectors					
	I	II	III	IV	V	VI
Potamogeton natans				+		
Potentilla anserina	+	+	+		+	+
Potentilla argentea	+					
Prunella vulgaris						+
Pyrus communis		+				
Ranunculus flammula		+				
Ranunculus lingua		+				
Ranunculus repens						+
Rorippa amphibia					+	+
Rumex hydrolapathum	+	+			+	+
Sagittaria sagittifolia				+	+	+
Salix cinerea	+	+				
Scirpus sylvaticus		+		+	+	+
Scleranthus perennis	+					
Scutellaria galericulata	+	+	+		+	
Solanum dulcamara					+	
Sparganium emersum			+			

Species	Sectors					
	I	II	III	IV	V	VI
Sparganium erectum			+	+	+	+
Spirodela polyrhiza			+	+	+	+
Stellaria graminea	+	+			+	+
Stratiotes aloides		+	+	+	+	
Tanacetum vulgare						+
Thalictrum flavum						+
Trifolium arvense	+					
Trifolium repens		+				
Typha latifolia		+				
Urtica dioica	+	+	+	+	+	+
Veronica anagallis-aquatica	+					
Veronica beccabunga	+					+
Veronica chamaedrys		+				
Vicia cracca	+		+		+	+
Viola arvensis	+					
Viola palustris	+					
Wolffia arrhiza			+			

Table 2
Jaccard's species similarity index for the phytocoenoses of the study sectors (1-6)

Study sectors	2	3	4	5	6
1	0.25	0.23	0.08	0.24	0.25
2		0.21	0.09	0.20	0.18
3			0.17	0.33	0.38
4				0.20	0.18
5					0.57

The analysis of the flora of the study sectors as an indicator of continentality showed that the species neutral to continentality were by far predominant (Table 4).

Spontaneophytes, the species which arrived or are native to the area and can exist there without human intervention, had the largest proportion (88.6%) in the flora of the study area. Anthropophytes, synanthropic plant species of foreign origin in a given area, occurring both in secondary, artificial habitats formed as a result of human activity and in semi-natural or natural habitats, accounted for 5.3% of the studied flora (Table 3).

Based on the classification adopted by Chmiel (1993a), the plant species found in the study sectors were representatives of different range elements, but the species included in the phytochorion with boreal elements: Euro-Siberian subelement, accounted for the largest number (ES; 29%). A large proportion of cosmopolitan species was also noted (21.9%; Table 4).

In the phytocoenoses of all the study sectors, the macrophytes commonly found in Poland had the largest proportion. In sectors V and VI, one species with a small number of stands in the country – water dropwort (*Oenanthe fistulosa*; Table 5) – was recorded. In sectors IV, V and VI, the occurrence of *Sagittaria sagittifolia* was noted, whereas in sector I *Hypochoeris glabra*, species threatened with extinction (Zarzycki et al. 2002).

Table 3
The proportions of different plant life-forms and historical-geographical groups in the flora of the studied sections of the Mietiułka River

Life forms (f)	Number of species	Proportion %	Historical–geographical group			Number of species	Proportion %
M – megaphanerophytes, trees generally growing to a height of over 5 m	5	4.4	Spontaneophytes	Sp – non–synanthropic spontaneophytes		56	49,1
N – nanophanerophytes, shrubs and small trees, from 0.5 up to 5 m in height	1	0.9					
Ch – woody chamaephytes (buds > 25 cm above ground)	3	2.6		Ap – apophytes		45	39,6
C – herbaceous chamaephytes (buds <25 cm above ground)	5	4.4					
H – hemicryptophytes (buds at ground level)	69	60.0	Anthropophytes	Metaphytes	Arch – archeophytes	3	2,6
G – geophytes (buds in soil)	10	8.8					
T – therophytes (annuals)	13	11.4			Ken – kenophytes	3	2,6
Hy – hydrophytes and helophytes (buds in water)	31	27.2					
li – lianas (plants rooted in soil, requiring supports)	0	0.0			D – diaphytes	0	0,0
pp – semiparasites	1	0.9					
• species of undetermined affinity	1	0.9	• species of undetermined affinity			7	6.1
Total	114	121.5	Total			114	100.0

Table 4
The proportions of geographical (range) elements and groups of species with different continentality indicators in the flora of the study area

Geographical (range) element	Number of species	Proportion %	Continentality indicator (K)	Number of species	Proportion %
CB – circumboreal	7	6.1	1 – Atlantic species	0	0
ES – Euro-Siberian	33	29.0	2 – sub-Atlantic species	2	1.7
E – Central European	12	10.6	3 – species neutral to continentality	110	96.5
sOZ – sub-Atlantic	1	0.9	4 – subcontinental species	1	0.9
overlapping elements	29	25.4	5 – continental species	0	0.0
KOSM - cosmopolitan	25	21.9			
• species of undetermined affinity	7	6.1	• species of undetermined affinity	1	0.9
Total	114	100.0	Total	114	100.0

Table 5
The number of stands and dynamic trends for the species comprising the flora of the studied sections of the Mietiułka River

Rating for the number of stands (A)	Number of species	Proportion %	Rating for dynamic trends (E)	Number of species	Proportion %
1 – the number of stands very small (from several to a dozen or so)	0	0.0	-2 – a large reduction in the number of stands	5	4.4
2 – a small number of stands (up to 100)	1	0.9	-1 – a reduction in the number of stands or a marked loss of individuals in the stands	14	12.3
3 – a large number of stands, mainly in one region	4	3.5	+1 – an increase in the number of stands, a marked growth in individuals in the stands	24	21.0
4 – a large number of stands in many regions	27	23.7	+2 – a large increase and the occupation of new stands	29	25.4
5 – common in the whole country	81	71.1	-/+ – the existing stands disappear and new ones appear	10	8.8
• species of undetermined affinity	1	0.9	• species of undefined dynamic trends	32	28.1
Total	114	100.0	Total	114	100.0

Fig. 1. The location of the study sectors in the Polesie National Park

Fig. 2. Sector I – the western part of the Mietiułka River in the Polesie National Park

Fig. 3. Sector III – the middle section of the Mietiułka River (Pociągi Meadows)

Fig. 4. Sector VI – the mouth section of the Mietiułka River

DISCUSSION

The flora of the studied sections of the Mietiułka watercourse is diverse in terms of species as well as in syntaxonomic and ecological terms. It is a mixture of typically aquatic vegetation and vegetation characteristic of the habitats surrounding the river. The species identified in the study area account for 11% of the entire flora of the Polesie National Park (if we accept the total number of vascular plant species in the PNP following F i j a ł k o w s k i and I z d e b s k i (2002) – 1027 taxa). The section of the river which is subjected to continuous human activity is characterized by the lowest floristic diversity, which can be attributable to the initial stage of secondary succession at which the vegetation of this area is.

The results of the study conducted in 2006 were confronted mainly with the results of the studies by B a n a c h et al. (2006) and B a n a c h (2007, 2008, 2009), who had analysed the species composition of the drainage ditches of the Polesie National Park. The nature of the habitats of the drainage ditches is comparable to the habitats formed by the Mietułka River, primarily due to its anthropogenic nature and the absence of a visible flow of water, rather its stagnation.

In the plant communities of the drainage ditches investigated in the years 2003-2006, in twelve 100 m long sections (1200 m), the occurrence of 222 higher plant species, belonging to 58 botanical families, was noted. The largest group comprised the species of the following families: Poaceae and Asteraceae, as well as Cyperaceae, Rosaceae and Fabaceae.

Among the macrophyte taxa identified in the flora of the studied sections of the Mietiułka watercourse, the botanical family Poaceae was also represented in greatest numbers, whereas in the western course of the river it was the family Asteraceae. From among the species recorded in all the sectors studied in 2006, 34 species were not found in any of the sections of the drainage ditches investigated by B a n a c h et al. (2006) and B a n a c h (2007, 2009).

In the phytocoenoses of all the study sectors located both in the western and eastern part of the Mietiułka River, the taxa belonging to two syntaxonomic classes, *Molinio–Arrhenatheretea* and *Phragmitetea*, were predominant. The proportions of representatives of the other classes were relatively small and they varied. Similar proportions of the species of different syntaxa were documented by B a n a c h (2007) during her study of the phytocoenoses of the drainage ditches, as well as by S a w i c k a (2004) during her study of the plant communities found in the drained "Pociągi" nature sanctuary in the Polesie National Park.

U r b a n and R a d w a n (2000) noted a large proportion of the communities with a dominance of *Glyceria fluitans* and *Glyceria notata* as well as *Leersia oryzoides* in the drainage ditches and in other small water streams in the Łęczna-Włodawa Lakeland. In the study sectors situated on the Mietiułka River, no occurrence of the abovementioned species was noted at all, and B a n a c h (2007, 2009) confirms the occurrence of only one of them in the plant associations of the drainage ditches of the PNP.

Ś w i ę s and W r z e s i e ń (2000) mention that the plant patches with the participation of *Urtica dioica* within the Park area are exceptionally commonly widespread on the slopes of the old canals and ditches. B a n a c h (2007, 2009) confirmed these observations founding that common nettle occurred almost at all the study sites, forming more or less dense aggregations mainly on the slopes of the ditches. On the slopes of the Mietiułka River, the occurrence of this species was also recorded in all the study sectors, however, the most numerous population of *Urtica dioica* was observed in the watercourse section which had been subjected to the most intense improvements. The occurrence of this nitrophilous species in great abundance at the places where the river regulation works were carried out is caused by a large amount of nitrogen compounds which are released from extracted organic deposits (stored on the edges of the watercourse) undergoing the process of humification and mineralization.

Among the species identified, 19 species were noted in the study area as strongly or totally invasive species, similarly to common nettle (C h m i e l , 1993a). *Elodea canadensis* and *Urtica dioica* occurred in all the study sectors, and *Potentilla anserina* in five of them.

In order to evaluate the diversity of communities, the so-called biological spectra are used (the number of life forms and life strategies) (F a l i ń s k a , 2004). Among the plant life-forms occurring in the studied sections of the Mietiułka River, hemicryptophytes – the species characteristic of the temperate zone – dominated by far. The studies of B a n a c h (2007, 2009) also indicated the dominance of this group in the habitats of the drainage ditches, and according to S z a f e r (1964), this group accounts for more than a half of the species found in the whole of Poland. The proportions of hydro- and helophytes as well as of therophytes in the investigated phytocoenoses of the eastern part of the Mietiułka River were higher than the proportions of these groups in the phytocoenoses of the western part studied in 2006. The abovementioned groups of species accounted for approx. 24% of all the plant species inhabiting the drainage ditches of the Polesie National Park (B a n a c h , 2007; 2009).

The analysis of the flora of the Mietiułka River sections as well as of the drainage ditches and their

neighbourhood (Banach, 2007; 2009) as an indicator of continentality showed that the species neutral to continentality were by far predominant. They account for more than 90% of the flora of the studied habitats.

The qualitative and quantitative proportions of species belonging to different historical-geographical groups can be used as an indicator of the naturalness of the studied flora (Chmiel, 1993a, 1993b). Spontaneophytes – the taxa which arrived or are native to the study area and can exist there without human intervention – had the largest proportion in the flora of the Mietiułka watercourse studied in 2006 (88.6% of species) and of the drainage ditches described by Banach (approx. 90% of species; 2009). Anthropophytes – the species which were introduced in a given area and function there only by human activity, accounted for nearly 2% in the flora of the drainage ditches of the Polesie National Park, and in the investigated sections of the Mietiułka River their proportion in the flora was only slightly higher, since it was 5.3%. In spite of the fact that drainage ditches are a typically anthropogenic habitat, according to Banach (2007), the lack of maintenance of the channels of the ditches and, in the first place, the establishment of the national park decided about the natural character of the flora of the studied habitats. But the Mietiułka River was significantly transformed by hydraulic works and it flows through the areas with different land uses, including agriculturally used land, hence the habitat differentiation promoting the persistence of both natural and synanthropic species.

The geographic distribution of species is primarily related to their tolerance to the variability of environmental factors in time and space (Chmiel, 1993a). The Euro-Siberian species were the dominant range element of the flora of the studied sections of the Mietiułka River, likewise in the flora of the drainage ditches described from the same area located within the Polesie National Park (Banach, 2007; 2009).

The floristically richest phytocoenoses are those functioning in the heterogeneous environments, since no species has an absolute dominance in them (Falińska, 2004). Such a situation is observed in the habitats which are formed by the channel and slopes of the Mietiułka River. The favourable habitat conditions create advantageous conditions for the functioning of the diverse flora, in whose species composition rare and protected species can also be encountered.

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Bogactwo gatunkowe flory wybranych fragmentów rzeki Mietiułki w Poleskim Parku Narodowym

Streszczenie

Celem badań była waloryzacja przyrodnicza 6 wybranych fragmentów zmeliorowanej rzeki Mietiułki obejmująca inwentaryzację i analizę flory naczyniowej związanej bezpośrednio z ciekiem. Wyniki badań wykazały, że flora badanego terenu jest zróżnicowana pod względem taksonomicznym, syntaksonomicznym i ekologicznym, a w jej skład wchodzą zarówno rośliny typowo wodne jak i gatunki charakterystyczne dla otaczających rzekę siedlisk. We florze sektorów badań oznaczono łącznie 114 gatunków roślin naczyniowych z 42 rodzin botanicznych, 15 klas syntaksonomicznych, charakteryzujących się przynależnością do różnych grup ekologicznych. W składzie gatunkowym flory wszystkich sektorów badań wyraźnie dominowały hemikryptofity, sponteneofity, gatunki neutralne wobec kontynentalizmu oraz gatunki zaliczane do jednostki fitogeograficznej elementów borealnych: podelementu eurosyberyjskiego. Największym udziałem charakteryzowały się makrofity pospolicie występujące w Polsce. Odnotowano jeden gatunek o małej liczbie stanowisk w kraju – kropidło piszczałkowate (*Oenanthe fistulosa*) oraz 2 gatunki narażone na wyginięcie *Sagittaria sagittifolia* i *Hypochoeris glabra*.