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Threat of small midfield ponds on Wełtyń Plain*

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A b s t r a c t. Wełtyń Plan is a typical agricultural region with intensive cultivation and fertilization. This causes different landscape changes as a result of application of high doses of mineral fertilizers and pesticides. Presented results were collected in the years 1995-2003. On the studied area 95 small midfield ponds were analyzed considering factors threatening the correct functioning of small ponds such as: changes of ponds forms, transformation (devastation and degradation) of plant cover introduced by different kinds of contamination. Summing up, it was ascertained that flora relatively quickly responded to changes in the environment caused by agricultural activity.

K e y w o r d s: midfield ponds, eutrophication, threat, Wełtyń Plain

INTRODUCTION

In Poland, every year disappeared 1.1% of small ponds, and in Pomerania over the last 100 years there disappeared over 57% of reservoir like this, and 22% of all midfield ponds in this area started to become terrestrial (Kochanowska *et al*., 1999; Pieńkowski *et al*., 2004). For years, the Wełtyń Plain, was the area where intensive agriculture forced the application of high doses of mineral fertilizers and pesticides, especially in the eastern part of the Plain. As a result of that, many small midfield ponds become degraded, devastated or completely eliminated. The paper presents the results of observation of threats to ponds, conducted in the course of floral and phytosociological research in the area of Wełtyń Plain. The observation included the identification of factors threatening which had influence on the correct functioning of ponds such as: changes in ponds forms and transformation (devastation and degradation) of plant cover resulted from introduction of different kinds of contamination.

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MATERIALS AND METHODS

The researches have been carried out for the years 1995-2003 on the Wełtyń Plain (West Pomerania, Poland) on 95 different ponds. Threatening factors occurring in the ponds were analyzed during the floral and phytosociological research on three kinds of ponds: with open water table, overgrowing and periodically drying up, in four floral zones: open water, littoral, scarp and nitrophilous (Kochanowska *et al.*, 1998; Matusiak, 1996). The selected floral differences were presented in a composite table which was based on 12 phytosociological photos from the littoral zone (the zones which was the most threatened by plant cover transformation) with the most frequent occurrence of floral association *Phalaridetum arundinaceae*. The remaining part of 68 phytosociological photos was used for characterization of the different biotopes affected by the threatening factors.

RESULTS

Among the studied ponds, overgrowing objects were dominant (57%), followed by the occurrence of ponds with open water table (25%), and finally by periodically drying up ponds (18%). The threatening factors were divided into three groups: factors causing eutrophication, factors causing devastation, and factors causing completely elimination of ponds.

Excessive application of mineral fertilizers on arable lands most often causes the ponds eutrophysation (79%). Input of mineral ingredients through the surface flow into such small and closed reservoirs (average ponds surface – 0.3 ha) causes quick silting of ponds bottom and expansion of rushes on the ponds area. This also causes a change in the form of ponds, which fundamentally affects their floral composition.

In small midfield ponds with open water table the average amount of species in individual zones was lower (in open water table zone-deficiency of species; littoral zone – 6 species; scarp – 10 species; nitrophilous zone – 7 species) than in overgrowing ponds (respectively 8, 10, 21, 17 species). The increased of fertilizers application and smaller depth of studied ponds had an effect on floral and habitat changes (Table 1). Only seldom in open water-table ponds associations belonging to the classes *Lemnetea* (for example habitats of *Lemna minor*, *Lemnetum gibbae*) and *Potametea* (for example associations of *Ceratophylletum demersi*, *Lemnetum trisulcae*, *Myriophylletum verticillati*) transformed with time into associations which belongs to the classes *Phragmitetea vulgaris* (for example: *Phalaridetum arundinacea*, *Phragmitetum australis*, *Typhaetum latifoliae*) and *Alnetea glutinosae* (associations of *Calamagrostis cane scens* and *Solanum dulcamara*). Also, under conditions of a certain periodic shortage of water, those associations were transformed into nitrophilous assemblages characteristic for untrodden areas, like *Artemisietea vulgaris* (*Calystegio-Epilobietum hirsuti*, *Urtico-Aegopodietum podagrariae*, *Urtica dioica* association) and *Agropyretea intermedio-repentis* (*Elymus repens* association).

Changes in plant cover were intensified by unfavourable climatic conditions during the last few years. Less precipitation caused a drop of the water table level (86%), and availability of new areas contributed to the evolution of silting plant associations from *Bidentetea tripartiti*: *Rumicetum maritimi* (36%) and *Bidens tripatitus* (5%).

Eutrophication of ponds was caused not only by surface flow, but also by direct input of solid and liquid substances, like municipal wastes (cloth, paper, foil), industrial wastes (household appliances, building debris) and organic wastes – 47%. This kind of substances, during their degradation caused changes in the plant cover. In the beginning their effect was limited only to the area of storage, but subsequently they gradually boosted the water trophy and sometimes caused total devastation of the ponds (4%). Water eutrophication was also accelerated by cutting trees which grew in the vicinity of the small midfield ponds (4 %). In the case of some of the object, trees cutting could have been caused by the cultivation of trees with soft and impermanent wood, such as: *Salix alba*, *Populus canadensis*, *P. nigra* trees which are most often met around the ponds (67%). However, in areas distant from human settlements, tree-covered ponds were used as places where people could

T a b l e 1. Plant communities of littoral zone with *Phalaris arundinacea* in open water table (1) and overgrowing (2) ponds

Species	Sort of ponds			
	Open water ponds (1)		Overgrowing water ponds (2)	
	S*	C*	S	C
Cl. *Phragmitetea*, o. *Phragmitetalia*				
Phalaris arundinacea	V	8750	V	8750
Rorippa amphibia	II	583	III	250
Oenanthe aquatica	II	166	III	250
Alisma plantago-aquatica	III	166	III	5
Iris pseudacorus	IV	750	II	3
Poa palustris	II	375	I	1
	Average No. species			
	6.2		10.1	

*S – stability: I – proportional participation of species < 20%, II – 40-20%, III – 60-40%, IV – 80-60%, V – 100-80%; C – cover, the coefficients were estimated for six phytosociological stages.
Sporadic species: *Carex vesicaria* II-166 (1), I-83 (2); *C. elata* II-166 (1), I-83 (2); *Glyceria fluitans* II-166 (2); *Carex pseudocyperus* II-85 (1); *Agrostis capillaris* II-83 (2); *Sparganium erectum* I-1 (1).

Others: Cl. ***Molinio-Arrhenatheretea*** - *Galium uliginosum* I-1 (1), V-90 (2); *Lythrum salicaria* I-1 (1), III-250 (2); *Lysimachia vulgaris* III-5 (1), I-166 (2); *Vicia tetrasperma* I-83 (1), I-166 (2); *Festuca pratensis* II-166 (2); *Juncus effusus* II-85 (2); *Symphytum officinale* II-85 (2); Cl. ***Artem isietea vulgaris*** - *Cirsium arvense* I-1 (1), III-376 (2); *Urtica dioica* II-166 (1), IV-333 (2); *Galium aparine* I-83 (1), II-85 (2); Cl. ***Bidentetea tripartiti*** - *Rorippa palustris* II-85 (1), III 458 (2); *Bidens tripartita* I-83 (1), III 250 (2); *Solanum dulcamara* II-3 (1), I-1 (2); *Rumex maritimus* I-83 (2) Cl. ***Lemnetea*** - *Lemna minor* III-375 (1), III-86 (2); *Spirodela polyrhiza* I-1 (1).

come to collect wood for fuel and where floating fragments of woods were colonized by nitrophylus species like: *Artemisia vulgaris*, *Cirsium arvense*, *Galium aparine* and scrub species, like: *Anthriscus sylvestris*, *Lysimachia nummularia*, *Solanum dulcamara*. Such a phenomen caused accelerated terrestrial transformation of the ponds. Apart from the different kinds of wastes, field stones could be often found near the ponds (60%). Most often they were deposited in the scarp zone (59%) or they were thrown out directly into the water (31%). The presence of field stones caused local domination of ruderal assemblage, like *Urtica dioica* (87%) or *Anthriscetum sylvestris* from *Galium aparine* association (13%). The researches revealed also ponds completely devastated by fire (5%). Uncontrolled burning of post-harvest stubble and unmoved meadows which often border with fields destroyed all whole plant cover near the ponds. Also, fires caused accelerated succession of nitrophilus and ruderal species, which resulted in total withdrawal of marshy flora, characteristic for ponds zone. Degradation of ponds caused by discharge of liquid manure (3%) and by the application of pesticides on fields (0.3%) was observed rather seldom. Those factors caused total withdrawal of vegetation in all floral zones and also caused tree and shrubs defoliation. In the scarp zone, which is located further from open water-table ponds, only nitrophilous species characterized by low viability survived, like *Elymus repens* (after discharge of liquid manure) or *Urtica dioica* and *Symphytum officinale* (after application of pesticides). Quite rarely the ponds were completely obliterated through purposeful sandbinding (3%), because sometimes farmers treated them as barriers in agriculture. Small midfield ponds without trees and shrubs, with small slope inclinations (up to 5°) were the most frequently eliminated in this way. Occasionally, nitrophilous plant zones of ponds were destroyed by agricultural machines (4%). The research also revealed that all the four zones (open water table ponds zones, littoral, scarp and nitrophilous zone) were often damaged in ponds which were fulfilling the recreational function (20%).

DISCUSSION

The greatest floral diversity in ponds with overgrowing water-table is confirmed by the research from Wielkopolska Region (Ratyńska *et al.*, 2002) or from Pomerania (Kochanowska *et al*., 1999). Those studies support the existence of correlation between increase of contamination and floral abundance (Nagengast, 1994). However, the measure of biodiversity is not only the floral abundance, but also the presence of important differences in plant systematic and live forms between species. Progressing water trophy causes a decrease of flora diversity, especially in habitats of water plants. That was confirmed by the small number of species in devastated ponds. The domination of *Phalaridetum arundinaceae* (in littoral and scarp zone) was confirmed also on the Masurian Lakeland (Kloss *et al.*, 1987), where simultaneously a decrease of *Typhaetum latifoliale* area was pointed out along with progressing water trophy (Fijałkowski and Chojnacka-Fijałkowska, 1990). Other more hygrophilous rushes species, except *Oenanthe aguatica* and *Rorippa amphibian*, started to receded during the progress of water trophy. Both of those species were defined as belonging amoung the permanent kinds of plants (Koc and Polakowski, 1990). Accrued presence of species of slimy coast (*Bidentetea tripartiti*) accompanied by meadows species (*Molinio-Arrhenatheretea*), rushes species (*Phragmitetea*), nitrophilus species (*Stellarietea*) and ruderal species (*Artemisietea*) was also observed around the lowered surface of water table of the drained Maltan reservoir (Borysiak and Ratyńska-Nowak, 1996). Observed succession in plants associations was approximated in lakes of Lublin area. Also in that area there existed two different plants associations, which was the beginning of *Ceratophylletum demersi* and *Myriophyllo-Nupharetum* succession (Fijałkowski and Chojnacka-Fijałkowska, 1990).

CONCLUSIONS

1. The general conclusion was that the numerically predominating water ponds with overgrowing water table are still characterized by floral abundance, despite the progressing water trophy.

2. It was ascertained that the biggest threat to water ponds on the Wełtyń Plain was trashiness of water ponds and additional inflow of biogene through surface flow of unused mineral fertilizers. This kind of threat was a result of the proximity of human settlements and of the intensity of agriculture.

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