

SPECIES DIVERSITY OF THE FLORA IN MELIORATION DITCHES IN DRY-GROUND FOREST AND POST-BOG MEADOW HABITATS

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Summary. A study of the flora in melioration ditches was performed on two meadow sites – a post-bog meadow and a mineral meadow. The study, conducted in the period of 2007–2009, revealed various numbers of species in ditches situated in the two meadow sites. Greater species diversity was found in the ditches in the post-bog meadows, which was due to higher trophy of the soils and waters in that habitat. In the mineral dry-ground forest site a lower number of species appeared, which resulted from lower trophy of the habitat and from the cessation of mowing of vegetation from the scarps and the bottom of the ditches. The study showed that more species appeared on the bottoms of the ditches than on the scarps, which indicates an effect of the aquatic factors on the diversity of the flora.

Key words: melioration ditches, flora, biodiversity, maintenance of ditches, post-bog meadows

INTRODUCTION

Feed canals and melioration ditches are habitats of many species of vascular plants [Gamrat *et al.* 2008, Grzywna *et al.* 2008]. Shallowing and overgrowing of ditches and neglect in mowing affect the species diversity of the flora of those specific habitats. In recent years in Poland there has been a progressing reduction of maintenance work on detail melioration ditches, which may cause significant changes in the moisture status of meadow habitats [Kasperek *et al.* 2008] and result in changes in the phytocenoses under such conditions [Grzywna *et al.* 2008]. High species diversity of the flora in melioration ditches, feed canals and canals creates the possibility of estimation of the water purity status in those melioration facilities, which has found an application in the Mean Trophic Rank method [Holmes *et al.* 1999, Zbierska *et al.* 2002]. The reduction in the

species diversity of flora in rural areas, including meadows and pastures, caused by various forms of anthropopressure, may be significantly attenuated by plant assemblages occurring in melioration ditches [Dajdok *et al.* 2005]. Melioration ditches provide a refuge for numerous species of hygrophytes which are threatened under conditions of strong anthropopressure [Zaluski *et al.* 1999, Kiryluk 2004]. The importance of melioration ditches and extensive grasslands in the conservation of species diversity of flora has also been confirmed by their inclusion in various agro-environmental and rural areas development programs (PROW for 2007–2013) [www.minrol.gov.pl].

The objective of the study presented here was to identify the species composition of vegetation communities in melioration ditches in two meadow habitats and of the factors affecting the species diversity of flora in those ditches.

MATERIAL AND METHODS

The study was conducted in the years 2007–2009 on two meadow complexes: the post-bog meadow complex Lower Supraśl, situated in the valley of river Supraśl, and the meadow complex Soce, situated on mineral soils in the valley of river Rudnia.

The different habitat conditions of those two study areas permitted comparison of changes in the species composition of flora in melioration ditches, resulting from the different trophy of waters in ditches situated in post-bog and mineral meadows. The post-bog meadow complex Lower Supraśl is under medium-intensive use, and the fertilisation applied does not exceed the level of 100 kg NPK ha⁻¹. The meadows in the complex Soce are under extensive use, mown once a year and fertilised at the level of ca. 40–50 kg NPK ha⁻¹.

The system of melioration drainage-irrigation ditches in the meadow complex Lower Supraśl is functional and permits the regulation of soil moisture in the meadows. Maintenance of the detail melioration ditches is performed once a year and consists in mowing the vegetation on the ditch scarps and bottoms. In the meadow complex Soce maintenance of the detail ditches has been stopped, and therefore deposits of slime have accumulated on their bottoms and their depth decreased.

The study of the vegetation in the melioration ditches was conducted with the expedition method, consisting in on-site recording of plant species identified in the ditches and water courses, and determination of their percentage share of the species in the plant communities [Dąbkowski *et al.* 1996].

In each of the two study areas two melioration ditches were selected, with length of ca. 150 m, in which floristic assays were conducted in June (before the first cut) in the successive years. The percentage share of particular species in area coverage on the scarps and bottoms of the ditches was determined, and the numbers of plant species in the particular years were recorded.

RESULTS AND DISCUSSION

In the detail melioration ditches in the post-bog meadow complex Lower Supraśl a high plant species diversity was observed, the average number of species in the ditches being around 50 (Tab. 1). Greater species diversity was noted on the bottoms of the ditches, which was due to favourable water conditions.

Table 1. Species composition of plant communities in the study area Lower Supraśl (area coverage by particular species, in %)

Species	Scarp of ditch			Bottom of ditch		
	2007	2008	2009	2007	2008	2009
<i>Alisma plantago-aquatica</i> L.				3	4	2
<i>Alopecurus geniculatus</i> L.	2	5	6	8	5	9
<i>Caltha palustris</i> L.	2	2	1	4	4	4
<i>Carex riparia</i> Curtis	6	5	3	+		+
<i>Carex acutiformis</i> Ehrh.	4	4	5	4	4	4
<i>Carex acuta</i> L.	10	6	8	4	3	4
<i>Carex elata</i> All.	6	5	4	+	+	+
<i>Ceratophyllum demersum</i> L.				2	3	2
<i>Elodea canadensis</i> Michx.				7	2	3
<i>Equisetum fluviatile</i> L.		+	2	4	1	+
<i>Galium palustre</i> L.	5	6	5			
<i>Glyceria fluitans</i> (L.) R. Br.	3	3	4	12	10	12
<i>Glyceria maxima</i> (Hartm.) Holmb.	5	7	3	6	8	10
<i>Hydrocharis morsus-ranae</i> L.		+	+	5	6	4
<i>Iris pseudacorus</i> L.	3	1	+	5	4	3
<i>Lemna minor</i> L.				12	12	10
<i>Lysimachia nummularia</i> L.				4	5	6
<i>Myosotis palustris</i> (L.) L. em. Rchb.						+
<i>Phalaris arundinaceae</i> L.	10	12	15	10	15	15
<i>Phragmites australis</i> (Cav.) Trin. ex Steud.	4	4	3	4	5	6
<i>Polygonum amphibium</i> L.				2	3	4
<i>Polygonum bistorta</i> L.	+	+	+			+
<i>Potaamogeton crispus</i> L.						+
<i>Potamogeton natans</i> L.				+	+	+
<i>Ranunculus repens</i> L.	4	6	2	3	2	+
<i>Rumex hydrolaphatum</i> Huds.		+		+	+	
<i>Sagittaria sagittifolia</i> L.	+					
<i>Scirpus sylvaticus</i> L.	5	8	10	+	+	+
<i>Sium latifolium</i> L.	+	3	2	+	+	+
<i>Sparganium erectum</i> L. emend. Rchb. s. str.			+			
<i>Spirodella polyrrhiza</i> (L.) Schleid				+	+	+
<i>Stratiotes aloides</i> L.				+	+	+
<i>Typha angustifolia</i> L.	4	5	4	1	3	+
<i>Typha latifolia</i> L.	+	5	4	+	+	+
<i>Urtica dioica</i> L.	20	10	15			
<i>Valeriana officinalis</i> L.	5	3	4	+	1	2
Total	100%	100 %	100%	100%	100%	100%
Number of species	21	23	23	29	28	31

+ – species occurring in the community

On the scarps of the ditches the area coverage was dominated by species from the family *Cyperaceae* which occupied from 20 to 26% of the area of the scarps (Photo 1). Notable areas were also occupied by *Urtica dioica* L. (10–20%), which may indicate high levels of nitrogen in the soil, released from mineralising peat [Kirylyuk 2007]. Approximately 10% of the area of the scarps was covered with reed grasses *Phalaris arundinacea* L. and *Glyceria maxima* (Hartm.) Holmb.



Photo 1. Melioration ditch in the meadow complex Lower Supraśl – domination of communities with *Urtica dioica* L. and *Phalaris arundinacea* L. (Photo A. Kirylyuk)

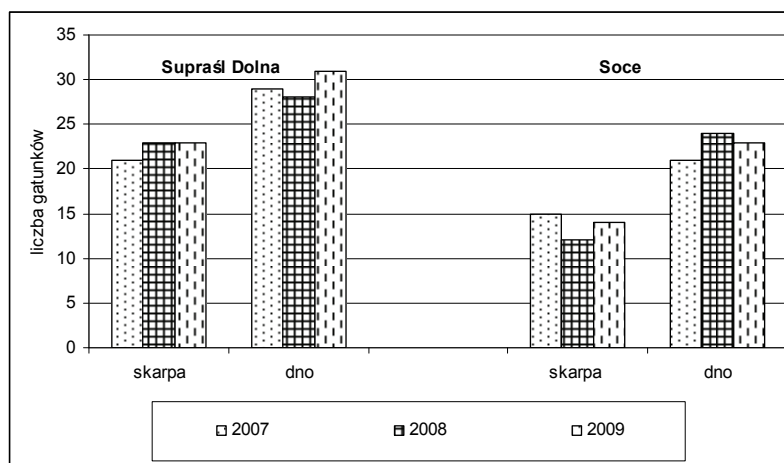


Fig. 1. Numbers of plant species in the melioration ditches in the years 2007–2009

On the bottoms of the ditches in the post-bog habitat the area coverage was dominated by plants from the family *Poaceae*, including *Glyceria fluitans* (L.) R. Br., *Phalaris arundinaceae* L., *Alopecurus geniculatus* L. Also fairly frequent were hydromacrophytes *Lemna minor* L. and *Lysimachia nummularia* L.

In the ditches in the mineral dry-ground forest meadow complex Soce smaller numbers of plant species were found, compared with the study area Lower Supraśl (Fig. 1). On average, ca. 33 plant species were identified in the ditches, greater species diversity being found on the bottoms of the ditches (Tab. 2).

Table 2. Species composition of plant communities in the study area Soce (area coverage by particular species, in %)

Species	Scarp of ditch			Bottom of ditch		
	2007	2008	2009	2007	2008	2009
<i>Acorus calamus</i> L.	8	6	5			
<i>Alisma plantago-aquatica</i> L.				6	10	8
<i>Alopecurus geniculatus</i> L.			+	5	5	6
<i>Caltha palustris</i> L.	+			2	3	2
<i>Cardamine pratensis</i> L.	3	3		+		
<i>Carex riparia</i> Curtis			6	12	10	9
<i>Carex acutiformis</i> Ehrh.	10	8				
<i>Carex appropinquata</i> Schumach.	5	7	7			
<i>Carex acuta</i> L.	10	8	8		+	
<i>Ceratophyllum demersum</i> L.			6	4	5	3
<i>Deschampsia caespitosa</i> (L.) P. Beauv.	12	15				
<i>Eleocharis palustris</i> (L.) Roem. et Schult			13	4	4	6
<i>Elodea canadensis</i> Michx.				10	7	6
<i>Glyceria fluitans</i> (L.) R. Br.				4	5	4
<i>Glyceria maxima</i> (Hartm.) Holmb.	10	15	+		+	+
<i>Iris pseudacorus</i> L.			14	3	4	3
<i>Lemna minor</i> L.				10	8	6
<i>Lysimachia thyrsiflora</i> L.	4	3				
<i>Phalaris arundinaceae</i> L.	21	17	4		+	+
<i>Phragmites australis</i> (Cav.) Trin. ex Steud.	10	10	18	4	5	4
<i>Polygonum amphibium</i> L.			9	3	5	4
<i>Potamogeton crispus</i> L.				4	4	3
<i>Potamogeton natans</i> L.				2	3	5
<i>Ranunculus aquatilis</i> L.				6	4	5
<i>Ranunculus repens</i> L.	+			4	4	7
<i>Rorippa amphibia</i> (L.) Besser				4	3	7
<i>Senecio aquaticus</i> ssp. <i>aquaticus</i>	3	4			+	
<i>Solanum dulcamara</i> L.	4	4	3			+
<i>Sparganium erectum</i> L. emend. Rchb. s. str.			7	7	4	6
<i>Spirodella polyrrhiza</i> (L.) Schleid.				2	2	2
<i>Typha angustifolia</i> L.	+			4	5	4
Total	100%	100%	100%	100%	100%	100%
Number of species	15	12	14	21	24	23

+ – species occurring in the community

On the scarps of the ditches there was a dominance of species the family *Poaceae*, including *Phalaris arundinaceae* L. and *Glyceria maxima* (Hartm.) Holmb (Photo 2). Notable areas of the scarps were covered with species from the family *Cyperaceae* that occupied ca. 25% of the area of the scarps.



Photo 2. Melioration ditch in the meadow complex Soce – macrophytes dominating in the community: *Glyceria maxima* L. and *Lemna minor* L. (Photo A. Kiryluk)

On the bottoms of the ditches in that study area the average number of species was 22, among which there were many green species, including also submerged macrophytes. The ditches in that study area were not maintained, therefore one can expect periodic increases in the numbers of species, with excessive growth of sedges, as well as the appearance of species that are synanthropic for that habitat, e.g. *Solanum dulcamara* L.

Analysis of floristic lists compiled in 2007–2009 indicates that the main factors affecting the diversity of the flora in the ditches are the trophy of the waters, the trophy of soil on the ditch scarps, rates of water flow in the ditches, and also the intensity of vegetation mowing on the scarps and bottoms of the ditches. Comparison of the numbers of plant species in the post-bog and the dry-ground forest areas indicates significant effect of the levels of nitrogen in the soil of the scarps [Kiryluk 2007] and of eutrophic waters on the meliorated bog, on greater species diversity of plant communities. Studies by Gamrat *et al.* [2008] indicate also a significant effect of the flow rates and water levels in ditches on species diversity. Cessation of mowing not always results in increased species diversity, which is supported by the results of the study on the meadow complex Soce.

CONCLUSIONS

1. In the melioration ditches forming the drainage-irrigation system on the post-bog meadow the study revealed the occurrence of an average of 50 plant species. In the melioration ditches on the meadow situated on mineral soils ca. 33 plant species were identified.

2. The cessation of mowing-pasture use of the meadows and the limitation or cessation of running and overhaul maintenance of the ditches caused periodic stabilisation and even an increase in the species diversity of the flora of the melioration ditches.

3. The lack of current maintenance of the ditches in the meadow complex Soce resulted in a reduction of the species diversity and an increase in the presence of some species and the elimination of other species. Under such conditions sedges are the expanding species, while low grasses and herbal plants are the receding species.

4. Infrequent running maintenance of ditches is conducive to the conservation of high species diversity of hygrophilous vegetation communities.

5. Greater species diversity on the bottoms of the ditches indicates the importance of the water factor in the shaping of plant communities of melioration ditches.

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RÓŻNORODNOŚĆ FLORY W ROWACH MELIORACYJNYCH W SIEDLISKACH ŁĄK GRĄDOWYCH I POBAGIENNYCH

Streszczenie. Przeprowadzono badania flory w rowach melioracyjnych na dwóch obiektach łąkowych – pobagiennym i mineralnym. Badania wykonane w latach 2007–2009 wykazały różną liczebność gatunków w rowach usytuowanych na obu siedliskach łąkowych. Większą różnorodność gatunków stwierdzono w rowach na łąkach pobagiennych, co powodowane było większą troficznością gleb i wód w tym siedlisku. Na obiekcie mineralnym grądowym wystąpiła mniejsza liczba gatunków, co było powodowane mniejszą troficznością siedliska i zaniechaniem wykaszania roślinności ze skarp i z dna. Badania wykazały, że w dnie rowów było więcej gatunków, niż na skarpach, co wskazuje na wpływ czynnika wodnego na różnorodność flory.

Słowa kluczowe: rowy melioracyjne, flora, bioróżnorodność, konserwacja rowów, łąki pobagienne