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DEPENDENCE OF BIODIVERSITY OF FISHPOND VEGETATION UPON THE INTENSITY OF FISH FARMING

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Summary. Effect of intensity of fish farming on biodiversity of fishpond vegetation is presented in the paper. Extensively used complexes irrespective of their area are characterized by the largest diversity of associations and communities as well as vascular plant species, including the threatened ones. Relinquishing of fish farming as well as fish culture intensification have an effect on impoverishment of vegetation.

Key words: biodiversity, vegetation, fishponds, fish farming

INTRODUCTION

Due to the large changes or disappearance of water-marshy habitats the natural value of fishponds increases. These objects (mainly created in the XVIII and XIX centuries) are an important element of cultural landscape of the Południowopodlaska Lowland and play a key-role in preservation of biological diversity [Falkowski and Nowicka-Falkowska 2001]. The value of fishponds is especially emphasized in the industrialized countries [Langley *et al.* 1998]. Their preservation is an important element of strategy of conservation of biodiversity of freshwater ecosystems in Poland. Our knowledge on biological and functional diversity of fishponds and their connections with landscape is still insufficient [Hillbricht-Ilkowska 1998, 1999]. The present work was prepared within the framework of research 6PO4G 003 21.

STUDY AREA, MATERIAL AND METHODS

Twenty-three fishpond complexes, of the total area of 1834 ha, situated in the left-bank catchment of the Bug river (Południowopodlaska Lowland) were the object of the studies. The whole fishpond complex with all its basins, dams, and system of irrigation and drainage ditches was considered to be a single examined station. Documentation of floristic composition was based on floral records made in optimal vegetation season. The total lists of species become completed in the other phenological periods of plant development. Totally, 72 floral records were made between 1996 and 1999, in which 7121 floral data were noted.

The phytosociological studies were concentrated on the vegetation of the foollowing classes: *Lemnetea*, *Bidentetea tripartiti*, *Isoëto-Nanojuncetea*, *Potametea* and *Phragmitetea*. Tomaszewicza. Phytosociological records were made according to Braun-Blanquet method [1964]. 1290 phytosociological records were made between 2000 and 2002, of which 1245 were used in this work. Identification of plant communities was made based on monographic elaborations [Miyawaki and Tüxen 1960, Tomaszewicz 1979, Popiela 1996, 1997]. Threatened species of vascular flora were separated using national and regional lists [Zarzycki and Szeląg 1992, Kaźmierczakowa and Zarzycki 2001, Głowacki *et al.* 2003].

The surface area of the studied objects was calculated using graph paper and polar planimeter. Data received as a result of both methods were averaged. The received results were considered to be a real area of fishpond complexes. All the complexes were divided into three groups according to intensity of fish farming: non-used, extensively used and intensively used.

RESULTS

476 vascular plant species were recorded in the studied fishpond complexes in the Bug river catchment in the Południowopodlaska Lowland. Among them there are 74 ta-

Table 1. Effect of fish farming intensity and area of complexes on number of species and plant communities

Tabela 1. Wpływ intensywności gospodarki rybackiej i powierzchni kompleksów na liczbę gatunków i zbiorowisk roślinnych

Fishpond complex Kompleks stawów	Manner of fishing use Sposób użytkowania	Area in ha Obszar	Number of species Liczba gatunków	Number of threatened species Liczba zagrożonych gatunków	Number of plant associations and communities Liczba zbiorowisk i zespołów roślinnych
Bartków	non-used	10	280	11	29
Cieleśnica	extensive	20	352	31	37
Czołomyje	extensive	60	306	17	35
Galki-Chojeczno	extensive	65	346	24	34
Golice	extensive	60	341	33	39
Gołębiówka	intensive	110	298	19	34
Gójszcz	intensive	10	265	12	26
Klimonty	non-used	270	307	16	30
Kotuń	extensive	103	317	20	41
Mościbrody	extensive	120	422	58	44
Przekop	intensive	20	257	9	24
Stawy Broszkowskie	extensive	156	351	36	40
Rudka	extensive	120	317	20	31
Rudnik	non-used	10	297	15	30
Rybakówka	extensive	190	379	45	42
Ryczyca	intensive	50	283	18	35
Seroczyn	extensive	60	309	22	35
Sinołęka	non-used	40	224	6	26
Sucha	non-used	50	238	21	32
Szczeglacin	intensive	20	244	5	25
Szostek	extensive	120	345	29	33
Woźniki-Czuchleby	extensive	110	340	33	34
Zagródzie	extensive	60	303	19	34

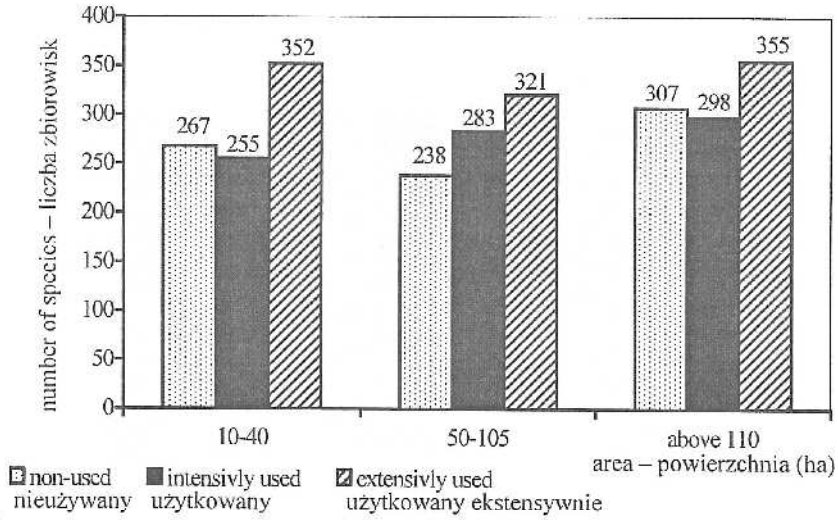

Fig. 1. Mean number of species in particular complexes
Rys. 1. Średnia liczba gatunków w poszczególnych kompleksach

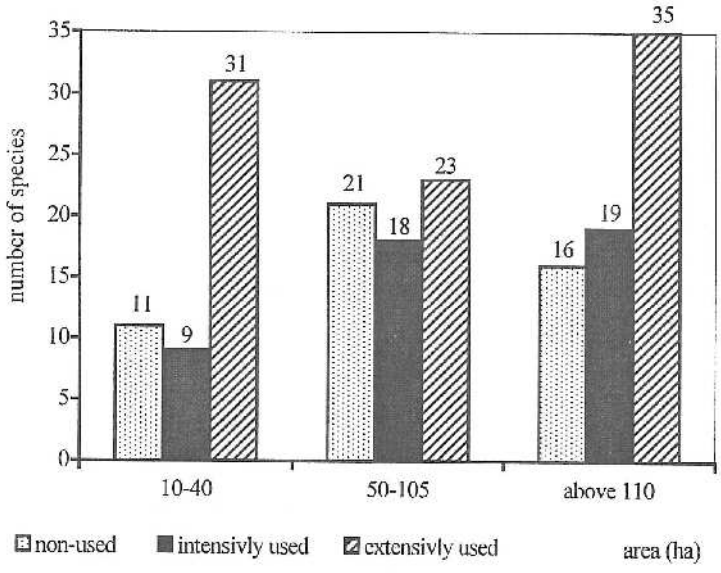

Fig. 2. Mean number of threatened species in particular complexes
Rys. 2. Średnia liczba gatunków zagrożonych w poszczególnych kompleksach

xa endangered of extinction in Poland and in the region. Three species from the Polish Red Data Book of Plants occur in the study area: *Ostericum palustre*, *Cyperus flavescens* and *Lythrum hyssopifolia*. On the basis of phytosociological records 47 phytosociological units belonging to 6 classes were distinguished: 43 of them in the association and 4 in community rank.

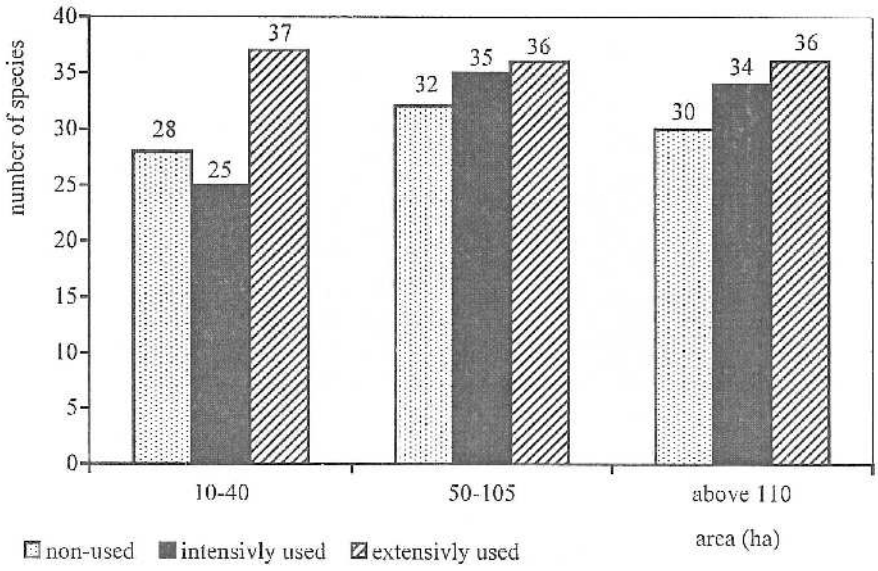

Fig. 3. Mean number of associations and communities in particular complexes
Rys. 3. Średnia liczba zespołów i zbiorowisk w poszczególnych kompleksach

The studied complexes visibly differ in the number of: vascular plant species, threatened species and phytosociological units. The manner of fishing use belongs to the main factors determining this variability (Tab. 1). The largest total number of vascular species (Fig. 1), the largest number of threatened species (Fig. 2) and the largest number of plant associations and communities (Fig. 3) were observed in extensive used fishponds, irrespective of their area.

DISCUSSION

Usually large differences in value of indices, which result from various intensity in fishpond exploitation, are characteristic of complexes of area less than 40 ha (Fig. 1, 2 and 3). The explanation of that fact can be the following dependence: the less area of a complex, the quicker reaction of vegetation to the changes caused by strong anthropopressure (intensive farming) or lack of anthropopressure (non-used complexes) visible in a decrease in biodiversity of vascular plants, associations and communities. The main reason for preservation of biodiversity of fishpond complexes in the Bug river catchment is maintenance of extensive model of fish farming. Only that model of inland fishery guarantees the highest vegetation biodiversity, observed in a large total number of vascular plant species, threatened taxa and number of plant communities. Periodical water drainage stimulates development of pioneer communities and causes increases in the habitat fertility. Long-term drainage, as a result of relinquishing of fish farming, causes degeneration changes in rush communities and total elimination of aquatic, silt

and rush vegetation due to the process of succession. Intensive farming reduces the development of rush communities (they usually have a simplified character) and makes development of water communities of meso- and eutrophic waters impossible.

CONCLUSION

The largest diversity of plant associations and communities as well as vascular plant species, also threatened ones, is characteristic of the extensively used fishpond complexes, irrespective of their area. However, due to a low profitability of carp-breeding, relinquishing or decrease in fish farming is observed. As a result of this, total drainage and transformation of fishponds into pastures is observed. Due to the natural value of fishponds it is necessary to undertake activities towards their protection. Creation of natural reserves and other forms of spatial protection, by many reasons important, is insufficient. Passive protection must be replaced by rational and periodical exertions of active conservation.

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ZALEŻNOŚĆ MIĘDZY BIORÓŻNORODNOŚCIĄ SZATY ROŚLINNEJ STAWÓW RYBNYCH A INTENSYWNOŚCIĄ GOSPODARKI RYBACKIEJ

Streszczenie. W pracy przedstawiono wpływ natężenia gospodarki rybackiej na bioróżnorodność szaty roślinnej kompleksów stawów rybnych. Największa różnorodność zespołów i zbiorowisk roślinnych oraz gatunków roślin naczyniowych, w tym zagrożonych, cechuje ekstensywnie użytkowane kompleksy stawów, niezależnie od ich ogólnej powierzchni. Zarzucenie lub intensywna gospodarka wpływa na zubożenie szaty roślinnej.

Słowa kluczowe: różnorodność biologiczna, szata roślinna, stawy rybne, gospodarka rybacka