ASSESSMENT OF INDICATIVE VALUE OF *TYPHETUM LATIFOLIAE* COMMUNITIES IN SMALL PONDS IN POST-AGRICULTURAL AREA (MASURIAN LANDSCAPE PARK)

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Abstract: Though indicative values of many different plant communities in lakes are estimated and described, their determination in astatic ponds seems to be difficult, due to the wide variability of habitat conditions in these water bodies. In the presented research, we tried to estimate indicative value of *Typhetum latifoliae* communities in extremely dynamic habitats of small ponds in post-agricultural landscape, where effects of intensive agrarian practices, especially eutrophication, are still visible. Due to extreme variability of habitat conditions in astatic ponds and broad ranges of ecological tolerance of *Typha latifolia*, the indicative value of *Typhetum latifoliae* phytocenoses in small ponds seems to be constricted. In our case, they were characterized by high concentration of potassium ions and ammonia ions in water, yet these differences were of no statistical importance. Therefore, each study case should be considered separately and generalizations should be performed carefully and only in justifiable cases.

Key words: astatic ponds, T*yphetum latifoliae*, bioindication
Słowa kluczowe: *zbiorniki astatyczne, Typhetum latifoliae, bioindykacja*

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1. Introduction

Isolated small ponds, characterized by high variability of physical and chemical conditions, are typical for European young post-glacial landscape. As a result of small size, astatic character and often complete isolation from other water bodies, water dynamics and hydrochemistry changes in small ponds tend to be poorly predictable, often determined by irregular processes such as floods or wind mixing or influenced by growing macrophytes. Therefore, their patterns remain unique and individual for particular ponds (Joniak et al. 2007).

Yet, quite often these fluctuations lead to distinct wet and dry phases in pond history (Lukacs et al. 2013; Tabosa et al. 2012; Patzig et al. 2012). For the European ponds, the wet phase starts in spring, when temperatures rise above zero and snow starts to melt, providing influx of surface waters. At the end of summer, exceeding evaporation rates and decrease in precipitation, cause lessening of ponds surface and depth (with high ratio of surface to depth maintained during whole wet phase). Finally, in August or September, ponds completely dry out and their dry phase begins. Hence, organisms inhabiting small water bodies and their surroundings show diverse adaptations to the summer dry period (Lukacs et al. 2013; Tabosa et al. 2012; Zacharias et al. 2007).

Usually, astatic ponds are colonized each year anew. However, under favorable climatic conditions or after implementation of hydrologic improvements, flooding period may become extended. In such case, succession processes will begin, leading to development of stable vegetation zones, resembling those in lakes, yet with higher proportion of reedswamp and pleustonic assemblages. Moreover, plant communities in small ponds are much more often dominated by one species than communities in lakes (Kłosowski and Jabłońska 2009). Such species-poor and uniform communities are widely viewed as perfect indicators of habitat conditions, *Typhetum latifoliae* SOO 1927 being one of them (Kłosowski 1985). On the other hand, determination of vegetation-habitat relations in astatic ponds seems to be difficult due to the much wider variability of habitat conditions than in lakes.

In the presented research, we estimated indicative value of *Typhetum latifoliae* communities in extremely dynamic habitats of small ponds in post-agricultural landscape, where effects of intensive agrarian practices, especially eutrophication, are still visible. Such habitats are of great interest to scientific community, since they support biodiversity and constitute sites of endangered species. Yet, they are under constant threat of irreversible degradation (Patzig et al. 2012; Kłosowski and Jabłońska 2009; Thiere et al. 2009; Declerck et al. 2006; Nicolet et al. 2004).

2. Study site

All the small ponds described in this article were located in post-glacial landscape of Northeastern Poland (the Masurian Lake District), where since the 1850s till 1990s intensive agricultural practices had been performed (Fig. 1).

After alteration of land exploitation forms, described area was included into the Masurian Landscape Park as semi-natural meadows subjected to extensive mowing. In 2009 small water retention program have been implemented in the Piska Forest, resulting in major hydrological changes in the neighboring post-agricultural landscape. These changes were reinforced due to intensive beaver activity. As a result, on previously drained areas numerous small ponds have emerged lately, increasing heterogeneity of post-agricultural landscape.

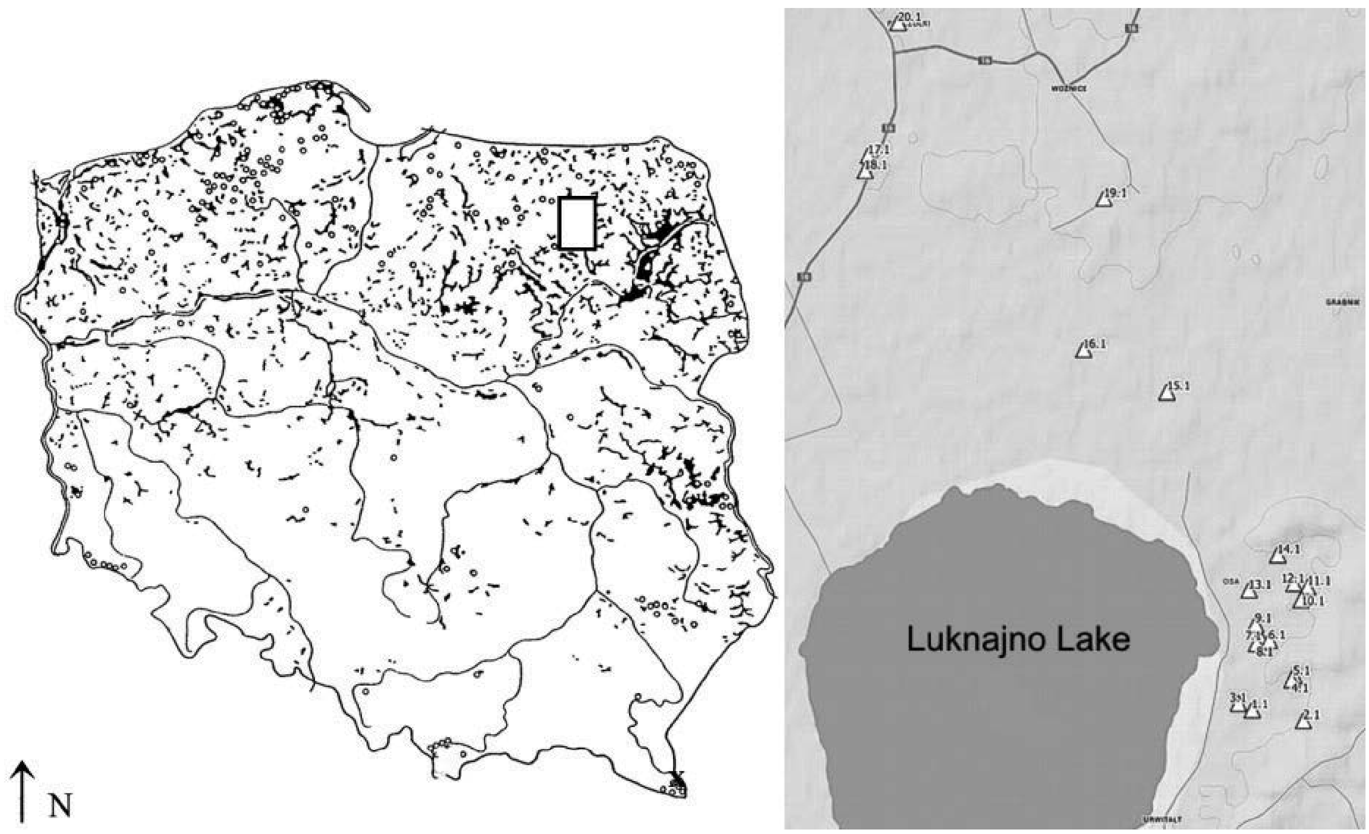

Fig. 1. Location of studied ponds
Ryc. 1. Położenie badanych zbiorników

3. Materials and methods

Since the character and size of the catchment area strongly affects the character of surface waters, for the purpose of our study 6 ponds were chosen, located in the extensively mown fallows, belonging to the same catchment, and dominated by reed communities. In the ponds and in their surroundings a phytosociological survey was performed according to the Braun-Blanquet method. Four different reed-forming associations were distinguished, dominating in these ponds: *Typhetum latifoliae* SOO 1927 in ponds 1; 4; 5; 13; *Sparganietum erecti* ROLL 1938 in pond number 6; *Caricetum acutiformis* SAUER 1937 in pond number 12; *Phalaridetum arundinaceae* (KOCH 1926 n.n.) LIBB. 1931 in pond number 16.

In every pond, in the middle part of the dominating phytocenosis, one monitoring point was established. Pond water samples were taken from each monitoring point in April, May, July and August of 2010 and in April, July and August of 2011.

Moreover, a network of piezometers was created, showing groundwater level in the immediate vicinity of each pond. Groundwater level was measured each month during our research.

Most analyses were performed on fresh water samples immediately after arrival. Analyses of chemical oxygen demand, phosphates, total iron, nitrates and ammonia ions were conducted on samples preserved with 1% HCl and stored in dark, cool place. The following analyses were performed according to the Polish Norms for water chemistry (numbers of method description are listed in references): pH (using pH-meter), electrolytic conductivity (EC, using conductometer), carbonate hardness (CH, Warthy-Pfeifer method), concentration of sodium, potassium, calcium and magnesium ions (Na^+, K^+, Ca^{2+}, Mg^{2+}, using atomic absorption analyzer SOLAR 939), total iron content (Fe_{tot}, rhodanate method), chloride ions (titration method), sulfate ions (SO_4^{2-}, spectrophotometrically using nephelometric method), phosphate ions (PO_4^{3-} spectrophotometrically using molybdate method), ammonium and nitrate ions (NH_4^+ and NO_3^-, spectrophotometrically).

All analyses were performed in the Laboratory of Environmental Chemistry in the University of Warsaw Biological and Chemical Research Centre (UW BCRC).

Obtained data were analyzed with STATISTICA 10 (non-parametric Kruskal-Wallis tests) and CANOCO for Windows Version 4.5 (Primary Component Analyses, PCA) (Ter Braak and Simlauer 1998).

4. Results and discussion

1. Dynamics of habitat conditions in the studied ponds

The studied ponds were mostly small water bodies, with a surface area of approximately 1 hectare and an

Tab. 1. Hydrochemical characteristics of the studied ponds. EC – electrolytic conductivity, DO – dissolved oxygen, CH – carbonate hardness

Tab. 1. Charakterystyka chemizmu wód badanych zbiorników. EC – przewodnictwo elektrolityczne, DO – tlen rozpuszczony w wodzie, CH – twardość węglanowa

Pond *Zbiornik*	pH		EC [mg/dm³]		CH [odH]		Na [mg/dm³]		K [mg/dm³]		Ca [mg/dm³]		Mg [mg/dm³]		Fe [mg/dm³]		NH_4 [mg/dm³]		NO_3 [mg/dm³]		Cl [mg/dm³]		PO_4 [mg/dm³]		SO_4 [mg/dm³]	
	mean *śred-nia*	SD	mean *śred-nia*	SD	mean *śred-nia*	SD	mean *śred-nia*	SD	mean *śred-nia*	SD	mean *śred-nia*	SD	mean *śred-nia*	SD	mean *śred-nia*	SD	mean *śred-nia*	SD	mean *śred-nia*	SD	mean *śred-nia*	SD	mean *śred-nia*	SD	mean *śred-nia*	SD
1	7,09	0,47	310,34	81,86	13,39	3,65	1,11	1,06	1,64	0,77	44,57	7,06	7,36	1,58	2,11	2,13	1,29	1,05	0,18	0,08	10,56	6,80	0,44	0,38	3,98	1,94
4	7,14	0,50	509,50	66,84	19,77	6,14	1,23	1,09	4,57	3,79	60,94	9,53	9,74	2,78	1,97	1,70	1,54	1,03	0,29	0,13	9,95	7,20	0,67	0,40	2,73	1,04
5	7,08	0,50	227,78	92,99	9,11	2,93	0,74	0,63	7,86	11,73	28,73	13,66	5,40	2,50	1,19	1,31	1,63	2,09	0,21	0,08	10,71	5,82	0,64	0,49	1,63	0,46
6	7,16	0,39	321,73	56,76	13,32	3,55	1,63	1,27	3,03	1,69	41,87	7,24	8,64	0,47	0,62	0,44	0,73	0,48	0,13	0,05	10,46	7,50	0,27	0,16	2,23	1,00
12	6,85	0,48	294,80	95,07	12,41	2,56	1,28	1,29	2,34	1,43	37,23	11,77	6,72	2,54	2,79	2,51	1,33	1,26	0,54	1,08	8,36	5,15	0,66	0,78	2,52	1,07
13	6,92	0,49	230,90	98,62	9,72	2,78	1,34	1,00	4,40	5,27	31,79	14,04	5,55	1,51	0,97	0,99	1,06	0,57	0,16	0,07	8,01	5,36	0,30	0,21	4,37	5,16
16	7,01	0,40	448,17	92,27	18,60	2,44	0,88	0,85	2,20	1,69	53,78	12,48	9,33	2,32	1,10	0,81	1,18	0,79	0,20	0,08	9,18	5,20	0,27	0,22	3,45	1,25

average depth below 1 meter. The biggest pond covered the area of 4 hectares, yet its depth was also below 1 meter.

During the study period none of the ponds has completely dried out in summer, yet in ponds number 5, 12, 13 and 16 significant drop of water level was observed.

The ground water level in the areas surrounding ponds was strongly differentiated, extending from 54 cm below ground surface to 70 cm above ground surface. However, the annual pattern of ground water level changes was uniform for all the studied ponds. In 2011 it followed the general rule of increasing in spring and decreasing in summer. Yet, in 2010 we observed the lowest ground water level untypically in April, with other months showing higher water level.

This phenomenon was probably a result of low precipitation rates in winter 2010. The amount of snow fallen altogether in January and February 2010 was 1,5 times lower than in the same period of 2011 (48 mm in 2010 and 72 mm in 2011), which significantly reduced spring water run-off that year. Moreover, April of 2010 was much drier comparing to April of 2011 (30 mm in 2010 and 45 mm in 2011).

As far as the chemical parameters are concerned, ponds number 4 and 16 are characterized by the highest concentrations of calcium ions and the highest values of electrolytical conductivity and carbonate hardness. However, these differences have no statistical significance. Hydrochemical characteristic of the studied ponds is presented in Table 1.

According to the Polish law, the amounts of ammonia and phosphate ions observed in water from the studied ponds are characteristic for the surface waters from the 3rd class of purity (highly polluted). Concerning nitrate ions, the studied ponds belong to the 1st class of purity. Such high content of ammonia (on average 10 times higher than nitrates) can be attributed to the past use of fertilizers rich in this particular ions on the studied area. High level of phosphates, however, can be a result of suspension of rich in phosphorous sediment particles, due to high turbidity of small ponds, which are classified as argillotrophic systems (Sahuquillo et al. 2012).

Annual dynamics of the measured parameters (ex--cluding sodium and calcium ions, and consequently pH and carbonate hardness, values of which were rather stable during the year) followed the pattern of water level fluctuations, with the highest values observed, when the water level was at the lowest. Despite simple effects of dilution and condensation, caused by changes in surface area and depth of ponds, seasonal variation in water chemistry might have been caused also by washing ions and nutrients by the surface run-off from anthrosols in the catchment area and by discharge of ions and nutrients from sediments into water.

2. Indicative value of Typhetum latifoliae communities in highly dynamic habitats

Knowing that the chemical features of pond water were either stable during the year or followed a pattern of fluctuations uniform for all the studied ponds, we decided to use all our measurements from each monitoring point in statistical analyses. Therefore, we compared 7 measurements from phytocenosis of *Sparganietum erecti* in pond number 6, 7 measurements form phytocenosis of *Caricetum acutiformis* in pond number 12, 7 measurements form phytocenosis of *Phalaridetum arundinaceae* in pond number 16 and 27 measurements from phytocenosis of *Typhetum latifoliae* in ponds number 1, 4, 5 and 13 (one measurement missing). Thus, we made a substitution of time for space.

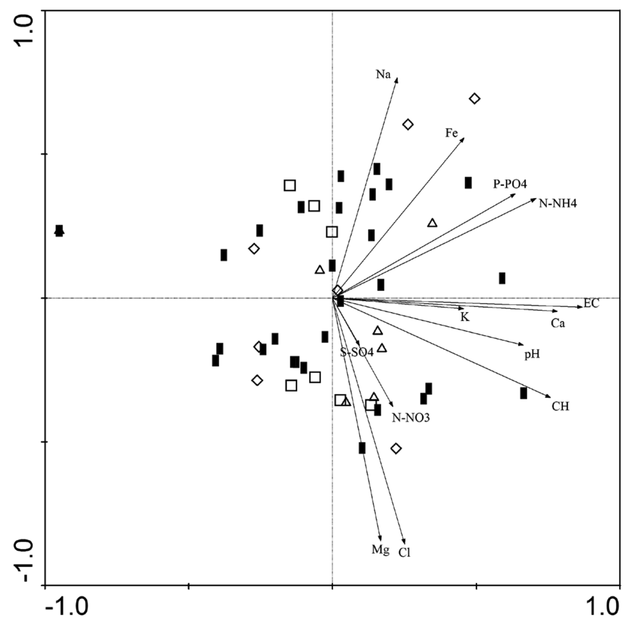

Fig. 2. PCA analysis of water chemistry in the identified plant communities. λ_1 = 0,300; λ_2 = 0,224; λ_3 = 0,148, λ_4 = 0,093. Black boxes – *Typhetum latifoliae* communities; squares – *Sparganietum erecti* communities, diamonds – *Carex acutiformis* communities and triangles – *Phalaridetum arundinaceae* communities

Ryc. 2. Analiza PCA zmienności chemizmu wód w badanych zbiorowiskach roślinnych. λ_1 = 0,300; λ_2 = 0,224; λ_3 = 0,148, λ_4 = 0,093. Czarne kółka – zbiorowiska Typhetum latifoliae; kwadraty – zbiorowiska Sparganietum erecti, romby – zbiorowiska Carex acutiformis, trójkąty – zbiorowiska Phalaridetum arundinaceae

According to the PCA analysis presented on the Fig. 2 samples from reed communities were characterized by huge variation in water chemistry, which remained unrelated to the occurring plant communities. Samples from different communities form one, loose and mixed group, with no distinctive assemblages. Samples located in the upper half of the diagram are characterized by higher concentration of sodium and iron ions and samples form the lower half of the diagram – by higher concentrations of magnesium ions, chlorides, nitrates and sulphates.

According to Kłosowski and Jabłońska, phytocenoses of *Typhetum latifoliae* formed in small astatic water bodies can be distinguished by moderately hard, neutral waters with high calcium and magnesium concentrations (Kłosowski and Jabłońska 2009). The chemical distinctiveness of waters from *Typha latifolia* community in small ponds is also strongly underlined by Joniak (2007), who explained it as a result of strong modification of habitat by helophytes with high biomass.

However, statistical analyses performed on our data showed no significant differences in the chemistry of waters form *Typha latifolia* community in comparison to other reed-forming phytocenoses (Tab. 2). We observed the highest concentration of potassium ions and ammonia ions in water from *Typhetum latifoliae* sites, yet differences were of no statistical importance.

Even the carbonate hardness, which according to Patzig (2012) has a strong effect on hydrophytes diversity, seemed to be of no distinctive value. Yet, in this case p value in Kruskall-Wallis test is the lowest ($p = 0{,}0675$).

In comparison to chemical optimum for *Typhetum latifoliae* in lakes, specified by Kłosowski (1991), communities studied on temporary ponds are characterized by roughly the same calcium ions concentration (on average in ponds 41,98 and in lakes 47,16 mg/dm^3); much higher concentration of phosphates (on average in ponds 0,51 mg/dm^3 and in lakes 0,064 mg/dm^3) and ammonia (on average in ponds 1,37 and in lakes 0,40

Tab. 2. Results of Kruskal-Wallis tests for chemistry of waters from *Typhetum latifoliae* association and other identified plant communities

Tab. 2. Wyniki testu Kruskala-Wallisa dla cech chemicznych wody różnicujących związek Typhetum latifoliae od innych badanych zbiorowisk roślinnych

Parameter/*Parametry*		Phytocenoses/*Fitocenozy*				p value in Kruskal-Wallis test *p wartość dla testu Kruskala-Wallisa*
		Typhetum latifoliae (N = 27)	*Sparganietum erecti* (N = 7)	*Caricetum acutiformis* (N = 7)	*Phalaridetum arundinaceae* (N = 7)	
pH	mean *średnia*	7	7,1	6,8	7	
	median/ *mediana*	7,2	7,3	6,8	7,1	0,4209
	range/*zakres*	5,9–7,8	6,5–7,6	6,0–7,5	6,3–7,4	
EC [mg/dm^3]	mean/*średnia*	323	322	295	448	
	median/ *mediana*	287	332	310	427	0,1276
	range/*zakres*	78–632	243–382	158–391	356–611	
CH [°N]	mean/*średnia*	13,1	13,3	12,4	18,6	
	median/ *mediana*	11,5	14,3	13,1	18,5	0,0675
	range/*zakres*	4,6–27,2	6,7–17,3	9,0–16,2	15,9–22,5	
Na [mg/dm^3]	mean/*średnia*	1,12	1,63	1,28	0,87	
	median/ *mediana*	0,62	0,98	0,72	0,48	0,4866
	range/*zakres*	0,11–3,15	0,40–3,07	0,12–3,28	0,17–1,97	
K [mg/dm^3]	mean/*średnia*	4,5	3,03	2,33	2,2	
	median/ *mediana*	2,45	2,36	2,1	1,6	0,7132
	range/*zakres*	0,22–31,40	1,94–6,59	0,78–4,81	0,27–4,92	

Ca [mg/dm³]	mean/*średnia*	41,98	41,87	37,23	53,78	
	median/ *mediana*	41,7	43,1	35,2	54,5	0,1779
	range/*zakres*	5,00–77,40	30,70–54,30	22,60–53,90	35,80–73,10	
Mg [mg/dm³]	mean/*średnia*	7,12	8,63	6,72	9,33	
	median/ *mediana*	7,06	8,62	6,76	10,35	0,2026
	range *zakres*	3,16–13,64	8,10–9,20	3,84–9,53	6,67–10,96	
Fe [mg/dm³]	mean / *średnia*	1,57	0,62	2,78	1,1	
	median *mediana*	0,69	0,47	2,12	0,98	0,3348
	range/*zakres*	0,11–5,82	0,13–1,35	0,29–7,42	0,29–2,40	
$N-NH_4$ [mg/dm³]	mean/*średnia*	1,37	0,72	1,32	1,18	
	median/ *mediana*	0,84	0,54	1,11	1,07	0,5140
	range/*zakres*	0,25–5,73	0,03–1,33	0,07–3,82	0,28–2,17	
$N-NO_3$ [mg/dm³]	mean/*średnia*	0,21	0,13	0,54	0,2	
	median/ *mediana*	0,21	0,13	0,15	0,21	0,1712
	range/*zakres*	0,04–0,43	0,06–0,21	0,08–2,99	0,11–0,30	
Cl [mg/dm³]	mean/*średnia*	9,77	10,45	8,36	9,18	
	median/ *mediana*	11	13,65	6,6	10,05	0,9657
	range/*zakres*	1,67–22,70	2,17–21,67	1,92–14,60	1,92–14,00	
$P-PO_4$ [mg/dm³]	mean/*średnia*	0,51	0,27	0,66	0,27	
	median/ *mediana*	0,43	0,2	0,56	0,21	0,3073
	range/*zakres*	0,10–1,52	0,13–0,54	0,11–2,34	0,06–0,67	
$S-SO_4$ [mg/dm³]	mean/*średnia*	3,25	2,23	2,51	3,45	
	median/ *mediana*	2,31	2,14	2,22	3,84	0,5249
	range/*zakres*	0,98–14,40	0,86–3,83	1,65–4,58	1,52–4,73	

mg/dm³); higher concentration of potassium ions (on average in ponds 4,50 and in lakes 1,80 mg/dm³), and finally, lower concentration of sodium (on average in ponds 1,12 and in lakes 3,99 mg/dm³) and magnesium ions (on average in ponds 7,12 and in lakes 15,00 mg/dm³). High values of ammonia, phosphates and potassium seem to be effects of the past fertilizer overuse and argillotrophic character of small ponds.

High concentrations of nutrients in pond waters should promote development and further distribution of *Typhetum latifoliae* association in the studied area, especially in case of extension of flooding period and decrease in red-ox potential of sediments and water (Li et al. 2010). Differences in optimum values described in lakes by Kłosowski (1991), and values measured by us in small ponds, show wide ranges of ecological tolerance of *Typha latifolia* and its phytocenoses, as far as the above parameters are considered.

5. Conclusions

Astatic ponds are extremely changeable habitats, characterized by high variability of physical and chemical parameters. Due to their small size, they are very susceptible to human impact, such as eutrophication, which last much longer than fertilizer application itself.

Due to extreme variability of habitat conditions in astatic ponds and the wide ranges of ecological tolerance of *Typha latifolia*, the indicative value of *Typhetum latifoliae* communities in the small ponds seems to be constricted. Therefore, each study case should be considered separately and generalizations should be performed carefully and only in justifiable cases.

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6. References

Declerck S., De Bie T., Ercken D., Hampel H., Schrijvers S., van Wichelen J., Gillard V., Mandiki R., Losson B., Bauwens D., Keijers S., Vyverman W., Goddeeris B., De Meester L., Brendonck L., Martens K., 2006: *Ecological characteristics of small farmland ponds: Associations with land use practices at multiple spatial scales*. Biological Conservation 131: 523-532.

Joniak T., Kuczyńska-Kippen N., Nagengast B., 2007: *The role of aquatic macrophytes in microhabitual transformation of physical-chemical features of small water bodies*. Hydrobiologia 584: 101-109.

Kłosowski S., 1985: *Habitat conditions and bioindicatory value of the main communities of aquatic vegetation in north-east Poland*. Polskie Archiwum Hydrobiologii 32: 7-29.

Kłosowski S., 1991: *Ekologia i wartość wskaźnikowa zbiorowisk roślinności szuwarowej naturalnych zbiorników wód stojących*. Fragmenta Floristica et Geobotanica 37: 563-595.

Kłosowski S., Jabłońska E., 2009: *Aquatic and swamp plant communities as indicators of habitat properties of astatic water bodies in north-eastern Poland*. Limnologia, 39: 115-127.

Li S., Lissner J., Mendelsshon J.A., Brix H., Lorenzen B., McKee B., Miao S., 2010: *Nutrient and growth responses of cattail (Typha domingensis) to redox intensity and phosphate availability*. Annals of Botany 105: 175-184.

Lukacs B.A., Sramko G., Molnar A., 2013: *Plant diversity and conservation value of continental temporary pools*. Biological Conservation 158: 393-400.

Matuszkiewicz W., 2001: *Przewodnik do oznaczania zbiorowisk roślinnych Polski*. PWN, Warszawa.

Nicolet P., Biggs J., Fox G., Hodson M.J., Reynolds C., Whitfield M., Williams P., 2004: *The wetland plant and macroinvertebrate assemblages of temporary ponds in England and Wales*. Biological Conservation 120: 261-278.

Patzig M., Kalettka T., Glemnitz M., Berger G., 2012: *What governs macrophyte species richness in kettle hole types? A case study from Northeast Germany*. Limnologica, 42: 340-354.

PN-92/C-04570/01 (Polish Norm for analysis of total iron content).

PN-C-04540-01:1990 (Polish Norm for analysis of pH).

PN-C-04542:1977 (Polish Norm for analysis of electrolytic conductivity).

PN-C-04953:1988 (Polish Norm for analysis of content of sodium, calcium and potassium ions).

PN-C-04556:1951 (Polish Norm for analysis of carbonate hardness).

PN-C-04576-4:1994 (Polish Norm for analysis of ammonium ions content).

PN-C-04576-08:1978 (Polish Norm for analysis of nitrate ions content).

PN-EN 1189 (Polish Norm for analysis of phosphate ions content).

PN-EN ISO 7980:2002 (Polish Norm for analysis of content of magnesium ions).

PN-EN ISO 8467:2001 (Polish Norm for analysis of chemical oxygen demand).

PN-ISO 9280:2002 (Polish Norm for analysis of sulfate ions content).

PN ISO 9297:1994 (Polish Norm for analysis of chloride ions content).

Sahuquillo M., Miracle M.R., Morata S.M., Vincente V., 2012: *Nutrient dynamics in water and sediment of Mediterranean ponds across a wide hydroperiod gradient*. Limnologica 42: 282-290.

Tabosa A.B., Matias L.Q., Martins F.R., 2012: *Live fast and die young: the aquatic macrophyte dynamics in a temporary pool in the Brazilian semiarid region*. Aquatic Botany, 102: 71-78.

ter Braak C.J.F., Smilauer P., 1998: *CANOCO Reference Manual and User's Guide to CANOCO for Windows: Software for Canonical Community Ordination (version 4)*. Microcomputer Power, Ithaca, New York, USA.

Thiere G., Milenkovski S., Lindgren P.-E., Sahlen G., Berglund O., Weisner S.E.B., 2009: *Wetland creation in agricultural landscapes: Biodiversity benefits on local and regional scales*. Biological Conservation, 142: 964-973.

Zacharias I., Dimitriou E., Dekker A., Dorsman E., 2007: *Overview of temporary ponds in the Mediterranean region: Threats, management and conservation issues*. Journal of Environmental Biology, 28: 1-9.

OCENA WARTOŚCI WSKAŹNIKOWEJ
FITOCENOZ *TYPHETUM LATIFOLIAE*
W MAŁYCH ZBIORNIKACH WODNYCH
W KRAJOBRAZIE POROLNYM MAZURSKIEGO
PARKU KRAJOBRAZOWEGO

Streszczenie

Artykuł przedstawia wyniki badań prowadzonych na drobnych zbiornikach wodnych w krajobrazie porolnym w Mazurskim Parku Krajobrazowym. Do badań wybrano 6 pokrytych zbiorowiskami szuwarowymi zbiorników podobnej wielkości, zlokalizowanych na ekstensywnie koszonych łąkach i charakteryzujących się podobną dynamiką stanu i chemizmu wód.

W zbiornikach oraz w ich otoczeniu wykonano zdjęcia fitosocjologiczne metodą Braun-Blanqueta. Na tej podstawie zidentyfikowano 4 zbiorowiska roślinności szuwarowej: *Typhetum latifoliae* SOO 1927 w zbiornikach 1, 4, 5, 13; *Sparganietum erecti* ROLL 1938 w zbiorniku 6; *Caricetum acutiformis* SAUER 1937 w zbiorniku 12 oraz *Phalaridetum arundinaceae* (KOCH 1926 n.n.) LIBB. 1931 w zbiorniku 16.

W każdym zbiorniku, w centralnej części płatu dominującej fitocenozy założono punkt monitoringowy, z którego pobierano wodę do analiz laboratoryjnych. Dodatkowo w pobliżu punktów monitoringowych założono sieć piezometrów, w których co miesiąc sprawdzano poziom wód gruntowych.

W czasie prowadzonych badań poziom wód gruntowych ulegał dynamicznym zmianom i obejmował zakres od – 54 cm do +70 cm. Najniższy poziom wód gruntowych na całym badanym terenie zanotowano nietypowo w kwietniu 2010 roku, podczas gdy w strefie klimatu umiarkowanego najniższy poziom wody rejestrowany jest zwykle na przełomie sierpnia i września. Zaobserwowana anomalia była efektem niewielkich sumy opadów w zimie i na wiosnę 2010 roku.

Chemizm wód powierzchniowych pochodzących z badanych zbiorowisk roślinnych był zróżnicowany. Zmian sezonowych nie zaobserwowano (stężenie Na^{+} i Ca^{2+} oraz odczyn i twardość węglanowa) lub wiązały się one z sezonowymi zmianami poziomu wody w zbiornikach (efekty rozcieńczania i zagęszczania – pozostałe parametry).Wody pobrane we wszystkich zbiorowiskach roślinnych charakteryzowały się wysoką zawartością jonów amonowych i fosforanowych, co jest konsekwencją przenawożenia tych terenów podczas ich eksploatacji rolniczej.

W artykule skupiono się na ocenie przydatności wskaźnikowej fitocenoz *Typhetum latifoliae* w dynamicznych siedliskach małych zbiorników wodnych. Powszechnie wiadomo, że ubogie gatunkowo fitocenozy, zdominowane zwykle przez jeden gatunek, można wykorzystywać do oceny warunków siedliskowych, w których się rozwijają. Jednakże badania dotyczące indykacyjnych właściwości zbiorowisk roślinnych prowadzone są głównie w stabilnych ekosystemach jezior. Opisane w artykule badania wykazały, że ze względu na znaczne zróżnicowanie i zmienność chemizmu wód zbiorników astatycznych oraz szeroki zakres tolerancji ekologicznej pałki szerokolistnej, woda pochodzącą z fitocenoz *Typhetum latifoliae* nie wykazuje cech charakterystycznych satysfakcjonująco odróżniających ją od wód pochodzących z innych fitocenoz szuwarowych.