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VEGETATION OF MID-FIELD WATER EYELETS IN THE KUJAWY LAKE DISTRICT PRESENT STATE AND CONSERVATION PROBLEMS

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Summary. The flora of mid-field water eyelets in the Kujawy Lake District comprises 285 species of vascular plants. Amongst the plants registered many are listed as rare and protected species, including, e.g.: *Wolffia arrhiza*, *Carex atherodes*, *Liparis loeselii* and *Epipactis palustris*. The vegetation growing within the characterized sites forms a patchwork of phytocoenoses belonging to 67 plant communities. The most valuable elements of this vegetation include patches of: *Sparganietum minimi*, *Wolffietum arrhizae* and *Caricetum aristati*. The mid-field water eyelets shall therefore be subject to protection in the form of „ecologically beneficial land".

Key words: vegetation, mid-field water eyelets, conservation, Kujawy Lake District

INTRODUCTION

Kujawy region is still reckoned among those less recognized, with regard to their nature, regions of this country. A long-term (going back to the Neolithic) agricultural management of the land makes it being considered to be an area of low natural value. However, few studies made so far within the Kujawy region show that the above widespread opinions are wrong. The data presented below concern the Kujawy Lake District which stretches in the eastern portion of Kujawy.

The present landscape of Kujawy has been shaped by the Baltic Glaciation, thus numerous post-glacial forms are amongst its dominant elements. One of those constitute little depressions in the fields, called mid-field water eyelets. They have originated as a result of melting of the co-called dead ice which remained in the sediments of bottom moraine or under the impact of ground or surface water. The mid-field water eyelets show a variety of features, amongst them a large differentiation in surface and depth. The surface area fluctuates between 0.01 and several hectares. Most frequently noted are depressions of the surface of 0.2 to 0.8 ha (Tab. 1). Usually they display a round shape. Their depth varies and attains from 0.5 m to 1 m. The density of sites under examination within the characterized area is from 5 to 20 depressions per 1 km^2, maximally attaining up to 40 eyelets per 1 km^2. Providing shelter for many hygrophilous species, they play an important natural role in the agricultural landscape of Kujawy. They also act as retention reservoirs within the area with severe water deficiency. However, farmers consider

the eyelets as negative elements of local landscape, blaming them for the so-called edge loss effect and for worsening the spatial structure of arable land.

Table 1. Morphological characteristics of selected eyelets and their floristic diversity
Tabela 1. Charakterystyka morfologiczna wybranych oczek i ich różnorodność florystyczna

No. of pond Nr oczka	Area Powierzchnia ha	Depth Głębokość m	Type of pond Typ oczka	Number of plant species Liczba gatunków	H	Land use in sampled margins Użytkowanie otoczenia
1	0.10	0.0-0.3	O	67	4.09	pasture, field
2	0.19	0.5-0.7	O	41	3.55	field
3	0.48	0.4-0.8	O	53	3.82	field
4	0.61	0.5-1.0	O	50	3.80	pasture, trees
5	0.62	0.5-1.0	O	40	3.58	pasture
6	1.52	0.1-0.5	O	65	4.02	pasture, field
7	2.71	0.5-1.2	O	77	4.20	pasture, field
8	2.78	0.5-1.0	O	108	4.51	pasture
9	0.28	0.5	T	77	4.19	meadow, trees
10	0.29	0.3-0.7	T	76	4.21	pasture
11	0.61	0.5-1.0	T	50	3.80	pasture, trees
12	0.77	0.3-0.7	T	81	4.25	pasture
13	0.85	0.5-0.7	T	72	4.12	pasture, trees
14	0.96	0.5-0.8	T	75	4.21	pasture
15	1.01	1.0	T	107	4.53	pasture
16	1.15	0.80	T	90	4.41	meadow, trees
17	1.25	0.5-0.8	T	105	4.57	meadow, trees
18	2.91	1.0	T	93	4.44	meadow, trees
19	0.11	0.0-0.5	I	48	3.75	pasture
20	0.30	0.0-0.4	I	46	3.70	meadow
21	0.46	0.0-0.5	I	42	3.59	meadow

Explanation: I – intermittent, T – transient (at high water level outflow along draining pipes occurs), O – outflow-less, H – index of floristic diversity.
Objaśnienia: I – okresowe, T – przepływowe, O – bezodpływowe, H – wskaźnik różnorodności florystycznej.

The aim of the work was to:

– demonstrate the present status of flora and vegetation of mid-field eyelets within the Kujawy Lake District;

– highlight trends of changes in the vegetation cover of the examined sites, and

– suggest conservation proposals.

STUDY AREA, MATERIAL AND METHODS

Study on flora and vegetation was made in the years 1987-2005 in more than a hundred mid-field water eyelets situated in the eastern portion of Kujawy. The study consisted in an inventory of vascular plants and bryophytes and in recognition and mapping of plant communities occurring in those sites. During the inventory a census of species encountered in an eyelet was made in addition to species growing in the peripheral belt around the site. It was assumed that the peripheral belt includes only a zone of a width of 5 m covered by meadow or rush vegetation, rarely including also woody plants. The vegetation was studied using the Braun-Blanquet phytosociological method [1964]. A part of sites were investigated during

long-term, almost 20 year-long, permanent observations of the vegetation cover. The data were processed taking advantage of the Shannon-Wiener equation [Krebs 1996]:

$$H = -\sum_{i=1}^{S} (p_i)(\log_2 p_i),$$

where: H – index of floristic diversity, S – number of species, p_i – average coefficient of covering of i – species in the complex .

RESULTS

The flora of Kujawy is build of about 1100 species of vascular plants [Wilkoń-Michalska 1971]. The mid-field eyelets examined so far were found to contain 285 species of vascular plants, which constitutes about 26% of the vascular flora of the whole region. On the characterized sites 44 bryophyte species were also found. Numerous hygrophilous species noted in the eyelets are listed as protected or rare plants, including [Rutkowski 1997], e.g.: *Wolffia arrhiza*, *Lemna gibba*, *Sparganium minimum*, *Nymphaea alba*, *Carex atherodes*, *Drosera rotundifolia*, *Liparis loeselii* and *Epipactis palustris*. The immediate zone around the depressions provides haunts for many meadow and forest species. These sites were found to shelter such species as, among others: *Huperzia selago*, *Dianthus superbus*, *Lathyrus palustris*, *Thalictrum flavum*, *Ophioglossum vulgatum* and *Triglochin maritimum*.

Phytocoenoses of more than 80 plant associations and communities were noted on hydrogenous soils and in aquatic bodies of the examined part of Kujawy, out of which as many as 67 were found in mid-field water eyelets [Kucharski 1996]. The most important elements of the vegetation include, among others.: *Sparganietum minimi*, *Eleocharietum acicularis*, *Wolffietum arrhizae*, *Potametum graminei* and *Caricetum aristati* (Tab. 2).

The vegetation of mid-field eyelets in the examined part of Kujawy is widely syntaxonomically differentiated and features a considerable fragmentation of patches, fluctuating distribution and species composition, as well as an inconsiderable share of species of forest and scrub communities. The mid-field eyelets with a permanent water table and surrounded with belt of pastures and meadows or shrubby vegetation have a typical strip system of plant community arrangement. The eyelets with temporarily stagnating water typically have an increased share of anthropogenic plant communities and a mosaic system of vegetation patches.

The preliminary results of study have shown that the above sites surrounded by a narrow belt of extensively managed meadow vegetation displays a high stability of flora and vegetation composition. No major changes in vegetation were observed on any of the objects covered by the long-term investigation. The sites deprived of protective vegetation belt are subject to eutrophication, which results in the synanthropisation of flora and vegetation. Generally, they have a lower index of floristic diversity (H) than those which are surrounded by plantings or meadow area (Tab. 1).

Table 2. List of most valuable plant communities occurring in mid-field water eyelets within the examined part of Kujawy, and major threats to their existence
Tabela 2. Wykaz najcenniejszych zbiorowisk występujących w oczkach śródpolnych badanej części Kujaw oraz stopień ich zagrożenia

No. Nr.	Name of plant community Nazwa zbiorowiska	Frequency of occurrence[a] Częstość występowania[a]	Trend[b] Tendencja[b]	Degree of threat[c] Stopień zagrożenia[c]
1.	*Lemnetum gibbae* Miy. et J.Tx. 1960	19	↕	V
2.	*Riccietum fluitantis* Slavnić 1956 em. R.Tx. 1974	2	↓ (1)	V
3.	*Ricciocarpetum natantis* Segal 1963 em. R.Tx.1974	2	↕	V
4.	*Rumicietum maritimi* Siss. 1946	5	↑	–
5.	*Eleocharetum ovatae* Hayek 1923 n.n.	1	↓ (1)	E
6.	Community of *Cyperus fuscus-Limosella aquatica*	2	↕	I
7.	*Ranunculo-Myosuretum minimi* Diem., Siss. et Westh. 1940	2	↓ (1)	I
8.	*Stellario-Isolepidetum setacei* (Koch 1926) Moor 1936	1	↓ (1)	E
9.	*Charetum vulgaris* Corill. 1957	3	0	I
10.	*Charetum asperae* Corill. 1957	1	0	V
11.	*Potametum graminei* (Koch 1926) Pass. 1964	1	↓ (1)	E
12.	*Potametum acutifolii* Segal 1961	1	0	–
13.	Community of *Potamogeton pusillus*	1	↓ (1)	–
14.	*Ranunculetum circinati* (Bennema. et West. 1943) Segal 1965	6	0	I
15.	*Hydrocharitetum morsus-ranae* Langendonck 1935	5	0	V
16.	*Myriophylletum verticillati* Soó 1927	2	0	I
17.	*Nupharo-Nymphaeetum albae* Tomasz. 1977	2	0	V
18.	*Sparganietum minimi* Schaff 1925	2	↓ (1)	E
19.	Community of *Utricularia vulgaris*	3	↓ (1)	–
20.	*Eleocharietum acicularis* (Baumann 1911) Koch 1926	2	↓ (1)	I
21.	*Scirpetum maritimi* (Br.-Bl. 1931) R.Tx. 1937	2	↓ (1)	I
22.	*Butometum umbellati* (Koncz. 1968) Phil. 1973	2	↓ (2)	I
23.	*Thelypteridi-Phragmitetum* Kuiper 1957	5	↓ (3)	I
24.	*Caricetum elatae* Koch 1926	10	↓ (4)	I
25.	*Caricetum distichae* (Now. 1928) Jonas 1933	12	↑	V
26.	*Caricetum paniculatae* Wangerin 1916	4	↓ (2)	V
27.	*Caricetum aristati* Ćwikliński 1986	1	↓ (1)	–
28.	*Sparganio-Glycerietum fluitantis* Br.-Bl. 1925 n.n.	15	0	I
29.	*Calamagrostietum neglectae* Steffen 1931	16	↑	V
30.	*Caricetum lasiocarpae* Koch 1926	3	↓ (2)	E
31.	*Caricetum diandrae* Jon. 1932 em. Oberd. 1957	1	↓ (1)	R
32.	*Orchido-Schoenetum nigricantis* Oberd. 1957	2	↓ (1)	–
33.	Community of *Eriophorum vaginatum* *Sphagnum fallax* Hueck 1928 pro ass.	1	0	E

Explanations: [a] number of community patches found; [b] ↑ – number of stands increases, ↓– number of stands decreases, number of stands which have probably vanished is given in parentheses, ↕ – number of stands is fluctuating, 0 – number of stands shows no change; [c] degree of threat to the community in Wielkopolska [according to Brzeg and Wojterska 1996].
Objaśnienia: [a] liczba stwierdzonych płatów zbiorowiska; [b] ↑ – wzrasta liczba stanowisk, ↓– zmniejsza się liczba stanowisk, w nawiasach podano liczbę stanowisk które prawdopodobnie zginęły, ↕ – liczba stanowisk waha się, 0 – liczba stanowisk bez zmian; [c] stopień zagrożenia zbiorowiska w Wielkopolsce [wg Brzeg i Wojterska 1996].

DISCUSSION

The floristic diversity of mid-field water eyelets of south Kujawy (285 species) is higher than in the Chełmno Region (212 species) [Kaźmierczak 1997] and Masurian Lake District (250 species) [Koc and Polakowski 1990]. In the biotopes of the Masurian Lake District 39 plant associations and communities were noted [Koc and Polakowski 1990]; in the Kujawy Lake District there are 67 plant communities.

Major threats to the sites under examination include: eutrophication brought about by soil erosion, efforts to drain and manage the land, and the succession of forest and scrub vegetation. Some of the eyelets are used as landfills where domestic and agricultural waste, such as low quality agricultural products, slurry, straw and the like, have been dumped.

It is thus necessary to embrace the mid-field depressions without outflow with protection in the form of „ecologically beneficial land" and to develop economic mechanisms advantageous for farmers that could assist in active protection of the sites within the framework of agro-environmental programmes. These sites qualify to „natural uses" and „buffer zones" packages which consist in creating two- or five meter wide strips of meadows at the edge of water and arable land.

CONCLUSIONS

1. The mid-field eyelets are shelters for numerous higrophilous plants and plant communities in the agricultural landscape of Kujawy.

2. Within those sites 285 vascular plant species were noted, which constitutes about 26% of the flora of Kujawy.

3. The vegetation is build by phytocoenoses of 67 plant associations and communities.

4. The sites shall be designated as „ecologically beneficial land" and subject to active protection within the framework of agro-environmental programmes.

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SZATA ROŚLINNA OCZEK ŚRÓDPOLNYCH NA KUJAWACH STAN I PROBLEMY OCHRONY

Streszczenie. Przeprowadzano badania szaty roślinnej około 100 oczek śródpolnych, leżących we wschodniej części Kujaw. Odnotowano w nich 285 gatunków roślin naczyniowych. Są wśród nich gatunki chronione i rzadkie, np.: *Wolffia arrhiza*, *Carex atherodes*, *Liparis loeselii* i *Epipactis palustris*. Roślinność badanych siedlisk buduje 67 zbiorowisk roślinnych. Najcenniejszymi jej składnikami są: *Sparganietum minimi*, *Wolffietum arrhizae* i *Caricetum aristati*. Zagrożeniem dla charakteryzowanych siedlisk są: eutrofizacja, próby osuszenia i zagospodarowania oraz sukcesja. Obiekty te należy objąć ochroną w formie użytków ekologicznych.

Słowa kluczowe: roślinność, oczka śródpolne, ochrona, Pojezierze Kujawskie